

## BIG BALE HAY STORAGE

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### INTRODUCTION

Several years before their acceptance in Ontario, large round balers had a strong foothold in Western Canada – largely because the 'dryland' climate was well suited to the big bale concept. Soon the benefits of **reduced labor** and **speed of harvest** moved these systems into Ontario where outside storage was initially tried in spite of our wetter climate.

There are now a large number of farmers who are attempting to eliminate or minimize the spoilage of hay which occurs with outside storage. This trend coincides with a new measure of respect given to big bale systems, as farmers' efforts toward a **quality** hay have increased in the beef and dairy sectors alike.

### WHY PROTECT BIG BALES?

Unavoidable dry matter losses of up to 5% are expected even with hay stored indoors. Additional spoilage losses occurring to unprotected round bales result from two factors:

1. **Outer layer** losses can be substantial for even an apparently small depth of material, as shown in Figure 1.

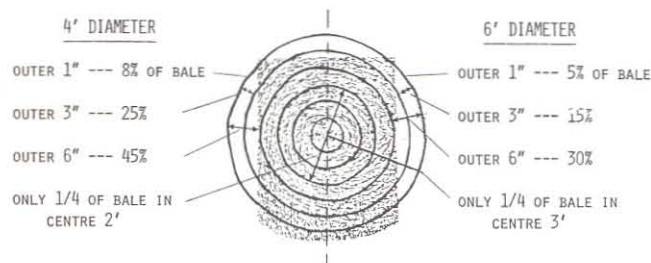


Figure 1 Outer layer losses from weathering

This sketch also suggests that the smaller diameter bales, which have recently become more popular, will suffer proportionately more weathering losses than larger bales. However, in either case, moisture infiltration will be lessened by providing bales with especially dense outer shells.

Note that although the hay immediately beneath the weathered shell may appear to be fine, it probably is somewhat mouldy and will not be readily eaten by live-stock. Total weathering losses always exceed what our initial glance might suggest.

2. **Ground Moisture**, which is pulled into the base of the

bale by wick action, can easily double the amount of spoiled material normally expected in outer layer losses. A sloppy bale which tends to 'squat' will place more of its base in contact with the ground, thereby increasing moisture absorption.

Various research and farmer experience suggests that, depending on the year, and length of storage period, the losses resulting from outdoor storage may total 15 - 20% more than those from hay stored indoors.

A major consideration in the decision regarding how much protection to provide for bales is convenience. The problems of bales freezing to the ground, or of having to move snow to get to them, or of having to chop off the spoiled and frozen outer shell of the unprotected bale can be frustrating and time-consuming.

### PROTECTION ALTERNATIVES

Efforts to reduce spoilage with large round bales range from simple to elaborate. Here are a few of the methods used today:

A. **Outdoor Storage** – For a variety of reasons, some farmers will continue to 'field store' big bales – an approach which may be quite acceptable for bales which are to be fed by



Figure 2 Proper placement of field-stored bales

fall. Bales should touch end-to-end only, with rows a couple of feet apart, and running up and down the slope (Figure #2).

Placement of rows in a north-south direction will allow the sun to penetrate both sides of the row – thus helping to keep the area dry.



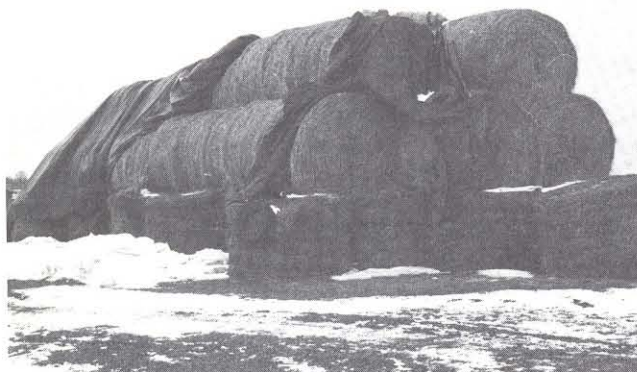
Some farmers choose to stack bales in pairs, or trios, with the bottom one or two bales set on end and the other bale set normally atop. While there is little difference in the resulting total amount of spoiled material, this method occupies much less field area than otherwise required.

**B. Outdoor Storage on Crushed Stone** – a layer of coarse stone on the ground under the bales will eliminate moisture absorption by wick action. Research work has indicated that 4" of 'clear' 1" crushed stone can cut storage losses in half. Although one might be tempted to use gravel here, it is best to avoid it since capillary movement of ground moisture can still be substantial through the finer material.

**C. Outdoor Storage on Rails, Tires, Pallets** – Materials such as these will accomplish the same effect as crushed stone, but with much less convenience in placing and removing bales.

#### D. Outdoor Storage, Plastic Covering

(i) **Polyethylene Sheets** – Efforts to cover stacks of bales using polyethylene have had mixed success – largely due to the work of placing the cover, then trying to keep it on. One important factor lies in **avoiding the use of construction grade polyethylene**.

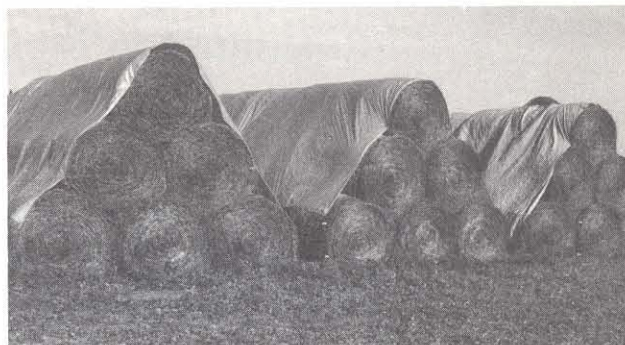


**Figure 3** Inferior polyethylene, poorly fastened spells failure

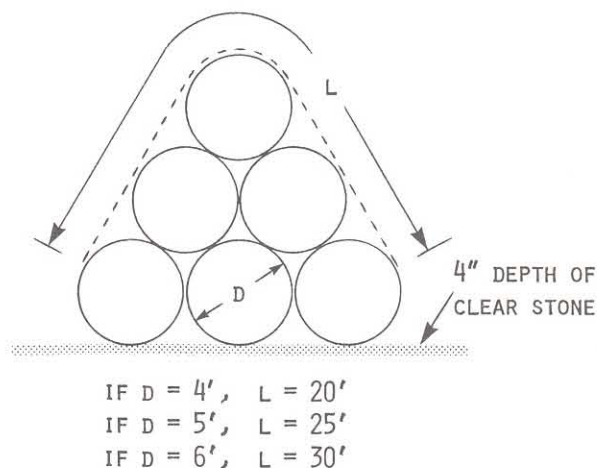
The better quality poly film – typically 32' or 40' by 100' – will cost 20% more since they are not made from reclaimed plastics. However, they have vastly superior physical properties (stretch, puncture, fatigue), which provide a better chance of surviving an entire season. A generous supply of rope or twine with old tires or other material as weight to anchor the cover is essential. When a stack can be located in a wind-sheltered area, best results are likely.

Note that a 1-2-3 pyramid of bales will be more successful than a 2-3-4 pyramid since the latter allows sagging of the cover between the two top bales. Subsequent snow and ice build-up may then lead to punctures, followed by concentrated wetting of the bales underneath.

(ii) **Polyfabric Tarp** – Much more durable than 6 mil polyethylene, these woven tarps (Figure 4) will tolerate less substantial tie-downs, and often have perimeter grommets to



**Figure 4** Polyfabric tarps are easy to secure



**Figure 5** Minimum cover widths to provide rain protection

attach twine or rope. Their 3 to 4 year life expectancy makes them price competitive with the single-use polyethylene. Where possible, select tarp sizes to suit the size of bales in the stack as shown in Figure 5. Avoid folding the tarp over the ends of the stack, in order to allow the stack to breathe. (If possible, wait 2 or 3 days after baling before placing hay under plastic to minimize condensation problems.)

(iii) **Individual 'Stretch' Wrap** – Two layers of thin stretch plastic on the shell (not necessarily the ends) of a bale effectively minimize weathering losses. Wrapping is accomplished manually with a hand-held narrow strip of plastic as the bale turns slowly on a 3-point hitch rotating spear, or is performed by various machines with wide or narrow rolls of



**Figure 6** Stretch wrap protection



plastic.

(iv) **Mesh Wrap** – Several baler manufacturers have provided the option of using a mesh wrap rather than twine to tie the bale. The mesh flattens the entire outer layer of the bale to provide better shedding of rainwater. Mesh wrapping is also faster than twine tying since the bale rotates only 1 1/2 times in the chamber before being ejected.

**E. Pole Frame Storage, Roof Only** – A pole supported roof structure accomplishes the primary goal of keeping rain

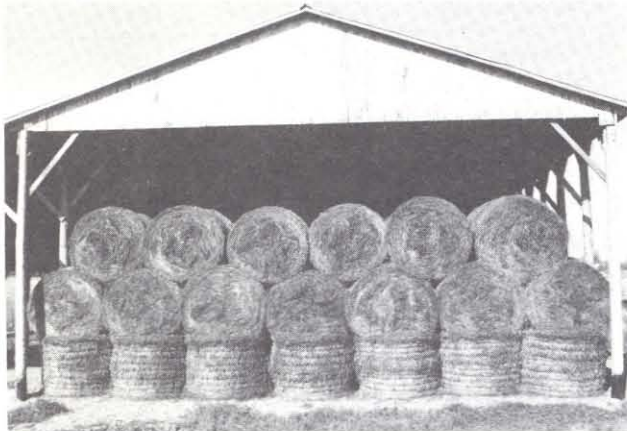


Figure 7 Pole-frame hay storage

off the hay. (In addition, a course stone base will minimize ground moisture problems.) Keep in mind however that the high sidewalls do allow some small amounts of snow and blowing rain to enter the storage area.

From a structural standpoint, builders must ensure that these buildings are well anchored against up-lift forces.

**F. Pole Frame Storage, Enclosed Building** – The approach often used to justify the expense of an enclosed building involves its potential as a dual or multi-use facility – loafing shed, machinery storage, hay storage, etc.

Since these buildings typically have 16' to 20' sidewall heights, the primary structural concern is that adequate wind-bracing be provided.

Plan buildings such that the bottom chord of the roof truss will clear the expected stack height by a **minimum of 2'**. Even this leaves little room for error, considering that you will be handling a heavy package of hay which will obscure your view when putting it into place with a loader.

Providing adequate ventilation of an enclosed building will eliminate condensation from forming on the underside of the roofing steel during cool fall nights. Good ventilation is possible by using soffits and by installing ridge ventilators. (Provide at least 1 square foot of ridge opening per 1000 square feet of building area.)

Regardless of bale size and stacking method, any building with 16' sidewalls will accommodate at least 1 ton of hay in every 20 square feet of floor area.

Figure 8 shows a method of stacking hay which satisfies

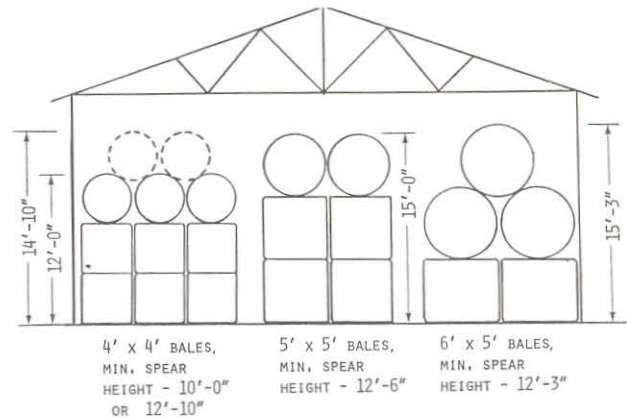


Figure 8 Inside stacking possibilities & height requirements

two basic criteria: (1) Avoids putting outward forces on sidewalls or poles, and (2) Maximizes the quantity of hay in the storage. Other comments from those using this stacking method indicate the stack is much more stable, and the voids created by the columns of hay allow some breathing to occur.

**G. Two-storey Barns** – The lofts of many 2-storey barns are used less than previously, now that tower silos are common. Unfortunately, in many cases, these lofts do not lend themselves well to big bale storage, due to the difficulty in placing and retrieving bales. Occasionally, they can be used as an area for cutting up big bales with bale knives or electric chainsaws.

**H. Other Structures** – Many farmsteads have old structures which are now unsuited for their initial purposes. Where possible, farmers are using these buildings – often with little or no modification – to store big bales.

## ECONOMICS

For Ontario conditions, most studies would suggest that by providing protection for big bales, we would reduce losses by 15 - 20% over 'field stored' hay. If hay is worth \$60 per ton, this amounts to typical losses of \$9 to \$12 per ton, while for better quality hay at \$80 per ton, losses would be \$12 - \$6 per ton.

With this in mind, the values found in Figure 9 may provide a reference point for decision-making. For instance, even with the additional labour required to cover stacks with plastic, the storage costs of less than \$2 per ton make the effort well worthwhile.

The cost-per-ton values for pole buildings are substantial, whether the farmer contracts the construction of the building or erects it himself. However, the costs are not unreasonable, and can be justified by the farmer who takes a serious approach to hay-making – i.e. – cutting at the proper stage of maturity, minimizing harvest losses by tedding and raking hay at proper moisture contents, baling when hay is neither too wet, nor too dry, and so on.

**Figure 9** Costs of Some Storage Alternatives

STORAGE METHOD	LIFE EXPECTANCY	SIZE	COST	BALE CAPACITY*	TONS	** COST PER TON/YEAR	
4" of clear, crushed stone (1")	5 yr. payback	60' x 100' surface	75 cubic yds @ \$9 = \$675	180 bales = 5' x 5'	103.5	\$1.30	
Stretch wrap - shell only	1 year	2 layers	\$2 per 5' x 5' bale	N/A	.57	\$3.50 plastic only - machine costs additional	
6 mil polyethylene	1 year	24' x 100'	\$85	150 bales = 4' x 4'	45	\$1.90	
		32' x 100'	\$115	120 bales = 5' x 5'	69	\$1.65	
		40' x 100'	\$160	120 bales = 6' x 5'	102	\$1.55	
Polyfabric Tarp	4 years	20' x 30'	\$70	24 bales = 5' x 5'	13.8	\$1.25	
		20' x 40'	\$90	60 bales = 4' x 4'	18	\$1.25	
		40' x 60'	\$375	72 bales = 6' x 5'	61		
Poly Structure - Roof only	10 & 20 year paybacks @ 12% interest, + taxes and insurance	40' x 100' x 18'	\$12000 material only	480 bales, 5' x 5'	276	10 Year	20 Year
			\$19000 contracted			7.80	5.90
						12.35	9.35
Poly Structure - totally enclosed	10 & 20 year paybacks @ 12% interest, + taxes and insurance	40' x 100' x 18'	\$16500 material only	480 bales, 5' x 5'	276	10.75	8.15
			\$26000 contracted			16.95	12.80

\* Assume all hard core bales @ 12 lbs/cu. ft. density,  
i.e. 4' x 4' weighs 600 lbs., 5' x 5' weighs 1150 lbs., 6' x 5' weighs 1700 lbs.  
Note that density varies with grass/legume ratio and baler type: Hard Core Bales 12 - 15 lbs./cu. ft.,  
Soft Core Bales 10 -12 lbs./cu. ft., Small Square Bales 6 - 8 lbs./cu. ft.

\*\* No Labour cost included