

HAY STORAGE METHODS FOR KEEPING COSTS LOW

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For most beef cattle operations in Georgia, hay is a critical component of winter feeding. However, hay is *THE* major expense for these beef cattle operations. Keeping hay costs low generally requires hay to be stored efficiently and cost-effectively. Regardless of how one stores their hay, there is a cost associated with it. Yes, even hay stored outside on the ground has a cost associated with it. In fact, I would argue that the cost of storing hay outside on the ground is much higher than the cost of building a barn to store that hay. In this month's article, I seek to provide information about various hay storage options, including the amount of loss that can be expected and the approximate cost of each storage method.

Damage to Hay Subjected to the Elements

Hay that is stored outside and subjected to wetting and drying cycles will develop a fibrous, weathered layer. This is because nutrients (carbohydrates, lipids, fatty acids, etc.) are leached or washed out of the forage each time the plant material is wetted. The loss of nutrients in this way effectively causes the fiber component of the forage to represent a larger proportion of the dry weight. As a result, the weathered layer will commonly have a TDN value of 40% or less (Table 1). Interestingly, the crude protein of weathered forage actually increases, since proteins are not leached as readily as carbohydrates or other components. Nonetheless, the quality of the weathered layer is very low, and animals will rarely eat this portion of the bale. Evidence of this is often seen where the animals eat into the middle of a round bale, leaving the weathered layer behind as a "doughnut"-shaped shell.

Table 1. Digestibility and crude protein of weathered and unweathered grass and grass-legume hay.*

<i>Hay Type</i>	<i>Portion</i>	<i>Digestibility</i>	<i>Crude Protein</i>
		----- % of dry weight -----	
Grass	unweathered	58.8	13.5
	weathered	42.5	16.4
Grass – legume mix	unweathered	56.5	14.2
	weathered	34.2	16.9

* Adapted from Lechtenberg et al., 1979. Purdue Univ. Agric. Exp. Stn. West Lafayette, IN.

The layer of weathered material is not unlike the thatch used as a roofing material on primitive huts. Like roofing thatch, the weathered layer must be thick enough to prevent water from penetrating. The depth to which this weathered layer forms is dependent upon many factors. Weathering is deeper when rainfall is poorly shed from the bale. In round bales, the strands of forage fiber are oriented in parallel to the flow of water and this allows for comparatively less infiltration. For round bales, the largest amount of water infiltration usually occurs when bales are not densely formed (i.e., not tight).

Most modern variable-chambered (belt-type) balers have settings to alter the density of the bales. If bales are to be stored outside, it is important to increase the bale density. However, there is a tradeoff to the benefit of bale density. Making very dense round bales (> 12 lbs of dry matter/ft³) risks mechanical stress on the baler and decreases the ability of the animal to pull large bites of forage from the bale when it is fed.

Unfortunately, the rainfall and relatively high humidity levels in Georgia sometimes causes the weathered layer to stay moist (if not saturated) for considerable lengths of time. This problem is made worse by storing the bales in the shade or too closely to neighboring bales. When organic matter is kept moist in this way, it is subjected to deterioration and decomposition (i.e., rot). Additional rainfall following this breakdown causes additional leaching and penetrates deeper into the bale's surface.

Losses Associated with Weathering When Hay is Stored Outside

Weathered layers will often be several inches thick. Bales that are insufficiently dense and/or improperly stored may suffer weathering depths of up to 12 inches (see Figure 1). Generally, however, an average weathered layer of 4 – 6 inches should be expected if bales are stored outside on the ground. Since animals typically refuse, bed down in, or soil the weathered material, this layer is essentially a complete loss. When considering the volume held within the outer most inches of the cylindrical bale, losses of even a few inches represent a substantial portion of the whole. This is especially true of shorter bales (i.e., less bale diameter). For example, a 4-inch weathered depth on a 5-ft bale will equate to about 25% loss. So, for every 4 bales stored outside, only 3 bales worth of hay will be consumed by the cattle. Storing those 4 bales outside cost the producer at least the equivalent of one bale of hay (typically \$35-40).



Figure 1. This bale exhibits the extremes of weathering losses. After 2 years of outside storage, the weathered layer extended 14 inches deep (~74% of the bale's volume is lost to weathering).

Though weathering is the largest source of hay loss, it is not the only source of dry matter loss. Respiration and other aerobic deterioration can occur even at low levels of moisture. Much of this loss occurs in the first few weeks of storage, especially if the moisture of the hay is above 15%. Poorly tied bales, rodent damage, and other incidental issues cause minor losses, as well. As a result, it is expected that most hay will lose at least 2-5% of its dry matter, regardless of storage method. This will be true, even if the hay is stored in a barn or similar structure (Table 2). Unfortunately, however, the most popular method for storing hay (outside on the ground) has the highest loss of dry matter and is mostly the result of weathering.

Table 2: Typical ranges in storage losses for various hay storage methods.

	<i>Twine</i>	<i>Net wrap</i>
	<i>% of dry weight</i>	
Pole barn	2-5%	2-5%
Hoop structure	2-5%	2-5%
Tarp	5-10%	5-8%
Stack pad,		
covered stack	5-10%	5-8%
uncovered stack	15-40%	10-30%
Plastic wrap	5-10%	N/A
Outside on ground,		
well-drained	20-40%	15-40%
poor drainage/shaded	30-60%	30-45%

It is important to understand the value of this loss. Table 2 demonstrates that the lost hay can represent a substantial cost, depending on the value of that hay. If the forage is of negligible value, weathering losses may merely be an acceptable cost of storage. However, hay producers have a significant investment in their hay (fertilizer, lime, pesticides, equipment, time, etc.). Bales that are produced in excess of the producer's need are also of considerable value, particularly in drought years.

Table 3: Value of hay lost.

% Loss	<i>Value of Hay</i> (\$/dry ton)			
	\$75	\$100	\$125	\$150
10	\$8	\$10	\$13	\$15
20	\$15	\$20	\$25	\$30
30	\$23	\$30	\$38	\$45
40	\$30	\$40	\$50	\$60
50	\$38	\$50	\$63	\$75
60	\$45	\$60	\$75	\$90

Hay storage is not cheap, regardless of the method used. However, I often remind folks that *if you are storing hay outside on the ground, you likely are paying for a barn whether you want to or not*. If you are storing your hay outside, I encourage you to take a closer look at the costs in this system. For more information on how to reduce your hay costs can be found on our website at www.georgiaforages.com and you can contact your local University of Georgia Cooperative Extension office at 1-800-ASK-UGA1 for more information. The recently updated publication entitled "Economics of Farm Storage Buildings" is an excellent source of additional information on this subject. To obtain a copy of this publication, visit the forages website for the direct link to this publication (<http://pubs.caes.uga.edu/caespubs/pubcd/B1173/B1173.htm>) or contact your local Cooperative Extension office.