LEAFY OR STEMMY; MOLD FREE OR MOLDY; HAY OR COMPOST

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Introduction

The objective of this paper is to create awareness among Indiana forage producers about the importance of knowing moisture content through the various phases of harvest so the greatest amount of yield and quality can be retained for consumption by the forage-consuming animal.

Method of harvest has an impact upon the amount and type of losses, harvest or storage (Figure 1). When the conserved feed is wilted silage, harvest-associated loss is less than storage-associated loss; whereas, when the forage is made as hay, harvest-associated loss is greater than storage-associated loss.

Moisture content at the time of a harvest operation also influences amount of harvest loss (Table 1.) Percent dry matter loss can be minimized by careful monitoring of moisture content at the time of the operation. For instance, if tedding occurs at 60 percent moisture dry matter and leaf losses are small, one and three percent, respectively, but increase to six and twelve percent if done when the cut forage is 33 percent moisture.

Moisture content at the time of packaging hay affects dry matter loss and loss of valuable nutrients while in storage (Table 2). Hay put into storage too wet without use of an effective preservative (e.g. buffered propionic acid/acetic acid mixture) will have increased temperature that promotes microbial proliferation that ultimately results in moldy hay. In the worst case scenario, hay put into storage too wet will result in spontaneous combustion and potential loss of the hay storage facility. Digestibility decreases, in part, because the fiber content (In Table 2 measured as NDF, neutral detergent fiber) of the hay increases when put in storage too wet. A greater portion of the crude protein in hay is bound (In Table 2 measured as ADIP, acid detergent insoluble protein.) and unavailable to the consuming animal when hay is stored too wet. Hay stored as small square bales (i.e. less than 70 lbs.) can be safely stored at a moisture level less than 20 percent, whereas hay stored as large round bales should be no greater than the high teens. Large square bales (e.g. 1000 lbs.) should be in the mid teens as density of bale is typically greater than large round bales. The major concern of packaging hay too dry is increased harvest- associated loss and poor retention of highly digestible leaves.

Table 3 gives some guidelines for proper moisture content when making silage or hay. The broad range of moisture associated with silage making results because type and size of silo influences best moisture level for proper fermentation and little loss of effluent. Silage placed in a small bunker silo can be at the high end of the range of moisture noted in Table 3 (70 percent) and round bale silage can be ensiled at 50 percent moisture.

Techniques to measure moisture content in forage include a squeeze test with hands, resistance-type moisture detectors (e.g. Delmhorst), portable electric drying units (e.g. Koster Tester), and the microwave oven. The squeeze test has major limitations, but can be a quick way to determine if a sample chopped by the silage chopper is too wet for proper fermentation. If moisture can be squeezed from the chopped forage the crop should continue to wilt to a more desirable moisture range. Resistance-type moisture detectors are an excellent tool in letting one know if the crop is getting "in range" for chopping or baling. Their degree of accuracy can be fine tuned if time is taken to measure moisture content of like forage with a portable electric drying unit or microwave oven. These appliances are the most accurate way for producers to measure moisture content of forage to be made into hay or silage. The advantage of the microwave oven over traditional oven drying (e.g. Koster Tester) is much reduced time (minutes as compared to hours) in determining the moisture content. For determining moisture content with a microwave oven see:
www.agry.purdue.edu/ext/forages/publications/ID-172.htm
Another excellent resource to read is:
ianrpubs.unl.edu/range/g1168.htm

Figures and tables below are from ID-317, Purdue Extension Forage Field Guide. Copies can be ordered by contacting your local Purdue Extension Educator or by visiting: www.agry.purdue.edu/dtc/forage_guide.html

Figure 1.

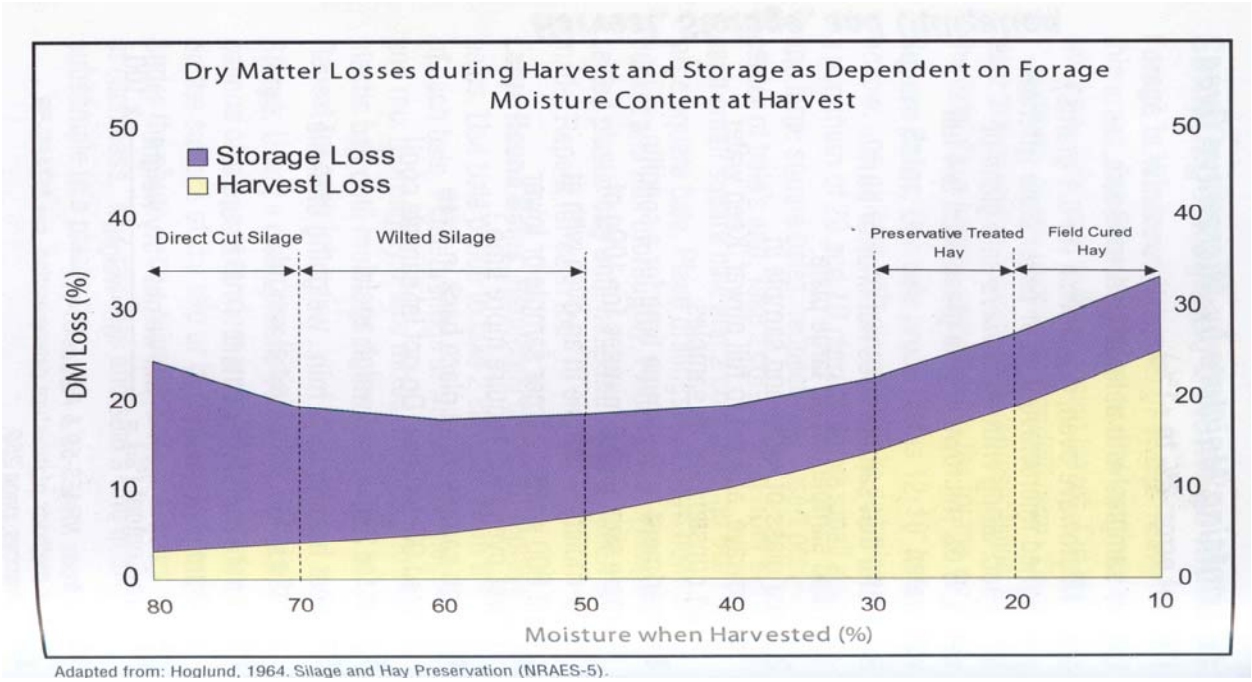

Table 1.

Operation	% DM lost	% leaves lost
Mowing	1	2
Mowing/Conditioning		
reciprocating mower, fluted rolls	2	3
disc mower, fluted rolls	3	4
disc mower, flail conditioner	4	5
Raking		
at 70% moisture	2	2
at 60% moisture	2	3
at 50% moisture	3	5
at 33% moisture	7	12
at 20% moisture	12	21
Tedding		
at 70% moisture	1	2
at 60% moisture	1	3
at 50% moisture	3	5
at 33% moisture	6	12
at 20% moisture	11	21
Baling, pickup + chamber		
at 25% moisture*	3	4
at 20% moisture	4	6
at 12% moisture	6	8
Baling at 18% moisture		
small square baler	5	8
round, variable chamber	6	10
round, fixed chamber	13	21
Stack wagon	15	24
TOTAL	7-31	12-50
*Requires a preservative for safe storage		
Source: Kjelgaard, Rotz, & Hundtoft , Silage and Hay Preservation (NRAES-5)		

Table 2.

Changes in Untreated Alfalfa Hay During 6-Month Storage

Hay moisture content at harvest (%)	DM loss (%)	Digestible DM loss (%)	Crude protein loss (%)	Increase in ADIP (%)	Increase in NDF content (% DM)
11-20	5	6	6	1	1
20-25	8	12	9	7	4
25-34	11	14	8	9	5

Note: Losses are expressed in terms of percent of initial content.
DM = dry matter, ADIP= acid detergent insoluble protein, NDF= neutral detergent fiber.

Source: Rotz and Abrams (1988), Silage and Hay Preservation (NRAES-5)

Table 3

Characteristics of Stored Forage by Percent of Dry Matter and Moisture

% Dry Matter	% Moisture Content	Results	
15	85	Silo leaks effluent	Undesirable fermentation
20	80		
25	75	—	
30	70	Good Silage Range	
35	65		
40	60		
45	55		
50	50	DANGER ZONE Fire hazard in silo or hay mow	
55	45		
60	40		
65	35		
70	30		
75	25		
80	20	Good Hay Range	
85	15		

Source: Extinguishing Fires in Silos & Hay Mows (NRAES-18)