SAVING THOSE VALUABLE LEAVES DURING HAYMAKING

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Introduction

Field dry hay needs to be reduced from near 80% moisture to 20% or less to prevent spoilage during storage. Drying hay to safe baling moisture often takes several days. Sources of loss during forage harvest include mechanical losses such as mowing, conditioning, chopping, raking, packaging and handling as well as respiration and leaching. The general relationship between forage moisture concentration at harvest and losses during the field and storage phases is shown in Figure 1. Harvest losses are greatest for very dry forage and are low for very wet material like direct cut silage. However, the latter is subject to excessive storage losses due to seepage and to quality deterioration. Storage losses are generally minimized by harvesting at low moisture levels. Many of the losses that can occur during the haymaking process impact the leaf component much more than the stem component, especially for legume hay crops such as alfalfa, and thus damage quality even more than hay yields.

Leaf and Stem Quality

Although alfalfa is inherently high in quality compared with many grass forages, there are still large differences between leaf and stem within the same plant. Leaf is much higher in crude protein concentration than stem (Fig. 2). Also, leaf quality is very consistent over a wide range of ages compared with stem, which declines greatly in quality as the shoot matures.

Figure 1. Field and storage losses of alfalfa over a wide range of harvest moistures.

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Alfalfa leaf is also very low in NDF and ADF compared with alfalfa stems (Fig. 3). Even the very young tip sections of the stem (referred to as young stem in Fig. 3) is much higher in fiber than the leaf portion of the forage. High fiber concentrations detract from a forage's intake potential when fed to livestock and thus greatly affects the production potential.

Physical Losses

Because of the type of leaflets legume forages have, being smaller than grass leaves and located on short petioles, they are much more subject to physical loss than are grass leaves. Severe physical treatments, such as with flail mowing or conditioning treatments involving flail attachments, can cause losses as large as 10 to 30%. In one study, alfalfa losses during field curing were greater than for either perennial or annual ryegrass grass when they were all cut with a reciprocating mower followed by tedding or raking over a 4 yr period. Field DM losses for grass hay were high, averaging 19%, but were only about one-half the 39% average loss for alfalfa.

Tedding at reduced moisture concentrations may increase DM losses substantially. These losses are generally much greater for legume than for grass forage due to differences in the way grass and legume leaves are shaped. Timothy tedding losses increased from 1-2% above 40% moisture to as much as 7% below 10% moisture. Under the same conditions, alfalfa lost 8% of the DM for forage of 40% moisture and even higher for dryer material.

Raking Losses

Raking losses are influenced greatly by crop moisture concentration. Raking losses of alfalfa increase rapidly when crop moisture falls below 40% (Fig. 4). Raking excessively wet forage will slow drying but leaf losses can reach levels above 20% of the dry matter if raking is done just before baling.
Rain Damage

Rainfall during hay curing reduces both yield and quality through the leaching effects of water and by increasing subsequent physical losses. Grasses are affected somewhat less by rain during curing than legumes. Field curing losses of alfalfa DM over 54 hay harvests averaged 17% without rain damage and 22% with rain damage. The extent of loss due to rain increases as moisture in the drying crop declines.

Figure 3. Neutral detergent fiber (total fiber) concentrations of separated alfalfa leaf and stem.

The impact of rain on hay quality is exerted primarily on the leaf fraction. More than 60% of the leaching loss and three-fourths of the respiration and leaf shatter loss from alfalfa of DM, N, ash and in vitro DDM are from the leaf fraction.

Baling Losses

Baling loss for rectangular bales of alfalfa generally ranges from 2 to 5%. Baling losses for round bales vary widely but generally range between 1 and 15%. Leaf loss of legume hay during baling generally increases as moisture declines. In dry environments, such as those encountered in haymaking regions of the Western U.S., night baling may be an effective means of reducing losses to an average of 0.8% by harvesting leaves with a higher moisture concentration. However, high humidity levels prevalent in the Eastern U.S. limit the utility of night baling since hay moisture quickly rises above safe baling moistures.

Figure 4. Shatter losses during raking of alfalfa hay (From Moser, 1980).
Measuring Moisture In Hay

It is critical that we have dependable information on the moisture concentration in the hay in order to be sure of adequate storage if it is dry hay or that the preservative rate is adequate if preservatives are being used. A typical home microwave oven is an excellent method for determining hay moisture. A 50-100 gram sample should be weighed and dried for 6 minutes. After that time, check the sample to see whether additional drying is necessary. If so, heat for 2 minutes and recheck. This last stem is repeated until no further weight is lost, indicating that the sample is dry. When the sample is dry, it can be reweighed and the moisture concentration calculated by the following formula.

\[
\text{Moisture Content} = \frac{\text{Sample Weight Wet} - \text{Sample Weight Dry}}{\text{Sample Weight Wet}} \times 100
\]

A system using regression charts with a microwave oven allows accurate determination of actual moisture with only one weighing and in a shorter drying time of 4 minutes. The shorter time is possible because the sample is not dried completely in this method. The weight after 4 minutes of drying is closely related to the actual moisture. The sample moisture is read from a chart showing columns for the microwave weight and the actual moisture.

Electronic probe testers are also available for field use in moisture determination. Of several electronic-type units tested, the "Delmhorst" moisture unit did the best job of predicting actual oven moisture determinations. Although the correlation between Delmhorst and actual oven moistures was very good, probe reading was not identical to the actual moisture concentration. At about 17% moisture, the two would give identical readings but above that moisture level, probe readings underestimated the actual moisture concentration.

A rule-of-thumb system for estimation of hay moisture when a tester is unavailable is shown below. Whatever the method used to determine moisture, a single sample or reading is not adequate to determine moisture on a field or lot of hay because moisture content varies considerably in different parts of a field cut at the same time. Based on the variation we found between measurements on the same bale, it would be necessary to take 12 readings to estimate moisture concentration within +2%.
### ESTIMATING HAY MOISTURE WITHOUT A TESTER

<table>
<thead>
<tr>
<th>Moisture Concentration*</th>
<th>Condition</th>
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<tbody>
<tr>
<td>30-40%</td>
<td>Leaves begin to rustle and do not give up moisture unless rubbed hard. Juice easily extruded from stems using thumbnail or knife or with difficulty by twisting in hands.</td>
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<tr>
<td>25-30%</td>
<td>Hay rustles-a bundle twisted in the hands will snap with difficulty, but should extrude no surface moisture. Thick stems extrude moisture if scraped with thumbnail</td>
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<tr>
<td>20-25%</td>
<td>Hay rustles readily-a bundle will snap easily if twisted-leaves may shatter-a few juicy stems may remain</td>
</tr>
<tr>
<td>15-20%</td>
<td>Swath-made hay fractures easily-snaps easily when twisted-juice difficult to extrude</td>
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</tbody>
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*Reproduced from Hoard’s Dairyman 132. 1987.*