Extension Service
West Virginia University

Forage Management

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PROPER HANDLING AND CURING OF HAY[1]

Hay made from the best-adapted species and fertilized properly can still result in suboptimal forage if not properly handled and cured. Haymaking is an art, and understanding the science behind it can help us become better artists.

Haymaking serves two main purposes:

- To conserve excess forage during the spring flush for use when forage growth is slower or nonexistent.
- To produce a cost-effective, nutritional livestock feed.

This paper will cover the basic tasks in haymaking and some of the management considerations needed to be taken to better achieve these two purposes.

Mowing

The first task is to choose when to start making hay. Forage yield and quality are covered in Hay Quality vs Hay Quantity (Fact Sheet 5817). When high-quality hay is needed, the harvest must start at an early growth stage, such as late boot to very early head in grasses and late bud to early bloom in legumes. In mixed grass-legume stands, the decision for the first cut should be based on the grass since the grasses usually mature earlier than the legume. Aftermath harvests should then be based on the legume growth stage. Where only moderate quality is needed and yield is the primary goal, then take the first cut when the grass is at early head to early bloom stage.

For most livestock farms having different classes of animals, some of which need high-quality forage and some of which can do with lower-quality forage, it is most practical to start harvesting early in the season, realizing that there will usually be enough later-cut, lower-quality hay. Then store the early-cut hay separately from the late-cut and feed the hay to the animals based on forage quality and animal need.

The next question is, should hay be cut early or late in the day? In the last few years, it has been reported that hay should be cut when the sugar and starch or total nonstructural carbohydrate (TNC) is highest in the plant. The TNC content of a plant is at its lowest at sunrise since the plant used carbohydrates for respiration during the night and could not fix sugar through photosynthesis. At sunrise, the plant can start photosynthesis to fix sugar, allowing the TNC concentration to increase through the day and reaching a peak in late afternoon around 6 P.M. (1800 hr) (Fig. 1). It is reported that hay made when the TNC is at the high point results in higher animal forage intake and performance. On the other hand, there is a problem. Cutting hay late in the day results in forage not drying very much before nightfall. During the night, TNC is lost by respiration. This loss increases with forage moisture and air temperature, as shown in Fig. 2. If hay at 70% moisture (700 g/kg) going through a cool 68°F night (20°C) it will lose TNC at a rate of 0.15 % of total DM per hour. However, hay at the same moisture going though a warm 86°F (30°C) night would lose TNC at 0.25% of the dry matter per hour. In the cool environment, the loss is 1.8% units TNC; in the warm environment, the loss is 3.0% units TNC. With a 2.5% daily range in plant TNC (Fig. 1), this means that with cool nights we can get a net gain but on warm nights we get a net loss in hay

[1] Presented at the Virginia Forage and Grassland Council Meeting. January 11, 2001, Verona, Virginia

TNC content. Much greater gains in forage TNC content can be achieved by harvesting hay at an earlier date or by increasing the legume content in the stand.

Figure 1. The time of day that forage is cut affects the amount of sugars and starches, expressed as total nonstructural carbohydrates (TNC), in forage (Smith 1975).

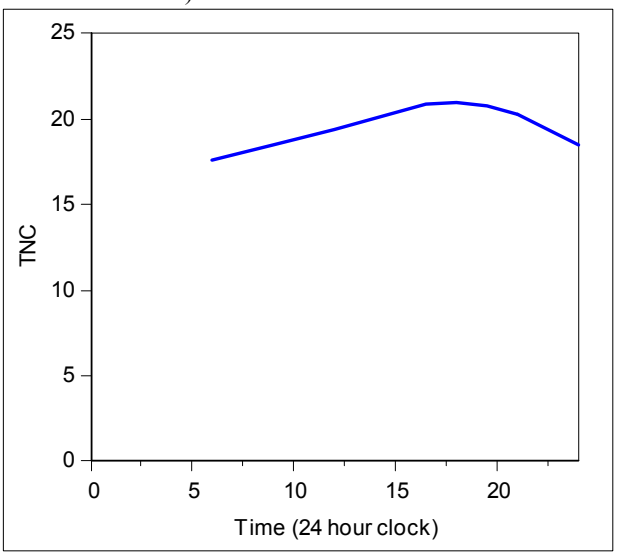
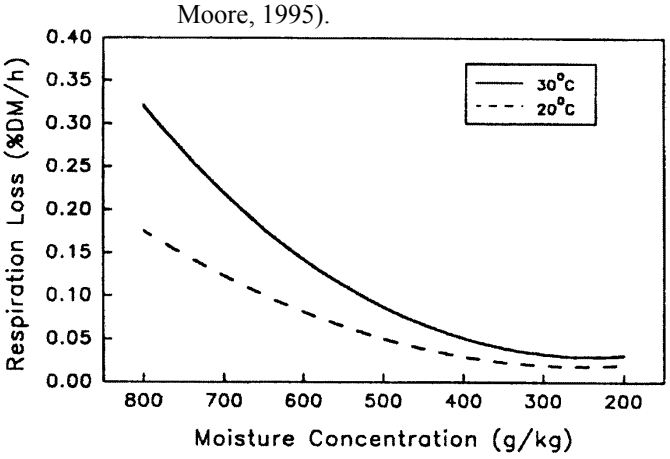


Figure 2. Respiration loss from hay curing in the field is proportional to the forage moisture content and air temperature (Collins and Moore, 1995).



It is practical to start mowing after the dew has dried off. This is about 10 A.M. on hilltops in West Virginia. By this time, the TNC in the hay is on the increase. Also, the dew on the plant's surface will dry quicker if the plant is standing than it will in the swath if cut too early. If harvesting a large acreage for hay, some of what is cut will be later in the day when the TNC is higher. When the weather is warm, the earlier cut hay will dry to a point that reduces the nighttime respiratory loss of TNC.

When mowing to make dry hay, set the mower to make as wide a swath as possible. This exposes more of the forage to the drying effects of the sun and wind.

A few words on what type of mower is "best." A person can cut more acres per hour with less maintenance downtime with a disk mower than a sickle bar mower. A mower-conditioner will crimp hay stems so that the hay dries faster and can be baled sooner than if a mower without conditioning roles is used. However, a new disk mower is more expensive than a sickle bar mower, and a mower conditioner is more expensive than a mower. Which to use comes down to the size of the haying operation, the local economic situation, and the preferences of the owner. When reliable custom operators are available, it is often more practical for the small operation to use their services rather than owning and making the hay on their own.

Tedding

Some resent research on hay tedding implies that it does not allow hay to dry any quicker. When looking at average hay moisture, this may be true. However, the value in tedding is to turn the swath and allow forage that was on the bottom or in clumps to come to the top and dry better, resulting in more uniform drying and reducing wet spots in the hay. On the other hand, if hay is tedded when it is too dry or if it is tedded too often, leaves will be broken off, causing a loss in forage quality and yield. The leaves are the part of the plant with the highest protein and digestibility.

In most cases hay should be tedded once. However, if the mower cannot be set to get an open swath, tedding the day of mowing may be warranted.

Tedding should usually be done the morning after the hay is mown. Tedding in the morning, after the dew is off but while the hay is tough, reduces leaf loss. When the hay's moisture content is above 50%, leaf loss is kept below 5% of dry matter (Fig. 3). Even on the second morning after mowing, the hay will usually be in

the 50%-60 % dry matter range, as shown in Fig 4. This is because when the nighttime humidity approaches 90%-100% the equilibrium moisture content of hay approaches 50% (Fig. 5). This means that dry hay gets tough (takes up moisture) when the humidity increases. Those experienced in haymaking have seen this on evenings when they baled later in the day than they wanted.

Figure 3. The effect of forage moisture on dry matter loss during raking of alfalfa hay (Collins and Moore, 1995).

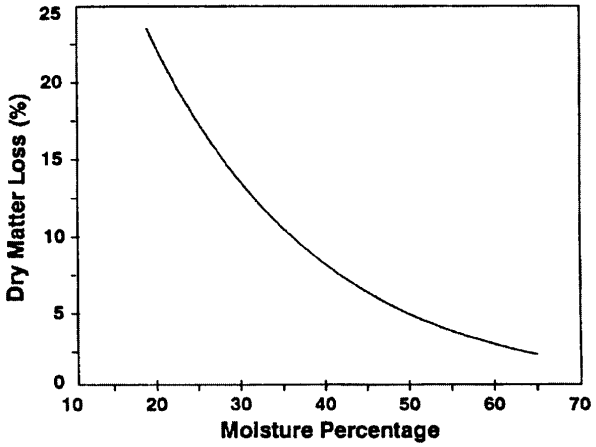
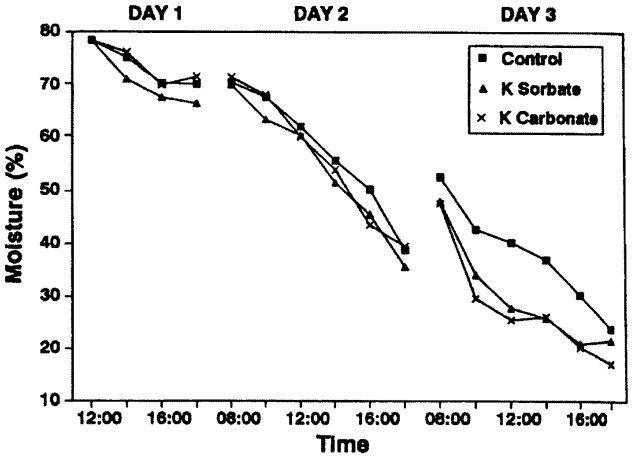
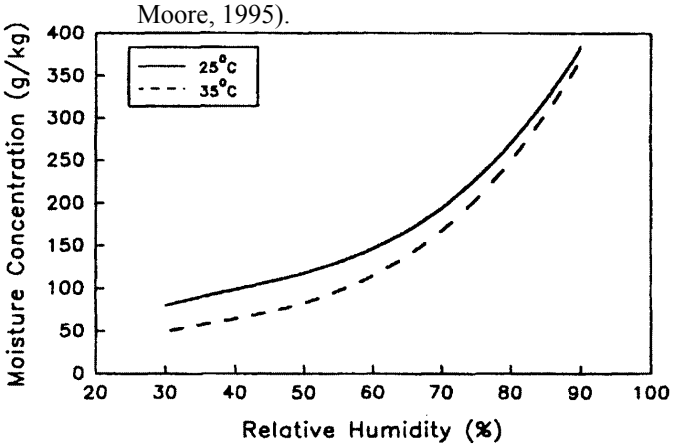


Figure 4. The effect of two drying aids on the loss of moisture from alfalfa during drying (Collins and Moore, 1995).



When purchasing a tedder, look at the total operation cost. A tedder that works two swaths requires half the machinery and labor time to work a field compared to a less expensive, one-swath tedder. Most tedders are light so the tractor size and fuel needed will be little more with the larger tedder.

Figure 5. Equilibrium moisture content of hay is proportional to the relative humidity in the air and the air temperature (Collins and Moore, 1995).



Raking

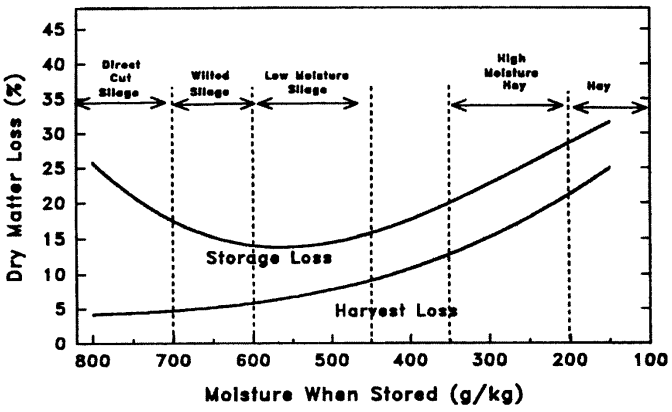
Raking the hay into a windrow allows for increased drying before the hay is baled. There are several new rake technologies that increase the openness of the windrow for drying. It is important to rake in a manner that will minimize leaf loss. The same principles that apply to tedding hold for raking. Raking when the hay is tough but not wet with dew will reduce leaf loss. Also, using rakes that handle the hay more gently or slowing the speed of the rake, if it is working the hay too hard, are ways to reduced leaf loss.

Baling

Making hay crop silage in plastic-wrapped big round bales is very popular. This technique allows adding a relatively low-cost silage option to an operation that already makes large round bales. By making balage, a producer can reduce dry hay losses but may have some silage storage losses if not managing carefully. When hay is baled at higher moistures, leaf loss is reduced. If moisture is too high, storage loss by seepage will occur (Fig 6). This happens even in wrapped bales due to daytime evaporation and nightime condensation when bales are exposed to the sun. In a silo, seepage loss is due to compression by the weight of silage in the upper part of the silo.

If hay is almost dry enough to put up without wrapping, it is too dry to wrap. In this situation, the hay will not ensile properly and harmful bacterial may grow, causing health problems and possible livestock death.

Figure 6. The effect of forage moisture at ensiling or haying on harvest and storage losses (Collins and Moore 1995).



Balage does not increase the quality of forage. Late-cut hay is still late-cut hay. Making balage can reduce the risk of rain damage, but quality hay made as balage still must be harvested at an early maturity stage.

Drying Agents and Preservatives

Drying agents and preservatives are other technologies that should be looked at closely to see if they have economic value. Drying agents are useful on legumes but not on grasses. They allow the water to dry from the legume forage faster, making it possible to bale the hay a few hours sooner (Fig 4). Preservatives allow the hay to be baled at a higher moisture content without molding and spoiling. The practical and economic value of both of these technologies depends on local product availability and cost and on the economics of the hay's planned use.

Conclusion

Hay can be a low-cost, high-quality conserved feed. Proper management is necessary to achieve this. Early harvest of hay containing legume will produce the highest quality hay. Good recycling of manure made from hay feeding and using legume-fixed nitrogen will reduce the cost of hay production by reducing the need for purchased fertilizers. Harvesting at the correct stage of growth and enhancing drying by judicious tedding and raking will help optimize forage quality.

New technologies also can be of great use in forage management. But not all of them will improve the bottom line on all farms. When purchasing technology for haymaking determine the following:

- your livestock's feed requirement,
- the local economic value of improved animal performance,
- the local economic value of increased forage yield,
- the quality and yield of hay being put up now,
- the increase in quality and yield provided by the new technology.

From this, you can determine the likeihood of a new technology increasing your net income or farming satisfaction.

References:

Collins, M. and K.J. Moore. 1995. Post harvesting processing of forages. *IN*. Forages - the Science of Grassland Agriculture. Vol. II. (ed.) R.F. Barnes, D.A. Miller, and C.J. Nelson. Iowa State Univ. Press, Ames, Iowa.

Moore, L.A. 1962. Grass-legume silage. *IN*. Forages - the science of grassland agriculture. H.D. Hughes, M.E. Heath, D.S. Metcalfe (ed). Second Edition. The Iowa State Univ. Press. Ames, Iowa.

Smith, D. 1981. Forage management in the North. Kendal Hunt Publishing Co. Dubuque, Iowa.
