Lesson 8: Harvesting and Storing Forages

There are more acres in the U.S. used for the production of forage and pasture crops than for any other agricultural purpose. Forages are crop plants that are grown or produced for animal feed. Production of forages takes place on more than 475 million acres of pasture or range land in the U.S. An additional 60 million acres are used for intensive hay production. Missouri is the second leading state in the nation in hay production (excluding alfalfa). Missouri produces an estimated 5.8 million tons of hay each year.

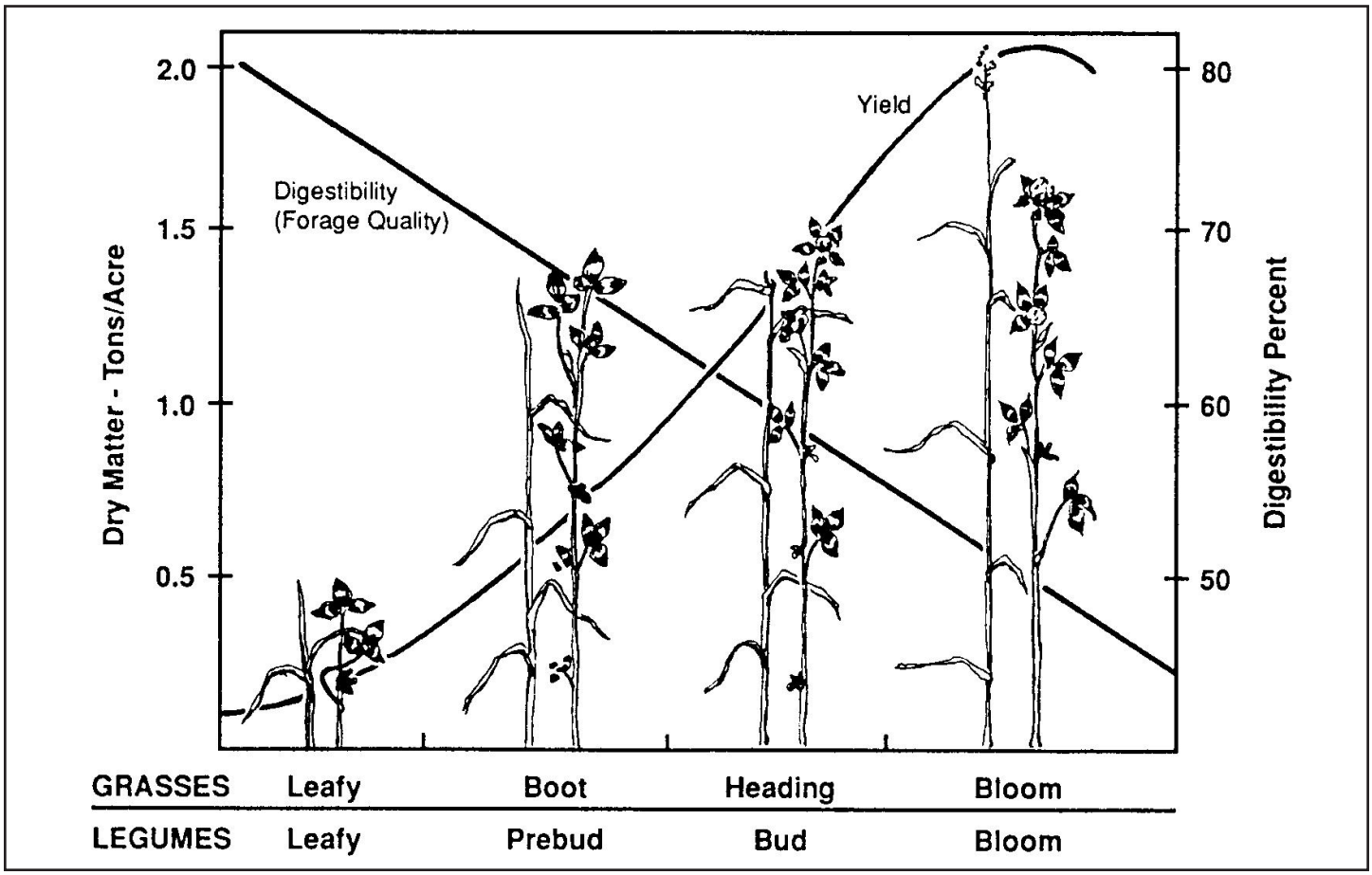
Many factors are involved in harvesting and storing forages. Supplying quality forages for livestock feed requires forage producers to make decisions regarding when to harvest, which harvesting method to use, and how to store forages to maintain quality. The term harvesting includes direct grazing, cutting for dry or high moisture systems, and baling.

Determining Harvest Time

Quality forage crops originate from quality seed. However, forage quality can be reduced if cutting and baling are done improperly or if weather conditions are not favorable. The nutrient content and palatability (taste) of forages are important; therefore, harvesting must occur at the optimum time.

Forage nutrient value is at its highest level at an early growth stage; however, yield would be low at that time. A balance must be reached between nutrient content and yield when considering the best time to harvest forages. Refer to Figure 8.1. Cutting early will reduce yield but produce the highest quality. Cutting later increases yield but reduces quality. If cutting is delayed, leaf drop and lodging (plant falling over on the ground) may become problems. The optimum time to harvest forages depends on the plant species. Refer to Table 8.1.

Figure 8.1 – Yield and Quality in Forages



Optimum time for baling forages is equally important to ensure quality. Baling too early when the forage is wet may cause mold and heat damage. Delaying baling past the optimum time may result in leaf shattering and a reduction in forage quality. Measures must be taken to estimate the optimum time to bale in order to avoid these problems. Figure 8.1 shows yield and quality at different growth stages of forage grasses and legumes.

Weather conditions should also be considered. Forage cutting can be hindered and forage quality reduced by undesirable weather conditions. Cutting hay before or during rain is detrimental to the nutrient quality of the forage. Rain will leach out nutrients from cut forage.

Determining Forage Quality

Forages can be consumed by livestock through pasture grazing or in the form of hay, haylage, or silage. Hay includes the entire vegetative part of a forage crop dried for feed. Haylage is cut forage stored in airtight systems at a higher moisture content. Silage is a forage crop preserved in a succulent state that ferments and is used for feed. Forage quality is important in order to supply nutrients to livestock.

The quality of forages affects milk production levels in dairy cattle and rate of gain in livestock. Care must be taken to provide quality forages. Factors that determine forage quality can be assessed by physical appraisal or chemical analyses.

Physical appraisal is the most common method used. It uses sight, smell, and touch when determining the quality of a forage. The three main characteristics that determine the quality of hay are visual appearance, color, and odor. Good quality hay should consist of a leafy forage that is not dominated by coarse large stems. Quality forages should also be free of foreign material.

Color can be used to judge whether or not the forage has been damaged or improperly dried. The appropriate color

Table 8.1 – Hay Types and Optimum Time to Cut

Type of Hay	Optimum Time for Harvest
1. Alfalfa	first flower to 1/10 bloom
2. Alsike clover	1/2 to full bloom
3. Birdsfoot trefoil	1/10 bloom
4. Cowpeas	when first pods have started to ripen
5. Corn silage	harvest when kernels are fully dented and glazed
6. Crimson clover	1/2 bloom
7. Fescue	boot to early heading
8. Ladino clover	full bloom
9. Lespedeza	early bloom
10. Medium red clover	1/4 to 1/2 bloom
11. Small grains	boot stage to early dough
12. Soybeans	when beans in the pod are half developed
13. Sweet clover	when first blossoms appear
14. Bromegrass	early bloom (anthesis)
15. Orchard grass	fully headed but before bloom
16. Reed canary grass	when first heads appear
17. Timothy	early bloom (anthesis)

of quality hay should be a bright green. The odor of hay should be pleasant. A musty or moldy smell would indicate damage due to excessive moisture or heat damage.

Chemical analyses are used when knowledge of the precise nutrient content of a forage is important. Scientists use chemical analyses to determine the levels of crude protein in a forage sample. Such information is needed to prepare a balanced feed ration that provides maximum animal performance. Digestibility is estimated by chemically analyzing the fiber content in the forage. Digestibility relates to the ability of animals to digest the forage. Chemical analyses are also used to determine the lignin content of forages.

When to Harvest Forages

Refer to Table 8.1, "Hay Types and Optimum Time to Cut," for information. Note that the optimum harvest time occurs before the crop reaches physical maturity.

Methods of Harvest

When harvesting forages, the use of the forage influences the best method of harvest. Forages to be used for grazing must be managed to provide feed for the number of animals which will be grazing the field. Grazing too many animals on a pasture can damage the forage crop stand and lead to soil erosion. Pastures managed properly by rotation grazing increases forage production and protects the soil.

Dry hay harvesting systems involve cutting the forage, drying it in the field (curing), and packaging it for transportation and storage. Methods used to package forage crops vary, depending on how the crop is to be used or stored. Common methods of packaging are conventional square or round bales, large round bales, large rectangular bales, portable haystacks, and field cubes. Each method uses different equipment and results in products of various weights and sizes. The preferred packaging method is dependent on the needs of the producer.

There are several steps in the hay harvesting process. The first step involves cutting the forage at the optimum time. After cutting, the forage can either be left in the swath (cut path) or raked into rows (windrows). Cutting can also be done by using a mower-conditioner. Mower-conditioners cut the forage, crimp or crush the stems, then windrow it to dry. Conditioning forages speeds up the drying process. Once the forage is dried to the desired moisture level, it is then baled, stacked, or cubed for storage. Chemical additives can be used to reduce drying time and the formation of molds.

High moisture systems involve cutting forages at higher moisture levels (40-75%) and storing them in airtight silos, bunkers, or bags. When forages are cut for silage, they should contain approximately 60-75 percent moisture content. Haylage is stored at 40-60 percent moisture content in an oxygen-free atmosphere. High-moisture silage is generally harvested with a mechanical chopper. The chopper cuts the standing forage crop into short lengths and blows it into a truck or wagon that is trailing behind the chopper. The freshly chopped forage is then taken to a silo and stored until needed for feed. Wilted silage or haylage is allowed to dry to proper moisture before storage.

Specialized forage processing machinery can be used to produce cubes or pellets. Stationary cubers force ground forages through extrusion dies to form cubes. Stationary cubing requires expensive machinery and much labor.

Pelleting machines produce pellets that vary in length. Pelleting machines use ground forages. Pellets are used for small animal feeds such as rabbits, sheep, and poultry. Alfalfa is a common forage used for pellets and is a primary protein source in mixed feeds.

Forage Deterioration

Forage deterioration can be caused by improper cutting, improper baling, improper harvesting methods, and improper storage. Early baling can cause forage deterioration due to high moisture content. Mold and heat damage will occur, causing deterioration. Mold and heat damage reduce the quality and palatability of forages.

Improper storage can also cause forage deterioration. Facilities that do not protect forage crops from heat damage, weather, or pests increase deterioration of stored forages. Deterioration of forages can be a costly problem. Steps should be taken to prevent forage deterioration.

There are four main steps that should be taken to reduce forage deterioration. First, to ensure quality forage, the crop must be harvested at the optimum time. Second, the appropriate harvesting method should be used to help maintain feed value. Conditioning cut forages can reduce drying time and limit field damage from pests or adverse weather. Methods that reduce the loss of leaves from the plant should be used since leaves contain most of the nutrient value of forage crops. If leaves are lost through drop or shattering, forage quality is reduced. Harvesting forages at the proper moisture content will help to maintain forage quality during storage. Maintaining proper storage facilities is the fourth important step to prevent forage deterioration.

Storage Requirements

The effort, time, and expense required to produce a quality forage crop can be wasted if it is improperly stored. The basic requirements for storing dry hay are to provide protection from weather, insects, animals, and birds and to provide adequate ventilation. For silage and haylage, protection from weather, insects, animals, and birds must be provided. However, silage and haylage require air-tight facilities because of the fermenting action which occurs during storage. Silage and haylage storage facilities should also provide for convenient filling, emptying, monitoring, and cleaning.

Improving Field Drying

Forage crops, when cut in the field for hay, should contain 15-20 percent moisture for baling. Methods used for field drying are swath drying, windrow drying, crushing or conditioning, and chemical additives.

In swath drying, the forage is left in the path it was originally cut to sun dry. Once dry, the swath is raked into windrows to be picked up and baled. Windrow drying involves cutting the forage and raking it into rows, allowing it to dry in the rows before baling. Both techniques are commonly used. Swath drying can cause bleaching of the forage if not done properly. Bleaching reduces the quality of the forage and causes the forage to lose much of its green color.

Crushing or conditioning is also a method used for field drying. The forage is cut by a conditioning machine that either crushes or crimps the stems to speed up the drying process. Conditioners place the crimped forage in windrows. Since a shorter field drying time is required, the chance of bleaching or damage from other sources is reduced. Chemical additives such as calcium carbonate can speed up the drying time and reduce nutrient losses from overexposure to sunlight. Other chemicals such as organic acids (i.e., propionic acid) can be used to prevent molding, thus permitting the forage to be baled at a higher moisture level.

Summary

Forages provide vital nutrients to many species of livestock. Millions of acres in the U.S. are devoted to the production of forages. Forages may be produced on pastures, on range lands, or in intensive hay crop production. Producing quality forages such as hay, silage, and haylage requires good management practices. Proper cutting time, baling time, harvesting methods, and adequate storage are important factors to consider in producing quality forages.

Credits

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