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PRODUCING QUALITY FORAGE

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Introduction

Producing quality forage is a combination of good management practices, science, art, and good fortune. We all know that the weather plays a major role in our ability to produce quality forage. Since we can't control the weather, we must focus on the things we do have control over, and do everything in our power to "stack the deck" in our favor. This article briefly summarizes some of the key management factors involved in harvesting and storing quality forage.

Silage vs. Hay

The loss of nutrients and dry matter yield during mechanical harvesting and storage of forages is extremely high. On average, 20 to 40% of the standing forage is lost during hay and silage making. In making dry hay, field losses are usually greater than storage losses. With silage, field losses are usually lower, but storage losses can be greater than with hay. In our humid environment, losses are usually lower for silage than for hay. Where possible, producers should consider the use of silage or wrapped balage systems to achieve high quality forage more consistently.

Plant Factors

Good quality forage can be produced from all of the legumes and grasses we grow, if they are harvested at the proper stage. But the "window of opportunity" for good quality forage is narrower for grasses than for legumes, because quality declines more rapidly in grasses. Forage quality usually declines more rapidly in the spring than it does in late summer, so a timely first harvest is important to achieve good quality. This is especially true of the grasses, but even alfalfa quality declines more rapidly in the spring than in late summer. Under intensive cutting schedules, allowing alfalfa to flower once in late summer can be a good practice to increase persistence without a large sacrifice in quality.

A method of estimating neutral and acid detergent fiber content of alfalfa in the field was recently developed at the University of Wisconsin. This method can serve as an aid in optimizing alfalfa harvest timing to achieve high quality forage. Instructions for this method are given in Table 1 and the accompanying chart. The accuracy of estimation has been tested in Wisconsin, Ohio, Pennsylvania, and New York, and it was found to be equally effective in all four states.

Minimizing Harvest Losses

The keys to minimizing nutrient and dry matter losses during harvest include rapid curing, mechanically handling the forage a minimum of times, and performing mechanical operations when the forage has the correct moisture content.

Solar energy (sunshine) is the single most important factor affecting drying rate. So "making hay when the sun shines" speeds drying, reduces plant respiration losses, and reduces the likelihood of rain damage. Should we always wait for sunny weather? If we wait, the crop continues to mature, which definitely reduces quality. Research over several years at the University of Kentucky demonstrated that hay cut at the right stage with rain damage had greater digestibility than hay that was mowed later without rain damage. One inch of rain reduces the nutritional value of alfalfa about as much as one week of delayed maturity. Also, there is no guarantee that the next good "weather window" for making hay will be any better than the current one.

Mechanical conditioning is an effective way to speed drying of all types of hay, sometimes reducing in half the time required for hay curing. Make sure the conditioning rollers are set properly so the stems are crushed.

Mow early in the day to maximize the hours of sunshine available for drying. Rapid drying reduces plant respiration, a process which essentially "burns up" soluble sugars.

Make wide swaths to maximize the surface area exposed to sunshine. It has been estimated that less than half of the solar radiation penetrates beyond a 1 inch depth in the swath. If the soil is wet at mowing, it may be best to make a narrower swath to let the bare ground dry and then ted or turn the hay after it dries on top.

Tedders used just after cutting can increase the interception of the solar energy by spreading out the hay. Tedding should be accomplished after the hay has wilted to about 60% moisture. Tedding after the crop reaches 50% moisture will increase dry matter losses and will not effectively increase drying rate. Tedders are very effective in breaking up windrows of rained-on hay to allow redrying. Tedding is generally more effective with grasses than with legumes.

Raking should be done at moisture levels of 40% or more, to reduce leaf shatter loss. Remember that every time forage is handled, some losses occur. The drier the hay when it is handled, the more loss. The "art" of haymaking involves choosing the right type and number of operations to achieve as rapid drying as possible without unnecessary losses.

Minimizing Storage Losses

Storage losses can be controlled by following two rules: bale hay at the proper moisture content and protect it from the elements. Proper moisture levels for baling are: less than 20% for small square bales, less than 18% for large round bales, and less than 16% for large square bales. The larger hay packages are more dense so water loss during storage is less. Thus, they should initially contain less moisture than small packages. Unprotected hay suffers extremely high storage losses. Losses in large round bales stored outside on the ground can exceed 40% under severe conditions, and average 25% during one season. Bales should at least be elevated off bare ground using crushed rock, poles, pallets, or some other means of providing air space between the bale and the soil. Bales covered in solid plastic don't need to be elevated, but research in Kentucky suggests that elevation is beneficial for netwrapped bales.

Hay Additives

Hay additives are grouped into two categories. Drying agents are chemicals sprayed onto the crop at the time of mowing to increase the rate of drying. Potassium and calcium carbonate are the primary active ingredients in drying agents. These are most effective when drying conditions are good, so they are less effective on first cuttings than during the summer. Mechanical conditioning is as effective as drying agents on first cutting. Drying agents should be only be used on legumes or legume-grass mixtures, as they are not very effective for grasses.

<u>Hay preservatives</u> work by chemically inhibiting or killing microorganisms that can spoil wet damp hay baled above 20% moisture. Sodium diacetate, proprionic acid, ammonium proprionate, urea, anhydrous ammonia, and others are known to be effective in preserving moist hay IF applied in sufficient quantities. Apparently, the critical factor with rate of application is maintaining the necessary concentration of active ingredient in the water contained in the hay. So as moisture content at baling increases, the rate of preservative to apply must increase. Acid-based preservatives are caustic and can damage equipment (not to mention skin). Ammonium proprionate is a buffered proprionic acid material that is less volatile and also less corrosive.

Anhydrous ammonia is also an effective hay preservative for hay containing less than 30% moisture. It should be applied at 1% rate (20 lbs anhydrous ammonia per ton of wet hay). Application of this product is difficult. Urea can be used as an alternative. It is easier to apply but not as effective. Damp hay treated with urea should be sealed in plastic.

One of the main disadvantages of drying agents (my opinion) is that you must commit to that investment early in the harvesting operation (at cutting). In contrast, the decision to use a hay preservative occurs later, at baling time. One can decide to use the preservatives only when it appears necessary to avoid rain damage by beginning to bale sooner.

Summary

I believe that we should always strive to produce and harvest forage of high quality, regardless of the nutrient requirements of the livestock it is intended for. If we aim for average or lower quality forage, we will often produce forage of poorer quality than we desired. There is always a market for high quality forage.

Acknowledgments

The following two papers were used as sources in writing this article:

Collins, M. 1997. Making and storing quality hay. p.1-13 In Proc. 1997 Ohio Forage & Grasslands Conf., Columbus, OH 22 March 1997.

Weiss, B. 1994. Harvest and storage aids for forages. p.19-24 In Efficient production and utilization of forages. Ohio State University Interdepartmental Series 941.

Table 1. Estimating pre-harvest alfalfa quality using Predictive Equations of Alfalfa Quality.
STEP 1: Choose a representative 2 square foot area in the field. **STEP 2**: Determine the stage of the most mature stem in the 2 sq. ft. area (see chart on next page). **STEP 3**. Measure the height of the ONE tallest stem in the 2 sq. ft. area. Measure it from the soil surface (at base of crown) to the tip of the stem (NOT the tip of the highest leaf). Note that the tallest stem may not be the most mature stem. Measure carefully, making sure yardstick is next to stem. ALSO, pull the stem relatively taunt when measuring. You want the stem length, not its height as it stands on its own. **STEP 4:** Based on the most mature stem and height of the tallest stem, use the chart on the next page to determine estimated NDF content of the standing alfalfa forage. Repeat the procedure in 4-5 representative areas across the field. Sample more times for fields larger than 30 acres. **NOTE:** This procedure estimates alfalfa NDF content of the standing crop and does not account for changes in quality due to wilting, harvesting, and storage. These factors may further raise NDF content by 2 to 5 units, assuming good wilting and harvesting conditions. This procedure is most accurate for good stands of pure alfalfa with healthy growth.

Estimating Pre-Harvest Alfalfa NDF Content					
Height of Stem (From soil to stem tip)	Stage of Most Mature Stem				
	Late Vegetative Stem > 12 in. No buds visible	Early Bud 1-2 nodes with buds	Late Bud more than 2 nodes with buds	Early Flower 1 node with 1 open flower	Late Flower 2 + nodes with an open flower
--inches--	----------------------------------- % NDF ---				
16	28.5	29.3	30.1	31.0	31.8
17	29.2	30.0	30.8	31.6	32.5
18	29.9	30.7	31.5	32.3	33.1
19	30.6	31.4	32.2	33.0	33.8
20	31.3	32.1	32.9	33.7	34.5
21	32.0	32.8	33.6	34.4	35.2
22	32.7	33.5	34.3	35.1	35.9
23	33.4	34.2	35.0	35.8	36.6
24	34.0	34.9	35.7	36.5	<u>37.3</u>
25	34.7	35.5	36.4	<u>37.2</u>	38.0
26	35.4	36.2	37.0	37.9	38.7
27	36.1	36.9	<u>37.7</u>	38.5	39.4
28	36.8	<u>37.6</u>	38.4	39.2	40.0
29	<u>37.5</u>	38.3	39.1	39.9	40.7
30	38.2	39.0	39.8	40.6	41.4
31	38.9	39.7	40.5	41.3	42.1
32	39.6	40.4	41.2	42.0	<u>42.8</u>
33	40.3	41.1	41.9	<u>42.7</u>	43.5
34	40.9	41.8	42.6	43.4	44.2
35	41.6	42.4	<u>43.3</u>	44.1	44.9
36	42.3	<u>43.1</u>	43.9	44.8	45.6
37	<u>43.0</u>	43.8	44.6	45.4	46.3
38	43.7	44.5	45.3	46.1	46.9
39	44.4	45.2	46.0	46.8	47.6
40	45.1	45.9	46.7	47.5	48.3