BOOTS, BUDS, AND BLOOMS...WHAT DO THEY MEAN TO YOUR LIVESTOCK?

Mark Sulc and Bill Weiss

The Ohio State University and
Ohio Agricultural Research & Development Center
Email: sulc.2@osu.edu

Storing high quality forage does not happen by accident. While weather conditions often do play a big role in our ability to store high quality forage, decisions on harvest timing and management are very important to achieving dairy quality forage. This paper focuses on management strategies for achieving dairy-quality forage from perennial cool-season legumes and grasses.

It is important for producers to grow the forages that are best adapted and suited to their particular operation. Usually several species are viable alternatives. No single forage is perfect under all conditions. Factors that must be considered include: soil characteristics, weather and climate conditions, prevalence of insects and diseases, harvest and storage constraints and characteristics, nutritive value desired, yield potential, and level of management input. Although species selection is important, harvest timing is the overriding factor that influences forage quality – and that is how boots, buds, and blooms (crop maturity) come into play.

Cool-Season Legumes

Forage Quality Goals. The neutral detergent fiber (NDF) content for alfalfa should be less than 44% when fed to high producing dairy cows; 40 to 42% NDF is ideal. Net energy of lactation (NEL) should be greater than 0.64 Mcal/lb and acid detergent fiber (ADF) should be less than 32%. For average producing cows (rolling herd average less than 18,000 lbs milk), NDF should be less than 48%, NEL greater than 0.6 Mcal/lb and ADF less than 35%. Alfalfa will usually be in the bud stage to achieve the higher quality required for high producing cows. Bud stage alfalfa will usually contain 22% or higher crude protein (CP) and 40% NDF, while early bloom alfalfa will average 20% CP and 40 to 45% NDF.

Composition of clover and trefoil will be similar to alfalfa harvested at similar stages of maturity, but will tend to have slightly higher CP concentrations than alfalfa. Clover and trefoil should generally be cut in early bloom stage, because cutting in the bud stage will adversely affect stand persistence.

Field Estimation of Alfalfa Fiber Content. The fiber content of a standing crop of alfalfa can be estimated in the field to help determine the optimal time for cutting the crop. Alfalfa NDF is estimated based on stem length and maturity stage. This technique is described at the end of this article (see "Estimating Alfalfa NDF in the Field"). This system works better than basing harvest timing on maturity stage alone. For example, under cool spring

conditions the development of buds and flowers is often delayed in alfalfa, yet fiber continues to accumulate at a steady pace. In contrast, under hotter and drier conditions in mid-summer, blooming alfalfa may have fine stems and be high in quality. Using the system described at the end of this article, the field estimated NDF was within 3 units of the actual wet chemistry NDF in 77% of 545 samples we collected from across a wide range of environments in the Midwest. This estimation procedure can be used throughout the growing season, not just on the first crop. It provides a reasonably accurate guide for timing alfalfa harvests according to your forage quality goals. The limitation is that it is designed for pure stands of alfalfa that are not under excessive stress. Calibrated Alfalfa Quality Sticks with NDF markings can be purchased that simplify the estimation procedure for field use.

Harvesting Guidelines. Achieving high quality alfalfa forage will usually require cutting at early maturity stages, which eventually tends to reduce stand life. A good compromise to extend stand life of alfalfa in a dairy operation is to harvest at least one cutting during the summer months in the early bloom stage to allow accumulation of root reserves. The first two cuttings should be taken near 40% NDF, and later summer cuttings can be taken in the early bloom stage. The NDF content of alfalfa declines more rapidly with maturity early in the season, but late summer harvests can be made at a later maturity stage with a lesser penalty on forage quality. The greatest proportion of the annual yield is produced early in the season, which is another reason for a timely first and second harvest.

Over time in the eastern U.S, harvesting alfalfa as silage rather than hay will yield 5% more dry matter and forage quality will be tend to be higher because of less rain damage. The advantage of silage is even greater for clover because of the slow drying and prolonged curing times needed when making clover hay.

Cool-Season Grasses

Many soils in this region are not well suited for alfalfa. If managed properly, cool-season grasses can be a viable alternative or complementary forage with alfalfa for dairy cows. Milk production can be maintained on grass-based diets, but proper cutting management, fertilization, and favorable environmental conditions (particularly rainfall) are required for grasses to provide high yields of high-quality forage.

Forage Quality Goals. The nutritional value of the different cool-season grass species (including orchardgrass, perennial ryegrass, smooth bromegrass, timothy, and reed canarygrass) is similar if they are managed correctly. The exception is endophyte-infected tall fescue, which should not be fed to dairy cows. Grasses fed to high producing dairy cows should have NDF levels less than 55%; near 50% is ideal. Notice that the recommended NDF level is higher for grasses (~50%) than alfalfa (~40%). The nutritional value of grass and legume NDF is different. Grass with NDF near 50% will provide about as much digestible energy as alfalfa with NDF in the 40 to 42% range. As with alfalfa, NEL of grasses should be greater than 0.64 Mcal/lb and ADF should be less than 32%. For average producing cows (rolling herd average less than 18,000 lbs milk), NDF should be less than 60%, NEL greater than 0.6 Mcal/lb and ADF less than 35%. Cool-season grass fertilized with adequate nitrogen and cut at frequent intervals (24 to 28 days) should contain about 20% CP and NDF in the 50 to 53% range.

Fertilization and Harvesting Guidelines. Nitrogen fertilization is critical to grass productivity and protein content on the frequent harvest schedules required for lactating cows. Annual nitrogen applications of 160-200 lbs/acre (actual N) should be split applied, with 70 - 75 lbs/acre in very early spring and 40-50 lbs/acre immediately after each harvest.

Forage quality is influenced more by the time of cutting (maturity of the forage) than by grass species. In general, the first harvest should be taken in late vegetative (pre-boot to very early boot stage) in the spring followed by a harvest every 24 to 28 days thereafter, depending on location. In northeastern Ohio, cutting orchardgrass on 28 days intervals provided forage of adequate quality for lactating cows, but in central Ohio cutting every 28 to 30 days resulted in NDF levels at or above 55% NDF. Grass forage with more than 55 to 58% NDF is not suitable for high producing dairy cows. So for high producing cows, orchardgrass must be cut closer to a 24-day cycle in central Ohio and Indiana. Delayed cutting greatly reduces nutritional value of grass forage. Grasses mature quickly and the optimal harvest window is only a few days. In the spring, these higher NDF levels occur once heads begin to appear. In subsequent harvests, the higher NDF levels will occur if cutting is delayed beyond the recommended 24 to 27 days. Orchardgrass, reed canarygrass, and perennial ryegrass are the species best adapted to the frequent harvest schedules required to obtain forage of adequate quality for lactating cows. Timothy and smooth bromegrass are not well adapted to frequent cutting.

Cool Season Grass-Legume Mixtures

Grass-legume mixtures offer many advantages over pure stands, but they also complicate some management decisions. Nevertheless, the advantages of mixtures often outweigh the disadvantages. Compared with pure legume stands, mixtures are often higher yielding, compete better with weeds, dry more quickly, and lengthen the stand life. Compared with pure grass stands, mixtures are usually higher yielding, require little or no nitrogen, and harvest windows are wider for achieving high quality forage.

Harvest management of grass-legume mixtures is not as well defined as for pure stands. In general, harvest timing should be based on the predominant species in the mixture. If predominantly grass, harvest timing should be based on the grass maturity. Mixtures with 50% or more grass should be harvested to achieve NDF content in the 46 to 48% range for high producing dairy cows. If legumes are the major component of the mixture, harvest to achieve NDF levels in the 40 to 44% range, and harvest can be timed a little closer to what would favor the legume. If grass is the major component of the mixture, a more frequent harvest schedule is required to obtain forage of adequate quality for lactating dairy cows, and maintaining the legume component in such mixtures is extremely difficult. The most likely scenario is that the minor legume component will be lost within a short time under the intensive cutting schedule required in grass-dominant stands.

Summary

Harvest timing is the overriding factor that influences forage quality of all forage species. Although rainy weather can foul up the best-laid plans, understanding crop development and using tools like the one described here for estimating alfalfa NDF content in the field can serve as useful guides toward harvesting dairy quality forage. Frequent cutting and N fertilization are required for harvesting dairy quality forage from pure grass stands. Grass-legume mixtures offer many advantages and should be considered.

Estimating Alfalfa NDF in the Field

Step 1: Choose a representative 2-square-foot area in the field to be harvested.

Step 2: Determine the most mature stem in the 2-square-foot sampling area using the criteria shown in the table at right.

Step 3: Measure the length of the longest stem in the 2-square-foot area. Measure it from the soil surface (next to plant crown) to the tip of the stem (NOT to the tip of the highest leaf blade). Straighten the stem for an accurate measure of its length. The longest stem may not be the most mature stem.

Step 4: Based on the most mature stem and length of the longest stem, use the chart at the right to determine estimated NDF of the standing alfalfa forage.
Example: longest stem is 28 inches, most mature stem has buds, but no open flowers; NDF = 38%.

Step 5: Repeat steps 1 to 4 in four or five representative areas across the field. Sample more times for fields larger than 30 acres. Average all estimates for a field average.

NOTE: This procedure estimates alfalfa NDF content of the standing crop. It does not account for changes in quality due to wilting, harvesting, and storage, which may further raise NDF content 3 to 6 percentage units, assuming good wilting and harvesting conditions. This procedure is most accurate for good stands of pure alfalfa with healthy growth. Calibrated Alfalfa Quality Sticks with NDF markings can be purchased that simplify this procedure for field use.

Length of Tallest Stem (from soil to stem tip)	Stage of Most Mature Stem		
	Late Vegetative no buds visible on stem	Bud Stage 1 or more nodes with buds visible	Flower Stage 1 or more nodes with open flower(s)
-- inches --	---------- % NDF ----------		
16	28.5	29.7	31.4
17	29.2	30.4	32.0
18	29.9	31.1	32.7
19	30.6	31.8	33.4
20	31.3	32.5	34.1
21	32.0	33.2	34.8
22	32.7	33.9	35.5
23	33.4	34.6	36.2
24	34.0	35.3	36.9
25	34.7	35.9	37.6
26	35.4	36.6	38.3
27	36.1	37.3	38.9
28	36.8	38.0	39.6
29	37.5	38.7	40.3
30	38.2	39.4	41.0
31	38.9	40.1	41.7
32	39.6	40.8	42.4
33	40.3	41.5	43.1
34	40.9	42.2	43.8
35	41.6	42.8	44.5
36	42.3	43.5	45.2
37	43.0	44.2	45.8
38	43.7	44.9	46.5
39	44.4	45.6	47.2
40	45.1	46.3	47.9