A2309

Sampling Hay and Silage for Analysis

Dan Undersander, Neal Martin, Terry Howard, Randy Shaver and Jim Linn

RELIABLE FORAGE ANALYSIS can improve your livestock feeding program. Determining the feed value of forage allows you to balance rations more accurately and buy hay based on nutritive value.

The key to successful forage analysis is taking a good, representative forage sample on the farm. Laboratory analysis can determine the quality of a submitted forage sample, but this will not help you balance rations if the submitted sample does not represent forage actually being fed to your animals. The largest error in forage analysis is improper sampling methods on the farm. You need to take a representative sample of forage from every hay or silage lot. These samples will reflect the variation in forage quality that occurs across your fields and during harvesting.

What to Sample

A lot of hay or silage is the forage harvested within one day from one field. It is taken from the same cutting, the same stage of maturity, and is uniform in its amount of grass, weeds or rain damage. A hay or silage lot also is uniform in visual quality—odor, amount of mold, color, stem texture and size, and leafiness.

To efficiently sample each lot, you must keep a complete inventory of hay and silage lot. Segregate each lot as you harvest and store it, and note the approximate number of bales or the silo depth. The entire height and width of one face of the hay lot should be exposed for visual evaluation and sampling.

The distribution of leaves, stems, weeds and other material is not uniform in most forage packages. Knowledge of forage stratification within a storage structure is critical to adequate sampling for analysis. Use a technique that will obtain a representative sample of the various concentrations of leaves and stems in the forage.

How to sample

Baled, loose or chopped hay

A hay bale is not uniform in composition. The baling process (picking up, transferring and packing hay) affects the leaf and stem distribution within the bale. Hay condition, environmental conditions at baling and hay-making practices also affect bale structure.

The small, rectangular two-string bale has been studied more than others. The leaves in these bales tend to concentrate toward the tight and solid sides of the bale (figure 1). The best place to core sample small rectangular bales is through the center of one end. For other bale types, inspect each bale for the distribution of leaves and stems and core sample from

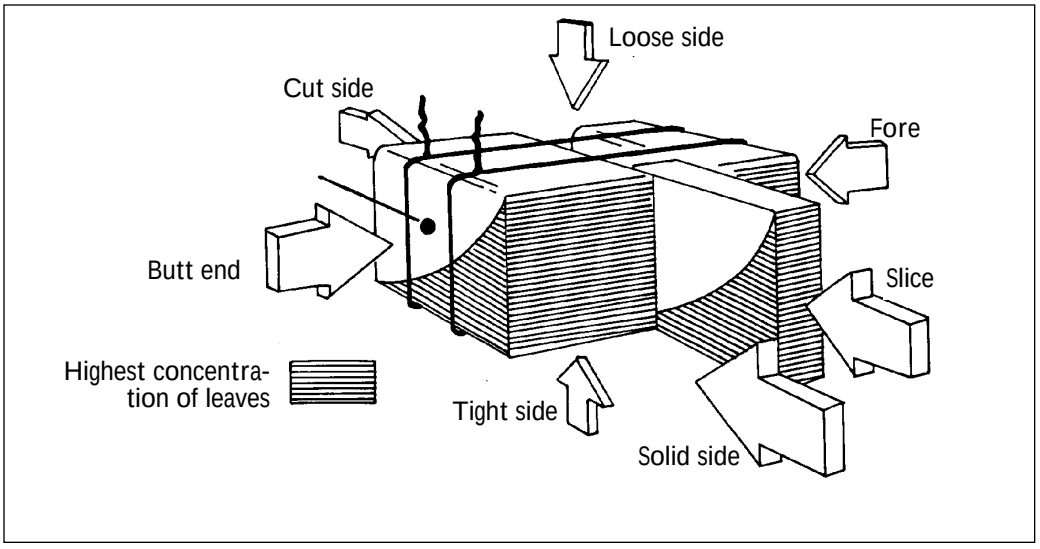
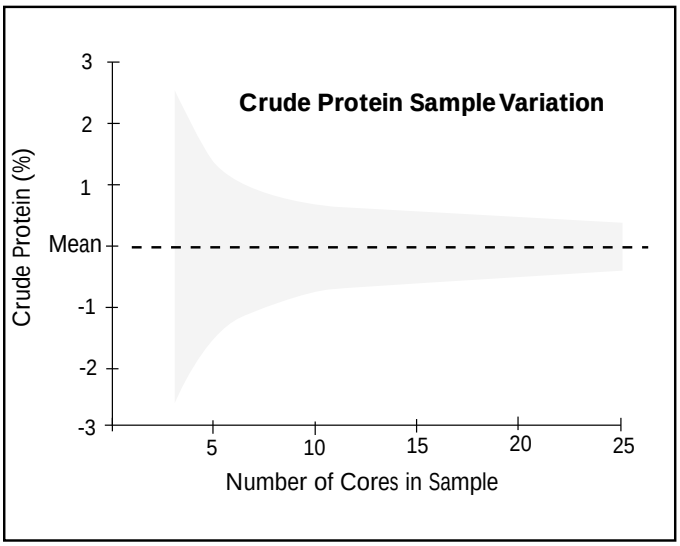


Figure 1. Alfalfa hay bale structure



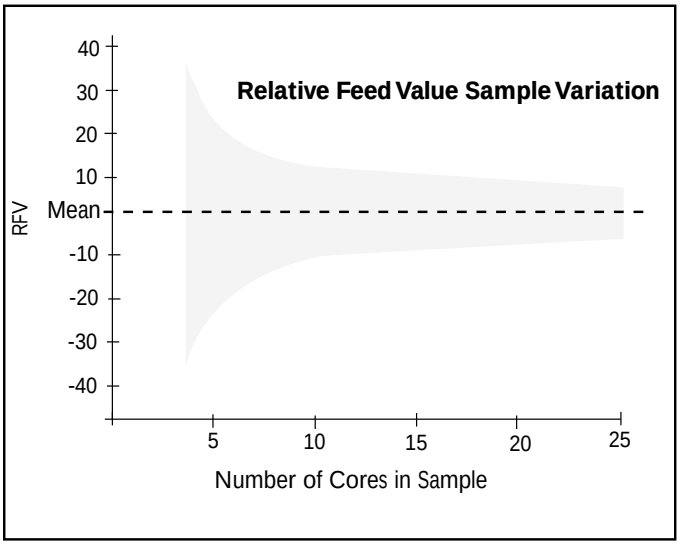


Figure 2. Bale sample variation due to number of cores per sample. For example, if a sample analysis from three cores resulted in a mean crude protein of 21%, the actual protein content of the hay lot has a 95% chance of being between 18.4 and 23.6. However, for the same result from a sample of 20 cores, the actual crude protein of the hay lot has a 95% chance of being between 20.5 and 21.5.

areas that do not contain disproportionate concentrations of either leaves or stems. Due to variation among bales from the same lot, it is important to sample from several bales.

Using a core sampler is better than taking a grab sample because it causes less separation of leaves and stems. Many cores taken from the same lot will yield a more accurate analysis (figure 2). Combine 15 to 20 cores from a hay lot into one sample for analysis.

1. Test each forage lot separately. Mark the location of each lot in the barn or storage shed for easy reference when feeding.

2. Take 15 to 20 widely separated sores or samples from each lot.

3. Use a bale core sampler to reduce error. The core sampler should have an internal diameter of at least 3/8-inch and a length of 12 to 18 inches. Keep the core sampler tip sharp so it cuts through bales rather than pushes stems aside. The core sampler works with either a variable speed 1/2-inch drill or a hand brace. Using the drill or brace, insert the core sampler its entire length into the center of the end of the bale, at a right angle to the end face (figure 1).

4. Mix the cores in a clean pail. Place the entire sample in a clean plastic bag or other container and seal tightly. *Do not divide* the sample. It is normal for the leaves and stems to separate and settle in the sample.

5. Label each container with your name, address, a sample number and forage type (e.g. alfalfa, alfalfa-timothy, or red clover).

Haylage and silage at harvest

Sampling the forage at harvest gives you advance knowledge of the quality of forage stored in silos. You can inventory by quality and plan for purchasing supplemental feedstuffs based on forage quality needs.

While some fractions can show significant change during the fermentation following ensiling, crude protein and fiber fractions (ADF and NDF) show little change where forage has been ensiled properly and normal fermentation occurs (table 1). Analysis will change when:

- Forage is ensiled at too high a moisture content and seepage occurs (crude protein and nonfibrous loss resulting in higher fiber)
- Forage is ensiled too dry and heats excessively (acid detergent fiber and acid detergent insoluble nitrogen increase)
- Fermentation is faulty.

Distribution of leaves and stems will not be uniform throughout the chopper wagon because leaves are lighter than stem parts and often accumulate towards the back and sides of a chopper wagon while the center front will have a higher concentration of stems. These fractions are mixed as the wagon is unloading and as the lot is distributed in the silo.

1. Sample legume, legume-grass, grass haylage, low-moisture corn or other silages from each field.

2. Collect three to five handfuls of haylage or silage from the middle of the load as the wagon is unloading. Place them in a plastic bag and immediately refrigerate or freeze. Follow

Table 1. Forage quality analysis before and after ensiling during 1988 and 1989, University of Wisconsin Ashfield Research Station

Before/after ensiling	Dry matter	CP	ADF	NDF
Alfalfa haylage				
before	44.1	19.9	32.3	40.5
after	42.4	20.7	34.8	40.4
Red clover haylage				
before	45.5	15.9	32.1	45.9
after	46.6	15.9	33.7	48.9
Corn silage				
before	34.4	9.7	29.2	49.5
after	34.1	11.1	29.0	48.8

[a]CP=crude protein; ADF=acid detergent fiber; NDF=neutral detergent fiber

the same procedure for several loads of forage throughout the day.

3. Combine refrigerated samples from a single harvested field and mix well. Place the entire sample in a clean plastic bag or other container and seal tightly.

4. Label each container with your name, address, the sample number and forage type.

5. Repeat for each field if more than one field is harvested in any one day.

6. For tower silos or silo tubes, keep an inventory of where each lot is in the silo or tube. Feeding colored plastic strips through the blower at the end of each lot may help identify the lots later. (A bushel of corn may also be used to mark haylage lots.)

7. Silos with seepage should be resampled upon feeding because seepage contains nitrogen and nonstructural carbohydrates. Loss of these nutrients will increase dry matter, acid detergent fiber and neutral detergent fiber, and will decrease crude protein. Similarly, at feeding resample silos that were filled with forage containing less than 50 percent moisture. These forages may have overheated, causing increased acid detergent fiber and acid detergent fiber insoluble nitrogen.

8. Recheck dry matter of silages at feed out. Fiber and protein are not likely to change significantly during storage, except as mentioned previously, but moisture can change.

Ensiled material from tower silos

It is easier to sample silage at harvest rather than sampling ensiled material as it is being fed. In addition, analysis results are available long before the forage is fed to allow more accurate ration balancing and time to purchase supplements.

If you do sample from the silo, do not sample the spoiled material at the top. Remove 2 to 3 feet of silage first.

1. Collect a 1 to 2 lb sample from the silo unloader while it is operating. Collect samples from morning and evening feedings of the same day.

2. Combine the samples and mix well. Place the entire sample in a clean plastic bag or other container and seal tightly. Store immediately in a freezer or other cold place until shipping.

3. Label each container with your name, address, the sample number, forage type and mixture.

Ensiled material from bunker silos

1. If feeding a total mixed ration (TMR)—Load silage from bunker into TMR mixer and mix well. Take several grab samples to collect a 1 to 2 lb total sample.

   If not feeding a TMR—Collect a 1 to 2 lb total sample from the different vertical layers of the silo face. Grab several handfuls from freshly exposed forage after the day's feeding has been removed. Do not sample the spoiled material on top of the silo.

2. Combine handfuls and mix well. Place the entire sample in a clean plastic bag or other container and seal tightly. Store immediately in a freezer or other cold place until shipping.

3. Label each container with your name, address, the sample number and forage type (e.g. alfalfa, alfalfa-timothy, or red clover).

Where to send samples

For accurate results, forage samples should be analyzed at a laboratory that participates in the National Forage Testing Association certification program. Laboratories participating in the NIRS Forage and Feed Consortium with the Universities of Minnesota and Wisconsin verify that their near-infrared instruments are working properly and that the equations they are using are appropriate for samples being tested.

You can obtain forage sampling information sheets from your county Extension agent, nutritionist or forage testing labora-

tory. Fill out an information sheet for each lot, answering all questions. It is important to label forage types clearly and to note when silage has had ammonia or urea added at ensiling.

Keep silage samples frozen in airtight containers. Place containers in insulated bags, and mail them early in the week—rather than over the weekend—to prevent molding and decay, which might change the analysis results.

Using Forage Analyses

Chemical analysis of forage has little value unless you use it to formulate rations or to sell or buy hay. To compare feeds and formulate rations, you need an accurate estimate of *dry matter* in forages, since water provides no nutrients and dilutes the nutrient density of a feed. Three important estimates of different dry matter components are protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF).

Protein

Use protein analysis to determine the amount of additional protein needed to provide a balanced ration for profitable milk or meat production.

Both overfeeding and underfeeding protein are costly to production. If a dairy operator underestimates the protein content of forage by 2%, the operator is spending $3 to $4 per ton of grain for unnecessary supplemental protein in the grain mixture.

Likewise, if a dairy operator overestimates the protein content of forage, the operator probably will not feed the herd enough protein to achieve top production. A shortage of 0.44 lb in crude protein can be corrected by feeding 1 lb soybean meal per cow. If all other nutrients are adequate, the added protein from the soybean meal will yield 5 to 7 lb more milk per cow. Thus, spending $0.08 to $0.12 per cow may return $0.60 to $0.80 worth of milk.

Neutral Detergent Fiber (NDF)

NDF is the percentage of cell wall material in forages. It is the most accurate predictor of how much dry matter an animal can eat. An increase in NDF means poorer forage quality, and an animal will eat less of that forage. Rations must then be adjusted to minimize the effect of lower intake of poor forages.

For example, a 1% point increase in NDF results in a 1.2% (1 lb) drop in milk yield. While this is largely due to the animal eating less, there is also a decrease in forage digestibility (increased ADF) associated with the higher NDF.

The opposite is also true, a 1% decrease in NDF (higher forage quality) can result in a 1.2% increase in milk production.

Acid Detergent Fiber (ADF)

Acid detergent fiber is the percentage of cellulose, lignin and ash in forages. It provides the best estimate of the energy (digestible fiber) available to an animal from forages. Low ADF results in greater energy density and greater milk yield per ton of forage. A 1% point increase in ADF (a less digestible forage) reduces milk yield by 0.6 lb milk/cow each day; reduces the milk production potential of a ton of forage dry matter by 50 lb/t; and reduces the milk production value of forage by $5 to $6.50 per ton.

Relative Feed Value (RFV)

Relative feed value is an index which ranks cool season legumes, grasses and mixtures by potential digestible dry matter intake. It should be used to allocate forages to the proper livestock class with a given level of expected performance. It can also be used to relate price and forage quality when buying or selling hay.

For additional information on forage types, analysis and rationing, contact your county Extension agent.

This publication is a revision of *Taking an Accurate Forage Sample*, by D.A. Rohweder, W.T. Howard and L.J. Miller. The authors gratefully acknowledge this earlier work.

Authors: Dan Undersander is a forage agronomist and Terry Howard and Randy Shaver are dairy nutritionists with the College of Agricultural and Life Sciences, University of Wisconsin-Madison, and University of Wisconsin-Extension Cooperative Extension. Neal Martin is a forage agronomist and Jim Linn is a dairy nutritionist with University of Minnesota and Minnesota Extension Service. Produced by Cooperative Extension Publications, University of Wisconsin-Extension.

University of Wisconsin-Extension, Cooperative Extension, and **Minnesota Extension Service,** in cooperation with the U.S. Department of Agriculture and Wisconsin counties, publishes this information to further the purpose of the May 8 and June 30, 1914 Acts of Congress; and provides equal opportunities in employment and affirmative action in employment and programming.

This publication is available from your Wisconsin or Minnesota county Extension office, or from:

Cooperative Extension Publications,
Rm. 245, 30 N. Murray St.,
Madison, Wisconsin 53715;
phone 608-262-3346.

University of Minnesota
Distribution Center
3 Coffey Hall, 1420 Eckles Ave.
St. Paul, MN 55108-6064
(612) 625-8173

A2309 Sampling Hay and Silage for Analysis