

## On-Farm Assessment of Forage Quality

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### Abstract

High forage quality is key to good levels of milk production. Frequent forage analysis is an absolute must; however, several on-farm assessments of forage quality and/or forage quality change can be made to suggest that forages should be retested and rations rebalanced. This paper suggests several new technologies that can be matched with forage testing to better provide consistent, high quality feed to the milking dairy cow. Starting at mowing, forage quality only declines from cutting to feeding, so it is important to cut when the alfalfa or grass is at high quality, as estimated by plant height. Forage quality can be estimated by attachments to choppers and balers. Silage moisture changes content of silage on the face of a tube or bunker changes daily and must be adjusted for. We should recognize heating as an energy loss and take steps to reduce it in future harvests. Similarly, mold should be monitored and attempts made to reduce it in future forage storage.

### Introduction

Dr. David Mertens (2012), USDA-DFRC, proposed that the five most important nutritional measurements for hay crops are: dry matter (**DM**), ash, amylase-treated neutral detergent fiber (**aNDF**), some measure of digestibility or energy value, and crude protein

(**CP**). More and more, these parameters can be estimated on-farm, or at least one can receive a flag as to when a parameter has changed.

As Figure 1 shows, when forage quality declines, additional concentrate can offset part of the lost milk reduction but not all. Thus, it is important to harvest forage when quality is high and to minimize losses of the quality through harvesting, storage, and feedout.

Several sources have indicated that forage analysis should be more frequent as herd size increases (St-Pierre and Weiss, 2007; Weiss and St-Pierre, 2009; Hoffman et al., 2010). The purpose of this paper is to give some tools to use to improve consistency of forage quality fed to animals in between the forage samplings.

### Harvesting

Forage quality of alfalfa changes on a daily basis in the spring (Table 1). Every day results in a gain of 0.4 unit NDF and loss of 0.4 unit of fiber digestibility. Grasses show similar response on first cutting when they are heading. At the same time, alfalfa adds about 160 lbs DM per acre dry matter per day. Harvesting early unduly stresses the alfalfa plant and can reduce later cutting yields and winter survival. So we want to harvest at the quality we need but not too early because each day early reduces yield and increases cost per ton of forage.

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Figure 2 shows that the rate of forage quality change is at a constant rate around harvest, but the lines have different intercepts. So that, for example, if one wanted to harvest at 180 relative feed value (**RFV**), there was almost a two week difference reaching this quality among years. Thus, calendar date is not a good indicator of when to start first cutting. Maturity stage is not a good indicator on first cutting since plants often do not flower normally. Similarly, some have recommended a Growing Degree Day model for determining when to harvest, while this may work at some sites, it is no better than calendar date over the wide range of conditions in the Midwest.

A method that has proven to have great utility is to measure plant height and harvest accordingly (Sulc et al., 1997). This makes biological sense given that the percentage stem increases as plants get taller and stems are lower in quality than leaves. The recommendation would be to harvest alfalfa at 28 inches or bud stage, whichever comes first, for dairy cattle or 32 inches or early flower for growing animals and beef cattle. Second and later harvests can be at 28 to 30 days for dairy cattle, which is normally about bud stage. Note that these recommendations are assuming that there will be a 10% quality loss from the standing to harvested forage.

Near infrared reflectance (**NIR**) equipment is available on some choppers for measuring forage quality. The moisture measurement is strongest and can indicate whether or not the forage is in the appropriate moisture range for harvesting. Protein and fiber measurements need to be validated by post-harvest sampling but can be an indication of quality change and possibly be used for inventorying heifer/dry cow vs lactating cow feed. Some systems are also moving towards yield estimates which would allow stand

determinations and site-specific applications of fertilizer, etc.

Attachments for balers are also getting much more sophisticated. Units are available that will monitor the moisture content of the forage going into the bale. Some units will adjust preservative application accordingly, since the amount of preservative needed is directly related to the moisture content of the hay being baled. This kind of attachment can be particularly valuable if fields are disuniform so that moisture content varies across the field. One company makes an attachment that will mark wet bales with spray so that they can be readily sorted and handled separately from dryer bales. Several companies have attachments that are estimating forage quality of hay in the bale and printing an RFID tag with quality information so that high quality bales can be separated from lower quality bales when removing them from the field.

### Leafiness

We all know that leafier forage is higher quality. However, few realize the extent to which this is true. Figure 3 is from a study done in MN, PA and WI in 2015. About 71% of the change in forage quality was due to changes in leaf content. This huge quality effect suggests two things:

1. Any movement of forage during the harvesting process results in leaf loss, which is both a dry matter, and especially, a forage quality loss. Therefore, move the forage as little as possible between mowing and harvesting.
2. Any change in leafiness during feedout should be a red flag that the quality of the forage has changed. The forage should be sampled, analyzed, and the ration rebalanced.

Also, beware of leaf drop prior to mowing. This can be significant in cool and wet conditions that are conducive to growth of fungi on the leaf that can cause leaf drop. If you are seeing high amounts of leaves on the ground when mowing, consider applying a fungicide 3 weeks prior to harvest to reduce the leaf diseases.

### Monitor Moisture

Figure 4 shows the variation in DM content of alfalfa haylage in a bunker at the USDA Prairie du Sac Research Station over time. Five samples were taken in an 'X' pattern across the face each day and averaged. The pattern of DM obviously reflects the rainfall pattern. Generally, a front comes through every 3 to 4 days, usually with rain, but not always. Haylage generally dried after rains the first of August and again after Sept 8, during which dry periods occurred. The important thing to notice is that DM could vary from 30 to 45% over a two week period. If the amount added to the TMR did not reflect the moisture change, then cattle were likely receiving less DM (or more) than expected.

Moisture can be determined quickly by taking a sample and microwave drying it. The sample must be dried 3 min., stirred, dried 3 min. again, stirred, and then dried at 1 min. intervals and weighed until no weight loss occurs. This is reasonably quick, but will generally take about half an hour time.

Another method is the Koster Moisture Tester, where the sample is put into a pan and heat from an infrared light blown through it. This system has the advantage of the operator being able to start the drying and do some other work while the sample is drying. Figure 5 shows an inexpensive DM tester than can be made on the farm: Simply take a piece of PVC pipe, cut a hole in to insert a hair dryer and then set the

sample on top in a colander or pan with screened bottom.

Instrumentation is being developed that will mount the NIR scanner on a loader and moisture can be read as the forage is dumped into the TMR mixer. Some TMR mixers are also made with moisture sensors.

### Heating/Mold Losses

Heating should be recognized as a loss of energy for animals being fed since it represents plant enzymes or microbes breaking down starch and sugars and releasing heat and CO<sub>2</sub>. Heating can be monitored in a bunker or tube by feel. Heating will occur because of several (mis)management practices. The most common causes of heating are:

1. Less than desired packing density. We recommend a packing density of 45 lbs silage per ft<sup>3</sup>. At this density, there is still 40% pore space; lesser density means air will move in faster and farther to initiate mold grow.
2. Feeding too little off the face. At 45 lbs silage per ft<sup>3</sup>, we would expect air to move in 30 inches from the face. Thus, the recommendation is to remove 1 ft/day from the face so silage is only exposed to air 2.5 days before being fed.

If excessive heating occurs in bunkers or tubes, it might be worthwhile to consider management changes for the next harvest period. It might also be worthwhile to consider adding *Lactobacillus buchneri* or some other acetic acid producing bacteria as an inoculant when the forage is ensiled as acetic acid reduces microbial growth and heating.

Heating can also occur in wet hay. If harvesting hay above 16% moisture in large square or round bales, consider using a preservative to minimize the heating loss. Other considerations are to make smaller bales of the wet hay (to increase surface area to volume and allow more heat exchange) and leave bales separate for two weeks. Another option is to wrap the bales in plastic. Wrapping in at least 6 layers of plastic within 24 hours of baling wet hay will reduce heating.

## Conclusions

Forage should be sampled frequently on a farm for analysis. However, more and more of the needed parameters can be estimated on-farm, or at least one can receive a flag as to when a parameter has changed. In addition, analyzing on farm can help develop good management for high quality forage. Harvesting forage when quality is high and minimizing leaf loss during harvest is the first step to high quality forage in the tube or bunker. In addition, monitoring moisture at feedout can assure that cows are getting the DM that they need. Heating is an energy loss to the cattle we are feeding and should be studied to determine how to minimize now and prevent in the future.

## References

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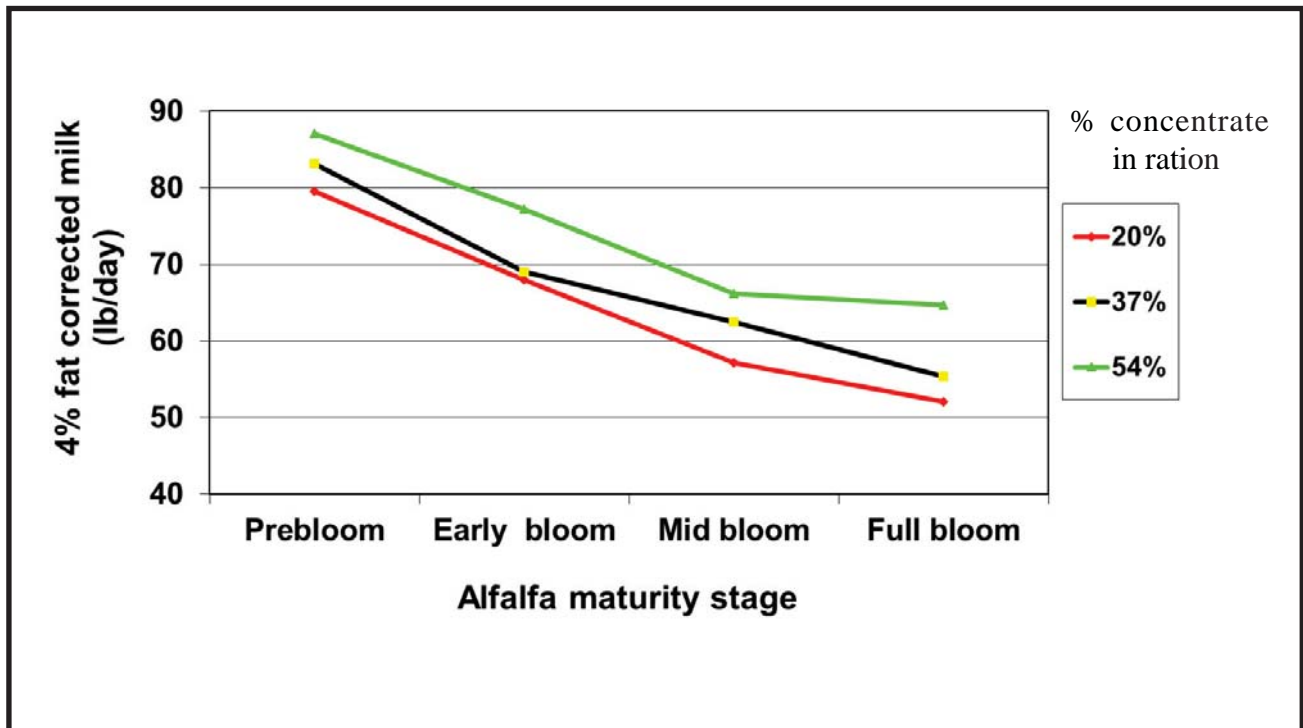
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**Table 1.** Rate of alfalfa forage quality change per day.<sup>1,2</sup>

Component	Mean
Crude protein, % of DM	-0.25
Acid detergent fiber, % of DM	0.36
Neutral detergent fiber, % of DM	0.43
Neutral detergent fiber digestibility, % of NDF	-0.43
RFV, points	-2.9
RFQ, points	-3.6

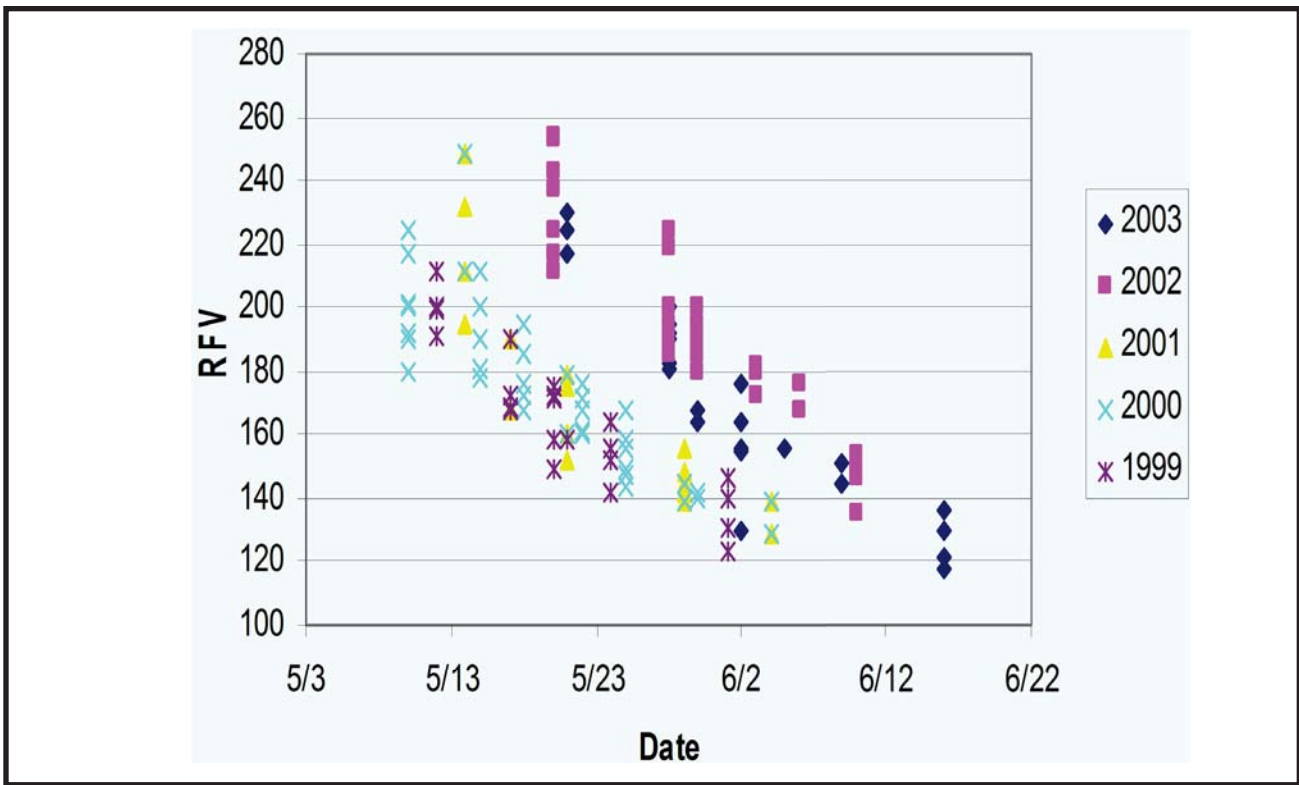
<sup>1</sup>Undersander, 2009 unpublished.

<sup>2</sup>RFV = relative feed value and RFQ = relative forage quality.

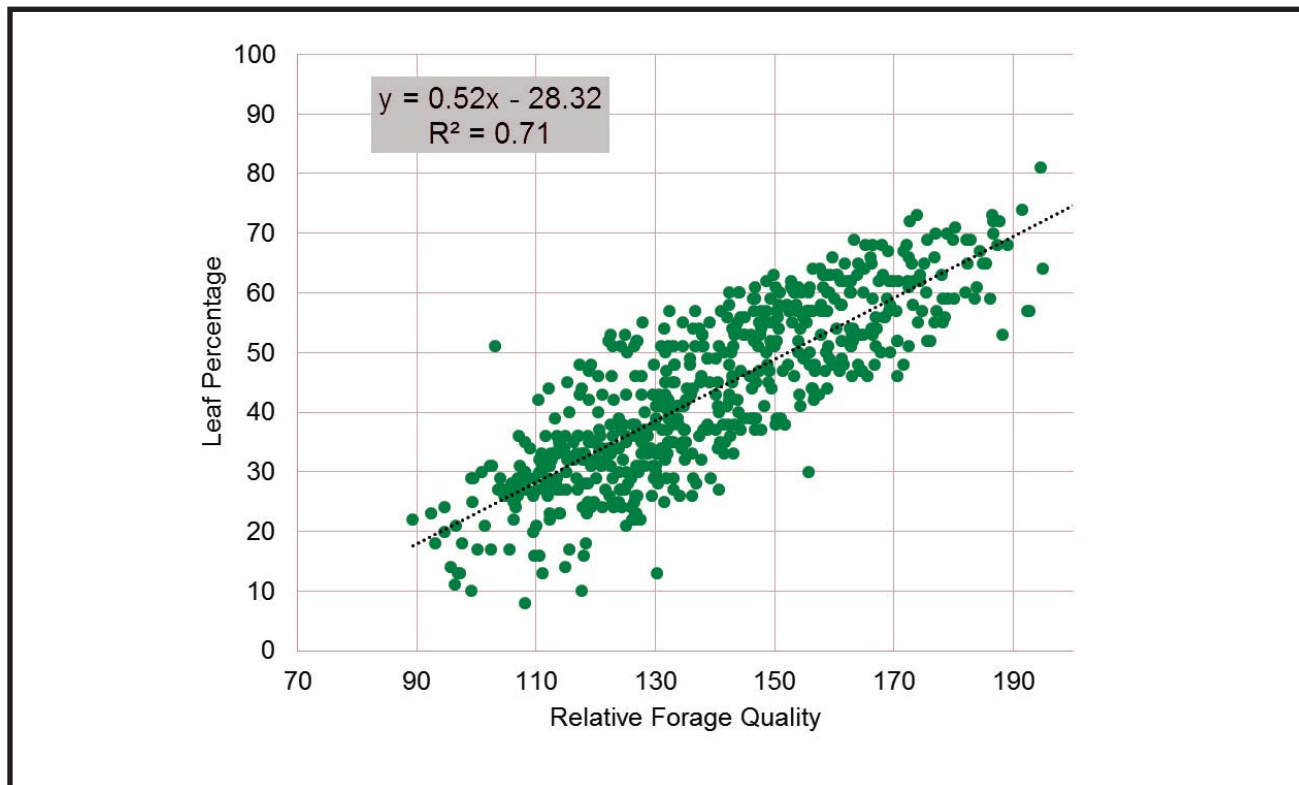


**Figure 1.** Effect of forage quality on 4% fat-corrected milk production at three concentrate levels.



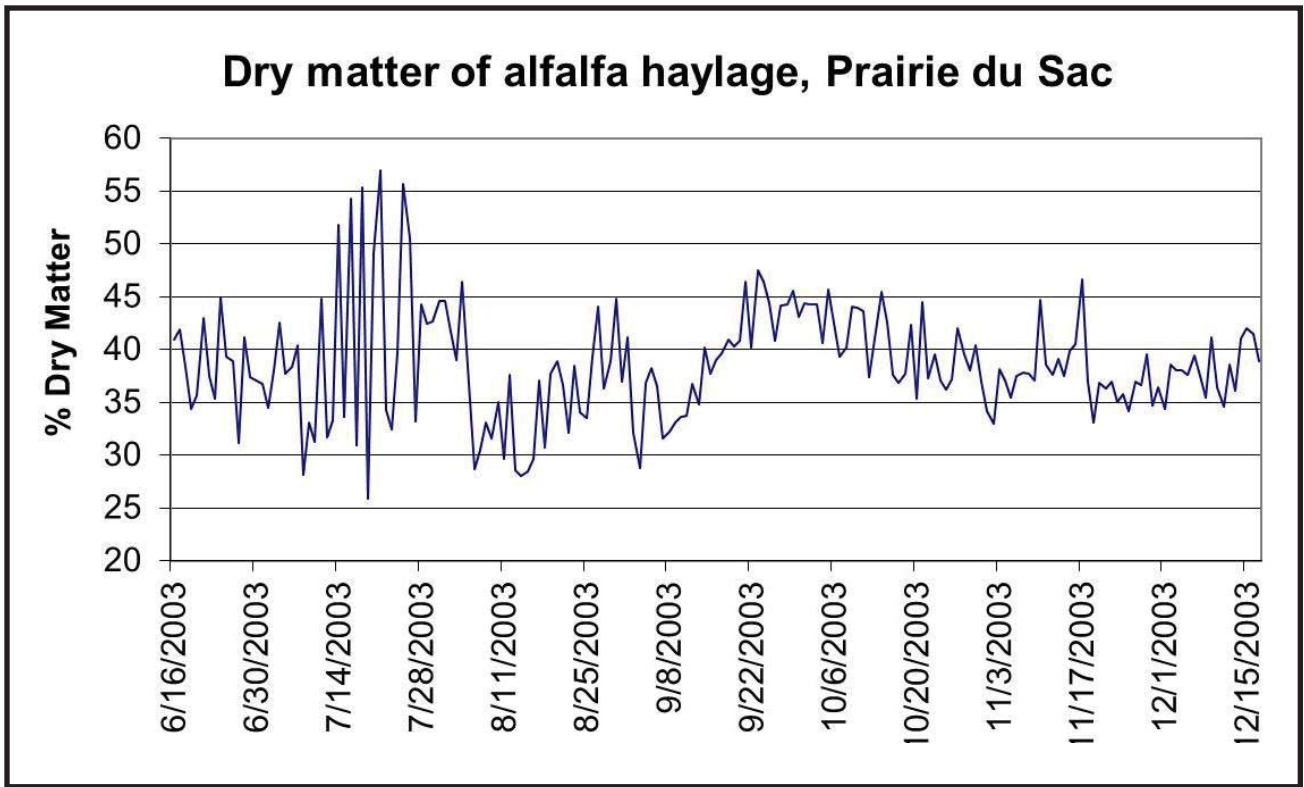


**Figure 2.** Rate of forage quality (RFV = Relative Feed Value) change per day in Wisconsin.



**Figure 3.** Effect of leaf percentage on forage quality.





**Figure 4.** Variation in alfalfa haylage dry matter in a bunker.



**Figure 5.** Cheap moisture tester.