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How much is a forage worth to a dairy cow?

by Bill Weiss and Alex Tebbe for *Progressive Forage* (used with permission)

One factor to consider when determining the price dairy farmers should pay for a forage is the ability of the forage to support milk production. That ability is based on the nutrient composition of the forage and the effect the forage has on feed intake.

Two common indices of forage quality, relative feed value (RFV) and relative forage quality (RFQ), are often used to price hay (higher RFV or RFQ = higher price). Both indices are related to the energy value of forage and attempt to account for effects on intake. However, forages provide other valuable nutrients such as protein and fiber. Those indices indirectly value protein because they are positively correlated with the concentration of crude protein (CP) in a forage, but the correlation is not strong and CP concentration can vary by up to 10 units within a RFQ value (see Figure 1).

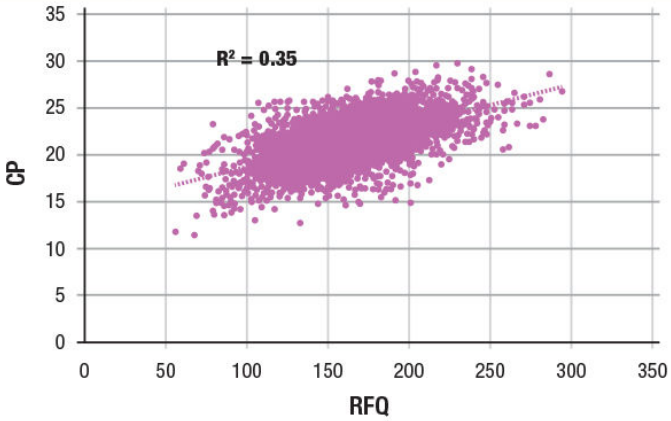
The typical deviation in CP from the average at a given RFQ could be worth plus or minus $20 per ton. Because RFV and RFQ have strong negative correlations with fiber (measured as neutral detergent fiber [NDF]), forages with high RFV or RFQ have low concentrations of NDF. Forage NDF is an essential nutrient and thus has economic value.

Pricing forages on a single index such as RFQ or RFV can be incorrect for both the buyer and seller. We think using a two-prong approach is more accurate. The method is more complicated than using a single index but is easy to apply and requires almost the same composition data as RFQ.

The first step is to determine the value of the nutrients provided by forage. The concentrations of NDF, CP and net energy of lactation (NEL) can be measured or estimated by labs. However, CP tends to overvalue the nutritional value of protein in forages relative to many protein supplements (e.g., soybean or canola meal). Dairy diets are formulated for metabolizable protein (MP) rather than CP.

For forage, the efficiency of converting CP to MP is 0.56 (MP = CP x 0.56). With these three nutrients–MP, NEL and NDF–we account for most of the value of forages. However, to compare forages to other feeds, we need to know the worth of MP, NEL and forage NDF. Various groups have developed software to estimate nutrient values based on market prices of feeds. We use the method developed by Ohio State with nutrient values published every other month for Ohio markets and broader regional markets across the U.S. (*Progressive Dairy*).

FIGURE 1 Relationship between RFQ and crude protein (CP)



The relationship is similar between RFV and CP.
Data provided by Cumberland Valley Analytical Services.

For June 2020 in Ohio, MP was worth 47 cents per pound, NEL was 4.4 cents per Mcal, and forage NDF was 13 cents per pound. These prices change with geography and date so current prices for your specific market should be used.

TABLE 1 Value of an alfalfa based on nutrient composition and quality[1]

Nutrient	Concentration	Amt/ton as-fed	Nutrient value	Nutrient value, $/ton
Nutrient value				
DM, %	85.0	1,700 lbs	...	
CP, % of DM	21.2	360 lbs	...	
MP, % of DM	11.9	202 lbs	$0.47/lb	94.94
NEL, Mcal/lb of DM	0.63	1,071 lbs	$0.044/Mcal	47.12
NDF, % of DM	39.8	677 lbs	$0.13/lb	88.01
Total				$230/ton as-fed

[1] Concentration data are provided by a lab (MP = 0.56 x CP), nutrient values are provided by a feed pricing model. For this table, we used central OH prices in June 2020 derived from Sesame Software, and nutrient values were determined by multiplying the amount of nutrients in 1 ton of hay (as-fed) by its nutrient value and summing.

Data provided by Cumberland Valley Analytical Services.

With nutrient composition data and the price of nutrients, you can estimate the value of a forage relative to other feedstuffs within a market (see Table 1). That value assumes the forage does not affect milk production. However, forage quality very definitely affects milk yield, so we need to include quality parameters when estimating economic value.

Although NDF is the primary reason we feed forages, given in excess it reduces feed intake and milk production. The concentration of NDF in forage is negatively correlated with intake. An even stronger positive correlation is found between in vitro NDF digestibility (IVNDFD) and intake. Based on several studies, for every percentage unit change in IVNDFD (measured either at 30 or 48 hours), dry matter intake (DMI) and milk production are expected to change by 0.26 and 0.47 pound per day, respectively. Because the response is based on a change in IVNDFD (not an actual value), we need to calculate the difference in IVNDFD between a sample and the average for the forage type.

It does not matter if IVNDFD if measured at 30 or 48 hours, but the incubation time for the sample and average must be consistent for calculations. Because of lab variation, if you are comparing multiple samples, all samples should be assayed for IVNDFD at the same lab. Based on a large U.S. database, these are the average 30- and 48-hour IVNDFD:

- Alfalfa, 41% and 47% of NDF for 30- and 48-hour, respectively
- Cool-season grasses: 61% and 65% of NDF
- Corn silage: 53% and 62% of NDF

At typical diet costs (around 11 cents per pound of dry matter), the quality adjustment per one unit change in IVNDFD ranges between $2.40 per ton of forage DM (when milk is $14 per hundredweight) up to $4.86 per ton of DM when milk is $22 per hundredweight. (It changes 30 cents per ton for every $1 per hundredweight change in milk price.)

If the alfalfa in the table had an IVNDFD-30 hour of 46%, the sample is five units higher in IVNDFD-30 hour than the average (46 - 41). If milk is $16 per hundredweight, one unit is worth $3 per ton DM ($2.55 per ton as-fed at 85% DM). The quality adjustment would be 5 x 2.55 = $12.75, which is added to the nutrient value of $230 and makes the alfalfa hay worth about $243 per ton as-fed.

Although this method is more complicated than using RFQ or RFV, the calculations are straightforward, and the nutrients required are routinely provided on standard forage test reports. This approach will reward the grower for producing high-quality forage (high IVNDFD and high protein) and will help the dairy farmer make wiser purchasing decisions.

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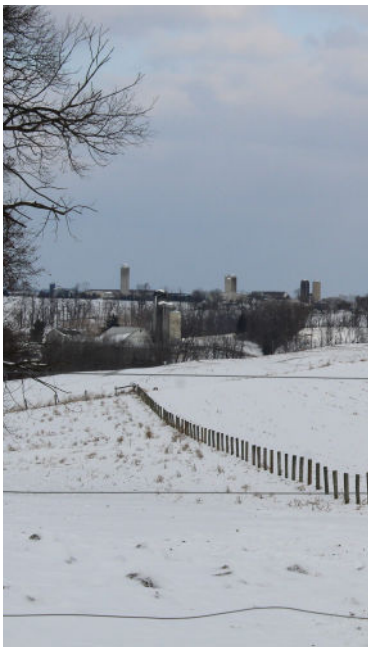

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