Volume 2, Number 1

Focus on Forages 2015

Dairy Focus at Illinois Newsletter

Forages have always been an important source of nutrients for the dairy cow. Feeding high quality forages can increase dairy efficiency and help reduce the feed costs associated with purchasing added supplements and concentrates. In addition, with the constant influx of new crop technology and innovations, forage management has become more sophisticated and is of greater economic significance to the dairy herd profitability.

As we approach the spring of 2015, harvesting high quality forages is on the minds of many dairy producers throughout the state. Last year (2014) was a difficult year for some dairymen trying to harvest quality forages due to weather conditions. The result was over mature forages containing lower neutral detergent fiber digestibility. Low quality forage not only lowers the dietary energy needed for high milk production, it also limits dry matter feed intake, thus reducing milk production even more.

The conditions in 2014 brought on a shortage of high quality alfalfa and grass forages throughout Illinois and beyond. This shortage created a greater demand for quality hay, which increased feed costs for dairy producers. In addition, the lack of quality forages had producers looking to other by-product feed sources to provide the needed nutrients for a balanced ration. The bottom line: Producers were made more aware of the need to understand how to evaluate and effectively use their forages based on quality. Forage testing at a certified forage lab is essential to know how to position your forages, and then testing throughout the year will help monitor any feed changes.

Factors Influencing Alfalfa Forage Quality

Forage quality begins in the field. Producing high quality alfalfa is largely dependent on harvesting at the optimum maturity and moisture. Alfalfa producers face several challenges in deciding when is the optimum time to begin harvesting the first cutting. It is well documented that alfalfa nutrient quality decreases as the plant matures from the bud stage to full flower. At the same time, the amount of plant material harvested per acre increases as the plant matures. Thus, the optimum harvest date is the compromise between the feed quality and the feed quantity produced. The Predictive Equation for Alfalfa Quality (PEAQ) program is still an excellent tool to help determine the first harvest date in the spring. PEAQ allows farmers to make an in-field prediction of forage quality by monitoring plant height and plant maturity. The plant height and maturity provide a close estimate of the Relative Feed Value (RFV) in the field. By determining the RFV of standing alfalfa, producers can more accurately gauge when to begin the first crop harvest schedule.

ILLINOIS

First cutting alfalfa needs to be harvested as soon as the RFV in the field reaches 170 in order to achieve a harvested value of 150 RFV (**Table 1**). Furthermore, the timely harvesting of the first cutting will set up the cutting schedule for the rest of the growing season. Subsequent cuttings should be taken every 26 to 30 days. While the RFV index is recommended to determine the PEAQ stage in the field, the Relative Forage Quality (RFQ) is the preferred index for balancing the dairy cow ration. Relative forage quality is based on in-vitro neutral detergent fiber digestibility (NDFD) testing and summative equations. RFQ provides a better linkage between forage quality and the actual cow response because it is a direct measure of the forage fiber digestibility and it can more accurately predict what goes on in the cow's digestive system. RFQ will have a similar mean range as RFV. However, when evaluating, purchasing or feeding forages, always use the RFQ index. The RFQ equation is not used in evaluating corn silage due to the starch fraction.

Table 1. Estimating Alfalfa RFV – In Field

Plant height (inches)	Relative feed value		
	Late vegetative	Bud stage	Flower stage
20	211	201	188
24	190	181	170
26	180	172	162
28	171	164	154
30	163	156	147

Factors Influencing Corn Silage Forage Quality

Producing high quality corn silage is dependent on a number of factors, with the most influential being hybrid selection, harvest maturity, and harvest and storage management. Corn silage hybrid selection should be made based on hybrid comparisons of nutrient characteristics and yield per acre. An excellent tool to compare corn hybrid silage performance is called Milk 2006. The Milk 2006 software program, developed by Dr. Randy Shaver, Dr. Joe Lauer, Dr. Jim Coors, and Pat Hoffman of the University of Wisconsin, is the latest version of the "MILK" series of spreadsheets for corn silage. It more accurately estimates the feeding value of corn silage than the past version, Milk 2000. In addition, it provides a guide for evaluating corn silages based on milk producing potential per ton and per acre. This program can provide valuable information in selecting specific hybrids to be designated as corn silage fields. Milk 2006 estimates silage performance based on nutrient content, fiber digestibility, starch digestibility, and estimated dry matter intake. Milk 2006 also accounts for the effects of whole plant dry matter content and kernel processing on starch digestibility. The Milk 2006 program is found on Dr. Shaver's website at http://www.uwex.edu/ces/dairynutrition.

Since feeding high quality forages can improve your profits by reducing your purchased feed cost and/or improving herd performance, it is absolutely necessary to have your stored forages tested for nutrient content. This will provide more accuracy when balancing the diet for your dairy herd.

Understanding Laboratory Forage Test Results

Laboratory forage analysis can be done by the near infra-red spectrometer (NIRS) or wet chemistry. Over the past few years there have been some changes in how forages are analyzed in the lab. The basic tests such as moisture, protein, pH, fiber, energy, and minerals are still the main tests to determine the comparative quality of feeds. However, many labs are now testing for neutral detergent fiber digestibility (NDFD), total tract neutral detergent fiber digestibility (TTNDFD), starch and starch digestibility, lignin, etc. The NDFD test is conducted via the in-vitro method which allows the feed to be digested in the cow's rumen fluids under laboratory conditions to determine the percent digestibility over a certain number of hours (48h, 30h, 24h). The starch digestibility factor is a calculated value based on ruminal and total tract digestibility. A forage test report can be a bit perplexing when you are looking at 20 to 30 lines of information; the common question is "what do these numbers mean and how does my forage compare"? Following is a list of some of the nutrient analyses and the suggested goals for forage tests.

Interpreting Forage Test Results

All forage testing results are based on 100% dry matter to standardize the laboratory values. Following is a description of the major tests conducted at the lab. The suggested goals are for high quality forages fed to lactating dairy cows.

Moisture – amount of water in the feed. Hay goal <18%; Haylage goal 60%; Corn silage goal 65% to 70% (68-70% in bags or bunker and 65-67% in stave upright silo).

Crude Protein – measures all forms of protein, including true protein and non-protein nitrogen. Hay goal >20%; Corn silage goal 8% to 10%. The higher the better.

Soluble Protein – the percent of crude protein that will degrade rapidly in the rumen. Legume silages can range from 20% to 70%; Corn silage 20% to 45%. Mid range preferred.

Rumen Undegradable Protein – proteins that break down slowly and escape the rumen for degradation in the lower gut. Goal of 15% to 40% with the mid range preferred.

Acid Detergent Insoluble Nitrogen (ADIN) – measures "heat damaged" or bound protein causing the crude protein to be tied up and not available to the cow. Should be less than 15% of total crude protein. The lower the number the better. If value is greater than 15% of total crude protein, use the adjusted crude protein number to balance the ration.

Acid Detergent Fiber (ADF) – measures the cellulose and lignin portion of the plant. These percentages will vary depending on plant maturity, variety, etc. Legumes goal 30%; Corn silage goal 25% to 30%. In all forages, as fiber levels go up, energy value goes down. ADF is correlated to digestibility. The higher the ADF the less digestible the feedstuff.

Neutral Detergent Fiber (NDF) – measures total cell wall. Influenced by maturity, variety

differences, etc. Legumes goal 40%; Corn silage from 30% to 60%. As NDF percentage increases, the feed intake of the forage will decrease. Lower NDF is preferred.

Neutral Detergent Fiber Digestibility-30 hr. (NDFD-30) or **Cell Wall Digestibility (CWD)** – is an excellent in-vitro test to determine NDF digestibility (NDFD) as a percent of total NDF. In-vitro measures the feed digested in rumen fluids (simulating a rumen) in the laboratory. This is a good indicator as to what the animal will actually digest in the "real world". The NDFD-30 will range from 30% to 50%. The higher the better.

NDFD-48 – which is used by some labs, is the same procedure as NDFD-30 with the exception that the feed is in the simulated rumen for a 48-hour duration. The range for NDFD-48 can be 40 to 70%. The higher the better. Be careful not to compare the 30hr with the 48hr because we will see higher NDFD percentage values in the 48-hour test.

Total Tract Neutral Detergent Fiber Digestibility (TTNDFD) – range from 40 to 50% with a goal of greater than 48%.

Lignin – a very important number. Lignin is the non-digestible portion of the fiber. Legume/grasses range 3% to 10%; Corn silage ranges from 1.5% to 6.0%. The lower the lignin the better forage quality. BMR corn varieties will have significantly lower lignin.

Starch – indicator of grain content in corn silage and kernel starch. Will range from 25% to 35%. The greater the amount of starch the better, with a goal of more than 30%.

Fat or Ether Extract – this is the vegetable fat (oil) content, which is a source of energy to the cow. This will range from 1% to 4% with a goal of less than 3.0%.

Using database information from the Marshfield Soil and Forage Testing Laboratory, Pat Hoffman of the Department of Dairy Science at the University of Wisconsin-Madison developed a reference chart of possible ranges for nutrient parameters available on forage test reports, with the desired value for lactating dairy cows and dry cows (**Table 2**).

Take Home Message

- Laboratory testing of forages for nutritional content and digestibility is essential to balancing dairy rations.
- Harvesting forages based on correct plant maturity and moisture plus proper storage management will have a significant effect on forage quality.
- Understanding the forage nutrient analysis is important to correctly allocate other feedstuffs needed in the cow's daily diet.

– Dave Fischer
University of Illinois Extension Dairy Educator, retired

Table 2. Numeric ranges of common forage tests and qualitative desired levels

Test	Common Abbreviations	Common Unit Expression	Range			Desired Level Within Range - Lactating Cows	Desired Level Within Range - Dry Cows
			Legume-Grass Silages	Legume-Grass Hay	Corn Silage		
Crude Protein	CP	% of DM	9.2-24.7	12.8-25.21	5.0-10.2	Mid-Upper	Mid
Soluble Protein	Sol-CP	% of CP	20.5-76.5	na	20.5-45.0	Mid	Mid
Acid Detergent Fiber Crude Protein	ADF-CP, ADIN	% of DM	.14-2.3	.20-1 .25	.22-.70	Lower	Lower
Neutral Detergent Fiber Crude Protein	NDF-CP	% of DM	1.0-8.8	2.27-5.08	.5-2.3	Lower	Lower
Rumen Undegradable Protein	RUP	% of CP	16.2-39.4	13.0-45.2	na	Mid	Mid
Acid Detergent Fiber	ADF	% of DM	obsolete	obsolete	obsolete		
Neutral Detergent Fiber	NDF	% of DM	32.3-70.8	29.6-70.6	30.1-61.9	Lower	Mid
Neutral Detergent Fiber Digestibility	NDFD	% of NDF	32.5-79.4	35.8-74.5	44.0-72.0	Upper	Mid
Lignin	Lignin	% of DM	2.45-9.78	4.7-9.9	1.6-6.0	Lower	Lower
Lignin	Lignin	% of NDF	5.39-23.1	10.9-23.3	3.82-16.1	Lower	Lower
Fat	EE, Fat	% of DM	1.0-3.8	.9-3.8	1.1-4.2	Mid	Mid
Starch	Starch	% of DM	na	na	7.2-38.1	Mid-Upper	Mid
Ash	Ash	% of DM	6.4-16.4	7.4-15.8	3.3-14.4	Lower	Lower
Calcium	Ca	% of DM	.31-1.61	.53-1.66	.13-.37	Upper	Mid
Phosphorus	P	% of DM	.16-.53	.08-.40	.15-.23	Mid	Mid
Potassium	K	% of DM	1.1-3.83	.67-3.74	.74-1.66	Mid-Lower	Lower
Magnesium	Mg	% of DM	.19-.40	.18-.41	.12-.26	Upper	Upper
Sodium	Na	% of DM	.01-.14	.01 -.12	.05-.09	Mid	Mid
Chlorine	Cl	% of DM	.26-1.25	.08-.83	.10-.40	Mid	Upper
Sulfur	S	% of DM	.13-.38	.10-.39	.05-.20	Upper	Upper
Total Digestible Nutrients	TDN	% of DM	47-72	49.0-69.6	42-76.4	Upper	Mid
Net Energy Lactation 3x	NEL	Mcals/lb	.47-.75	.49-.72	.72-.78	Upper	Mid
Relative Feed Value	RFV	na	obsolete	obsolete	obsolete		
Relative Forage Quality	RFQ_	na	63-230	69.4-237.0	na	Mid-Upper	Mid
Milk/Ton	na	lbs/ton	1650-3801	1790-3437	1582-3901	Upper	Mid