

Matching Your Forage Resources with Animal Needs

Larry E. Chase
Professor of Animal Science
Cornell University, Ithaca, NY
lec7@cornell.edu

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Introduction

Forages are the foundation of sound, economical and animal healthy rations. In most situations, home produced forages are the most economical source of fiber, protein and energy in the dairy ration. A primary role of forages is to provide a source of “effective” fiber to stimulate chewing and rumination activity. A wide variety of forages can be successfully used in dairy cattle rations. The type and amount of forage fed to the various animal groups on a specific farm will vary. There is no one specific forage type that is required to attain profitable levels of milk production and have healthy cows.

The Farm Forage System

The forage system on a dairy farm is an integrated system that includes soil types, crops produced, crop rotations, crop fertility, forage harvesting, forage storage and animal feeding considerations. Three key words that relate to this system are:

- A. Quantity – How much forage can be produced from the acres available? Are there opportunities to increase forage tons available from the same acres by altering agronomic practices?
- B. Quality – What is the nutritional quality (composition) of the various forages produced?
- C. Allocation – Are the forages stored by type and quality so that specific forages can be fed to specific groups of cows? This component of the system may require planning before harvest to store forages by type, cutting, quality, etc. If thus can be done, it provides flexibility for the nutritionist in developing rations to meet the nutritional needs of the various groups by using specific forages.

Forage Quality Variation

Table 1 contains data on selected nutritional parameters for samples submitted for testing over a 1 year period to the Dairy One Forage laboratory. Note the large variation that exists in nutrient composition. The standard deviation is a measure of variation. A larger standard deviation relative to the mean indicates greater variability. The “normal range” for these parameters can be calculated by adding and subtracting 1 standard deviation from the mean value. The normal range would represent about 2/3 of the total samples analyzed. There would

still be 1/3 of the total samples with values outside of the normal range. As an example, let's use grass hay NDF as an example:

Average NDF = 64.1%
 Standard deviation = 6.4
 Normal range = 57.7 to 70.5%

The variation in these values indicates the need for obtaining actual forage analyses on the types and qualities of forages on your farm. The most important factor in forage testing is taking the time to obtain a good, representative sample to submit for analysis. The error involved in taking forage samples is typically 3-5 times greater than the analytical variation in the laboratory. It doesn't make sense to spend money for forage analysis if a good sampling job is not done.

Table 1. Variation in Forage Composition

Item	Legume Hay	Legume Silage	Grass Hay	Grass Silage	Corn Silage
Number of samples for DM	13,881	3,539	5,333	3,597	18,402
Crude Protein, %	21.4 (2.5) ^b	21.1 (2.9)	10.3 (3.9)	14.5 (3.8)	8.0 (0.9)
NDF, %	38.3 (4.9)	45.1 (5.6)	64.1 (6.4)	59.0 (6.6)	44.8 (5.7)
Starch, %					30.7 (6.8)
Calcium, %	1.56 (0.24)	1.4 (0.26)	0.53 (0.23)	0.66 (0.2)	0.24 (0.07)
Potassium, %	2.4 (0.5)	2.8 (0.5)	1.8 (0.6)	2.4 (0.6)	1.1 (0.24)
Chloride, %	0.79 (0.37)	0.72 (0.3)	0.57 (0.46)	0.7 (0.4)	0.29 (0.16)
NDFD, 30 hour ^{cs}	37.7 (5.7)	47.9 (6.3)	53.1 (9.8)	61.1 (7.9)	48.9 (5.5)

^a Source: Dairy One Forage Lab, Ithaca, NY. Samples from 5/04 to 4/05.

^b Standard deviation

^c In vitro NDF digestibility for samples incubated for 30 hours

Forages for Dry Cows

The ration nutrient density requirements are lower for dry cows than lactating cows. Thus, dry cows can use a higher forage ration with slightly lower quality forages than lactating cows. This does not imply that dry cows can be fed "poor" quality or "poorly fermented" forages. There is a trend for dairy farms to grow, harvest and store specific forages for dry cows. This has taken place as a result of herd health and metabolic problems that have occurred when the forages fed to dry cows did not match their nutrient needs. The two most common forage problems that we see with dry cows are high potassium forages or wet, poorly fermented silages.

- A. High potassium forages – Feeding high potassium forages generally increases the risk of post-calving disorders and in some cases cow deaths. These animals will typically be sluggish, not able to get up and don't respond well to treatments. If they are down more than 2-3 days, there is a high probability of death. There are 2 basic approaches to resolving this problem.
- a. Select and feed lower potassium forages. Forages fed to these cows should contain < 2% potassium on a dry matter basis. This is difficult to do on many of our farms due to soil fertility levels and soil potassium content. One option is to grow forages on fields that have received little or no manure. A second option is to select the type of forage grown for dry cows. Timothy usually extracts less potassium from the soil than other grasses. A third option is to purchase a specific low potassium forage to be fed to dry cows. One example of this type of forage is straw.
 - b. Feed the higher potassium forage rations and balance for cations and anions. This involves calculating the ration cation-anion balance (CAB) using the potassium, chloride, sulfur and sodium content of the feeds and forages used in the dry cow ration. The goal is to have a slightly negative CAB for dry cows during the last 2-3 weeks before calving. If you use this approach, all 4 of these minerals need to be analyzed by wet chemistry. A specific mineral mix or commercial production will be needed to obtain the desired CAB balance. Urine pH needs to be monitored to determine if the desired shift in CAB was actually obtained. This approach was discussed at the 2004 conference by Dr. Goff.
- B. Wet, poorly fermented silages – These are typically < 30% DM and have a high pH (>5) and high butyric acid and ammonia levels. A number of forage testing labs offer fermentation profiles as an analytical option to better quantify silage quality. You should be able to detect these by smell at the farm. Cows fed these silages during the transition period tend to have increased ketosis and displaced abomasums problems. Feed intakes will be variable. The affected cows will frequently not respond to normal treatments for metabolic disorders. The only sure cure is to stop feeding this silage to the close-up and early lactation cows. A simple solution to this problem is to make sure silages are harvested and stored at the appropriate (> 30%) dry matter. Any forage with visible mold or spoilage should not be fed to any animal groups on the farm.

What about straw? There has been a lot of interest and popular press articles about feeding straw in dry cow rations. This practice has been adopted by a number of farms. There are a number of reasons for feeding straw. One is that it is low potassium and energy forage. Secondly, it is more consistent nutritionally than most other forages. Thirdly, it provides a lot of scratch factor, chewing and assists in formation of the rumen mat. Feeding rates up to 7-9 pounds of straw have been used. It must be fed in a total mixed ration and needs to be chopped to about 1-2 inches in length to minimize sorting. Straw is just one forage option that could be considered for use in dry cow rations. It is not a required or magic feed. With current demand, the price of purchased, clean straw is

rapidly increasing. However, the return on investment could be good if it helps in controlling metabolic disorders.

Forages for Lactating Cows

A wide variety of forage types can be successfully used in lactating cow rations. Research work has indicated that high quality forages of various types (legume, grass, corn silage, legume-grass mixtures) can all be used to support high levels of milk production. The type of forage fed to lactating dairy cows on your farm will depend primarily on your soil types and the forages best suited for production on these soils. Forage quality goals for lactating cows are in Table 2.

Table 2. Forage Quality Guidelines for Early Lactation Dairy Cattle

Forage Type	NDF, %	NDFD, %	Starch, %
Alfalfa	39 – 44	48	-
Grass	50 – 55	61	-
Corn silage	40 – 45	49	30 – 35

It is also important to measure and track forage digestibility. A number of commercial forage testing labs offer in vitro (or NIR) NDF digestibility determinations. Research trials have consistently reported the following responses when forages with higher NDFD levels are fed:

- Higher dry matter intakes
- Increased milk production
- Higher peak milk production in early lactation cows
- Improved efficiency of milk production (lbs. milk/lb. DMI).

Workers at Michigan State (Oba and Allen, 1999) used data from 23 research trials to “estimate” the importance of NDFD in forages. These trials used a variety of forages. Trials were divided into 2 groups based on forage NDFD levels. The high forages averaged 62.9% NDFD. The low forages averaged 54.5% NDFD. Key results from this study are:

- A 1 unit increase in NDFD was related to:
 - o + 0.37 lbs. DMI
 - o + 0.51 lbs. milk
 - o +0.55 lbs. 4% FCM

A recent paper from Washington State University (Johnson et. al., 2001) reported an increase of 1.4 lbs. of milk for each 1 unit increase in dry matter digestibility. These results were for cows producing > 90 lbs. of milk per day.

It would be nice if forage digestibility could be predicted from forage analysis data. A number of people have examined this possibility. At this time, it is not possible to predict NDFD from other forage components such as NDF and lignin.

How Much Forage Can Cows Consume?

There have been a number of approaches over the years to determine how to set forage intakes in dairy rations. The best current approach is to use pounds of forage NDF (F-NDF) as a percent of body weight. The current guideline for F-NDF intake in dairy cattle rations is 0.9 to 1% of body weight. This is calculated as follows:

Body weight = 1400 lbs.

F-NDF intake (0.9% of BW) = $1400 * 0.09 = 12.6$ lbs.

F-NDF intake (1% of BW) = $1400 * 0.1 = 14$ lbs.

If the forage being fed is 45% NDF, then we would feed 28 to 31 lbs. of actual forage dry matter ($14/0.45 = 31$). However, if the forage fed was 55% NDF, then the pounds of forage dry matter fed would be 23 to 25.5 lbs. In both cases, the actual total pounds of forage NDF fed are the same. This is a very simple way to determine the level of forage that should be included in the ration. The goal should be to maximize the quantity of forage fed in the ration of dairy cows in most situations.

Will Cows Milk on High Forage Rations?

We recently put together a data set of 16 Holstein herds fed high forage rations in the Northeast. Some of the key points from this survey are:

- Herd size varied between 50 and 550 cows.
- Herd daily milk production ranged from 69 to 100+ lbs/day.
- Forage NDF intake ranged from 0.85 to 1.16% of body weight.
- Forage (as % of total ration DM) ranged from 57 to 67%.
- All herds fed at least some corn silage.
- 9 herds fed some legume silage.
- The other herds fed grass silage or mixtures of legume and grass silages.
- 12 herds fed some dry hay.
- These herds fed a variety of energy and protein sources.
- The dairy producers surveyed reported the following benefits from feeding higher levels of forage in the ration:
 - o Lower purchased feed costs
 - o Better rumen health
 - o Lower vet bills
 - o Better milk components
 - o Lower cow culling rates

What are the Problems or Risks with High Forage Rations?

All systems have both advantages and disadvantages. There are a number of considerations when using high forage rations. These include:

- This will require 20-30% more forage to feed the same number of cows. Can you produce this extra forage on your current crop acres? Do you have the storage capacity to store this extra feed?
- A supply of consistent, high quality forage is required. Since forage is a greater proportion of the total ration, the impact of any variations in forage quality will be magnified.
- It may take 2-5 years to get your total forage management system organized to support a high forage feeding program. Changes in the types of crops produced, crop rotations, crop fertilization practices, harvest and storage management, ration formulation and feeding management practices may be needed.

Putting Together a Forage Management System

The forage program on your farm is a total farm system. The following aspects need to be integrated to attain the maximum benefits from your forage program:

1. Soil types and soil fertility – What soil types are present? Are soil tests routinely used to monitor soil fertility?
2. Crops produced – Have you worked with an agronomist to determine the best crops, rotations and fertility programs for your soil types?
3. Harvest management – Do you have the resources (equipment, labor, etc.) to harvest the crops in a narrow window. As an example, the goal should be to harvest each cutting of grass within 2-4 days.
4. Storage system – Do you have adequate total storage capacity? Do you have the flexibility to store forages by type and quality?
5. Feeding management – Are you able to allocate specific forages to meet the needs of the different animal groups on the farm? Do you routinely test forages for nutrient composition? Do you routinely determine dry matter on silages and adjust rations accordingly?
6. Ration formulation – Do you work with your nutritionist to maximize the use of forages in your rations based on quality?

Summary

Forages are the foundation of your dairy rations. Feeding higher levels of high quality forages can improve profitability and animal health. There are a large number of areas that need to be integrated to improve and control the total forage system on a dairy farm.

References

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