Grazing Management – Nutrition and Behavior on Pasture

Karen Hoffman, USDA-NRCS

Managed pasture is one of the highest quality forages that can be provided to dairy animals, when done correctly. Pasture should not be a swamp, exercise area, or brush lot – it should be green, vegetative, actively growing, 6 to 8 inches tall, and a mixture of grasses, legumes, and forbs. Cows should be moved to a new fresh paddock at least once a day, and after every milking is ideal. This type of management should result in forage that rarely exceeds 45% NDF, indicating the potential for pasture to comprise 60 to 100% of the diet. In organic dairies, this is the key to profitability. Also, pasture is a requirement in the National Organic Program Standards, and many certifiers and milk handlers require that at least 30% of intake be from pasture.

Numerous factors, including plant, animal, and human, have an influence over how much pasture forage an animal will consume. The higher an animal's requirements are, based on production level, the more important maximizing intake becomes. Thus, lactating dairy cows are the kind and class of livestock that are most sensitive to factors influencing intake.

The key to making a pasture-based dairy ration succeed is high dry matter intake, and nothing makes a ration fail faster than a pasture that doesn't meet intake needs. Most dairymen know that when intake is limited, regardless of feeding system, milk production suffers. This relationship is recognized when feeding in the barn, but often the relationship is forgotten when cows are grazing pasture. If the "pasture feedbunk" is empty, milk production is not optimized. If the pasture feedbunk is full, cows will achieve a higher DMI, resulting in higher milk production.

The place to begin looking at feeding grazing animals is in the pasture, because that is where a ration will either succeed or fail. The management of the pastures for high quality, as well as the physical attributes of the pasture (too tall, too short, no clover, too much stubble, etc.), are the key to milk production. A pasture sample should be taken as a basis to start balancing the ration.

PASTURE CHARACTERISTICS

The components of pasture that we need to be concerned about are plant density, number of tillers/plant, the height of the grass, and species composition. Research from around the world has clearly shown that dry matter intake from pasture is the result of a relatively simple equation. It is:

DMI = intake/bite x rate of biting x time spent grazing

A high plant density results in a higher intake level because the animal can stand in one spot in a pasture and graze from many plants – a high biting rate. A thinner stand will result in a lower biting rate because the animal needs to spend more time walking around and looking for plants to graze.

Intake per bite is strongly influenced by the number of tillers per plant – the more tillers each plant has, the greater dry matter will be available in each bite the cow takes. Compared to either a total mixed ration (TMR) or stored forages fed individually, a mouthful of grass has less total DM/bite. This is partly due to fresh pasture forage being only 15-25% DM, compared with a typical TMR at 40-50% DM or stored forages such as corn silage at 35-40% DM or dry hay at 85-90% DM. There is more "air space" between tillers at the top of the sward, so a higher tiller density results in less air space per bite. Thus, each bite of pasture should contain as many tillers as possible, as a way of increasing the DM contained in each mouthful, which leads to higher overall DMI.

If the sward isn't dense enough, or there are few tillers per plant, then intake per bite is restricted and DMI is decreased. Although animals may compensate by spending more time grazing, insufficient dry matter availability will still limit production. Research has shown that for every inch of forage height in a pasture above a 2-inch residual, there will be the following DM available per acre:

DENSITY	**LBS/ACRE/INCH**
LOW	150-200
MEDIUM	200-250
HIGH	250-300

Thus, a thick pasture that has 6 inches of grazeable forage will have 1500 to 1800 pounds of dry matter per acre, compared to a thin sward at the same height would have only 900 to 1200 pounds.

Pasture height also has a strong influence on DMI, and in many cases is the main factor that limits intake/bite. Research has shown that dairy cows generally graze off the top 1/3rd of the plants, regardless of height. When the sward surface height is around 8 inches, intake per bite is approximately 30% higher than when the sward surface height is only 3 inches. In other words, at 8 inches the cow will graze off approximately 2.6 inches compared to only .99 inches at the 3 inch height. Many times another animal will graze the same plant (providing it is not tall and stemmy) and take an additional 1/3rd off the top of the remaining plant mass, leaving an overall post-grazing residual height of 2 to 3 inches.

There is an upper limit on how much time an animal will spend grazing in a 24-hour period. Grazing time will fluctuate based on reductions in DMI due to bite mass or other factors. There is an upper limit of 10 to 11 hours per day for lactating animals. Dairy cows need to rest and ruminate, spend time for milking, as well as time for social behaviors.

There is an influence on grazing time from supplementation, where grazing time is reduced by 3.5 to 5 minutes/pound of grain/ cow. However, total DMI is increased in grazing dairy cows that are supplemented with grain by approximately 7 pounds/day, leading to higher milk production as well. However, feeding a large portion of the ration in the barn will discourage animals from grazing, especially if they have eaten their fill just before pasture. Many new dairy graziers have made this mistake and ended up frustrated by "why won't my cows graze?"

Plant species will also have an influence on intake, although to a lesser extent than the other factors discussed. Generally speaking, a diversity of cool-season grasses, clovers, and forbs will allow for good intakes. Species that go dormant in hot and dry weather, such as timothy and perennial ryegrass, should be in mixtures with those that are more drought-tolerant, such as orchardgrass and clovers. Mixtures also allow cows to select plants that vary in nutritional value, which provides a more balanced diet, as will be discussed later. Legumes in the mixture provide nitrogen for the grasses, and are highly digestible leading to higher intakes. Forbs provide both minerals and some have medicinal values to cows from secondary plant metabolites.

ESTIMATING FORAGE INTAKE

When animals are fed in the barn, it is simple to determine their intake by knowing amounts fed and weighing refusals. In a grazing situation, it is more of a challenge but not impossible. Intake will depend on forage quality - if quality is high, intake will be high. Intake will also be

influenced by the quantity available in the pasture and the supplemental feeding program in the barn.

There are two methods to estimate intake. The first is to measure pasture availability both before and after a paddock has been grazed. The use of a rising plate meter, electronic pasture probe, or a simple pasture stick is recommended. The paddock that is ready for grazing should be measured in several locations to determine the forage available before grazing. The density chart can be used to estimate availability based on forage height and plant density. Forage height determined with a pasture stick should be measured to the top of the sward where the stick begins to be hidden by the herbage. After the paddock has been grazed, measurements should again be made in several locations. Subtraction of the second measurement from the first gives approximation of the total herd intake. Paddock sizes greater or less than one acre in size will need to be adjusted to account for more or less availability.

The other method is to assume the animals can eat to their forage DMI requirements from the pasture. A general rule of thumb for dairy cows is that they will eat 1.8 to 2.2% of body weight from forage DM. When pastures are managed well, they are highly digestible and 2.2% is more realistic. Research with cows fed ***only*** grass/clover pasture has shown that they will eat 3 to 3.25% of body weight. The 2.2% figure is a good starting point when grain will be supplemented. Some cows will eat more than 2.2% of body weight due to their production level or genetic merit. After the estimate of forage intake has been determined, any stored forage fed should be subtracted from the total to determine pasture forage requirements. Another benchmark that can be used is to estimate intake based on NDF levels in the pasture. Research has shown that dairy cows can eat up to 1.4% of the body weight in NDF from pasture.

If the pastures are sparse, the amount expected for them to eat should be reduced based on the density chart found earlier. Also, if there are less palatable grasses or the grass has grown too tall, the estimate of DMI should be adjusted based on observation of grazing patterns in the paddocks. A pre-grazing and post-grazing availability calculation may be most helpful in this case.

PASTURE QUALITY AND NUTRITION

Once the level of pasture intake has been determined, the next issue will be the amount of protein in the diet. Generally high quality pasture will have 20 to 30% protein, depending upon species and management. This protein is usually very degradable in the rumen, and in some cases it has been as high as 80% degradable.

Problems arise when protein is in excess to such a degree that a large amount of energy is being expended to eliminate it from the cow's body. Milk production, body condition, and reproductive performance may suffer from a lack of energy in the diet. These problems become compounded when additional protein is fed to cows, as they generally do not need it. Thus, the next step is to try to get energy into the cows in the form of non-fiber carbohydrates (NFC), to help the rumen bacteria use more of the protein from the pasture and minimize the potential problems.

When choosing a source of NFC to feed, it is important to consider the particle size of the supplement and the moisture level of the grain. Particle size is important to ensure that the rumen bugs have an opportunity to utilize the energy source. If only feeding pasture and grain, a bigger particle size may result in less digestion occurring because the pasture is digested and passed out of the rumen so quickly. The grain particles may get caught in with the pasture as it passes out of the rumen, and you end up seeing lots of corn or other grain in the manure. However, the opposite also happens, where a slightly coarser grain resulted in better performance because the

bigger particles seemed to provide more long-term energy, similar to corn silage. (This seems to be a herd to herd difference)

Moisture content will also influence rate of digestion and the challenge for nutritionists is that many high moisture grains are quite variable in both particle size and moisture content, depending upon harvest and storage methods. Determining how those feeds will work in a pasture ration may require a lot of trial and error.

Corn silage makes a good supplemental forage because of its high NFC content. In general, herds that have had trouble maintaining body condition on cows seem to rectify the problem once they start feeding about 15 pounds of corn silage. Some of it is attributable to the fact that the energy from the silage becomes available more slowly than it does with other energy supplements.

There are some alternative energy sources used on organic dairies that are not commonly seen in conventional dairy nutrition. These include oats, barley, wheat, spelt, triticale, and molasses fed at a much higher rate per cow. Much of this is due to limited supplies of certified organic feed grains, and high prices for many of them. Some organic dairy farmers have started to grow their own small grains, as well. These sources of energy can all be considered under the criteria discussed above for how they may work in the rumen to provide the cows with NFC's.

Low or no grain strategies are being used by some organic farmers. It is important to understand that those who are doing this successfully are using a different approach in most aspects of their management. Many of them have smaller-framed crossbred cows, which have lower requirements. They also are willing to accept a lower level of milk production, and do not feed grain to "push" the cows to produce more milk. Those who feed some grain are generally using it to ensure the cows maintain a bit more body condition than they would otherwise, and are judicious in the amounts fed and which cows they feed it to. Some are also using higher rates of molasses as an energy source, feeding it at a rate of 1/3rd as much as they would feed from grain sources such as corn.

The feeding of supplemental protein to dairy cows on pasture is generally not necessary. A well-managed pasture is at least 20% crude protein (most are much higher), and a lactating dairy cow only requires 16 to 18% protein in her diet. However, for many years it has been recommended to feed 1 to 2 pounds of a high bypass protein source, especially for higher producing herds to make sure the cows get the amino acids they need. Ironically, if you look at most of the research that has been done with feeding bypass protein to pastured cows, there generally is no difference in production by feeding it.

If a pasture is managed so as to not limit dry matter intake, and the density of the pasture provides a lot of feed with each bite the cows take, can they meet their protein needs? The answer to that is yes, even with some supplemental forage being fed in the barn. Of course, the cows should be moved to a fresh paddock after each milking (or whenever pasture becomes limiting), to ensure they can do so. In fact, observations with many herds indicate that feeding supplemental protein may be why milk production is lower than it should be.

Protein is not limiting in well-managed pasture. Thus, when supplemental protein is fed to meet bypass protein needs, we are only creating a problem in the rumen. Most of the feeds we use to supply bypass protein (especially organic-approved feeds) are not 100% undegradable in the rumen – at best, they are only 60% undegradable. This means we are still adding protein to the rumen – degradable protein – and we then are exceeding both the cow's and the rumen bacteria's requirements for protein. Unfortunately, this process takes energy that would otherwise be used

by the cow to produce milk. Studies have shown the energy cost to excrete excess protein can result in milk production losses of 8 or more pounds/cow/day. The energy cost also takes a toll on body condition, breeding performance, and the grain bill.

In addition to the energy cost, ammonia is toxic, and toxic foods cause animals to stop eating. If our cows stop eating pasture because they are feeling something toxic, what is the result? Since intake drives milk production, the next logical thought is there is an additional loss of production. Thus, by feeding excessive amounts of protein to pastured cows, we limit their milk production.

Behavioral studies from around the world have shown that when un-supplemented dairy cows, beef cattle, and sheep are provided with choice, they prefer 70% clover and 30% grass in their diets. Clover is generally higher in protein than grass, is more digestible, cows can eat more of it, and they can eat it faster than they can eat grass. Thus, in the absence of protein supplements, cows can more easily meet their protein requirements by eating clover than by eating grass, and that is what they do. This has been seen on farms here in New York – cows overfed protein either not eating much, or only eating grass and leaving clover behind. To get to some answers, a research project was conducted to examine what happens when the ratio of energy to protein in the barn ration was changed.

Pastures were seeded down to strips of pure clover, grass and clover mixed, or straight grass. These pastures were then fenced with temporary wire so that cows had access to all three types of seeding when they came into a paddock – they had a choice of where and what to eat. In the barn, they were supplemented with two different grain mixes for 4 days each. The first four days they were fed an 11% protein mix, the next four days a 21% protein mix, and then four days of the 11% protein mix again.

The results of the research clearly showed that dairy cows are sensitive to protein levels and will change their diet selection accordingly. When fed either the 11 or 21% protein mix, cows generally responded by eating more grass and less clover, and specifically, the higher the protein content of the supplement fed in the barn, the less clover they ate when in the pasture. This is a complete reversal of what cows would prefer to eat in the absence of protein supplementation. In effect, when we feed protein to a cow in the barn ration, we are altering the cow's natural foraging behavior and, in the process, replacing low-cost protein derived from clover with high-cost purchased protein.

The short of it is concentrate foods do more than simply substitute volumetrically for foods obtained from pasture. Specific nutrients are replaced through nutrient-nutrient, nutrient-toxin, and toxin-toxin interactions. This is especially true when feeding protein. Too much protein fed to cows in the barn will reduce dry matter intake from pasture and cause you to have to feed more in the barn. it is not a fair trade to replace the low-cost protein derived from clover with high-cost purchased protein. A better strategy for feeding pastured dairy cows is to feed them all of the energy they can eat in the barn and let them harvest their own protein.

SUMMARY

Pasture-based diets on organic dairies need to be based upon high intake of high quality forage, and supplemental feeding should focus on providing adequate energy rather than additional protein.