United States Department of Agriculture

Illinois Grazing Manual Fact Sheet

LIVESTOCK NUTRITION

Pasture-Based Feeding Programs for Dairy Cattle

General Information

A successful feeding system (pasture-based system, traditional component feeding system, and Total Mixed Ration or TMR) should meet the nutrient requirements of the cow, use economical feed sources available in the area, and optimize profitability and income over feed costs. When considering a management intensive grazing (MIG) system, dairy managers must consider and manage the following factors;

1. Optimize rumen fermentation
2. Manage dry matter intake
3. Feed sorting and selection
4. Effective use of fiber
5. Economics and positioning other feeds

Optimizing Rumen Fermentation

The challenge with a pasture-based feeding program is to maintain rumen pH values from 5.8 to 6.2 that will support optimal digestibility, nitrogen flow, and desirable components. If pasture quality is less than 35% neutral detergent fiber (NDF) and over 80 percent digestibility, rumen pH can drop below 5.8. If additional fermentable carbohydrates are added such as, molasses or barley, pH levels could drop below the optimal level. However, some starch and by-product grains can stimulate microbial growth and provide needed energy.

- Maintaining rumen pH from 5.8 to 6.2 will be challenge with high quality legume grass forages. Lush pasture will be low in effective fiber due to low level of NDF (neutral detergent fiber) and rapid rate of passage. New Zealand workers reported that cows consuming only clover and grass pasture (no concentrate) experienced rumen pH under 5.5 with no supplemental grain. Adding 2 to 5 pounds of long forage particles (over one inch in length) can form and maintain a rumen or hay raft in the rumen.

- Limit the amount of a concentrate mixture to 5 to 6 pounds per meal to avoid "slug feeding" of starch leading to lower rumen pH and lactic acid formation. Providing 2 to 5 pounds of long forage prior to the grain and pasture consumption can increase rumen pH.

- Balance the rate of available nitrogen (protein) and carbohydrate degradation in the rumen by feeding grain and/or corn silage before lush pasture is consumed. The challenge is pasture that is low in rumen fermentable carbohydrate while containing excessive degradable and total protein. Feeding starch or digestible NDF (by-product feed such as corn gluten feed or soy hulls) before milking allows cows to return directly to the pasture after milking.

- Provide adequate effective fiber by maintaining a minimum of 5 pounds of forage particles that are over one inch or longer in length. Feeding 1 to 2 pounds of straw (one pound of straw functions similarly to 2 to 3 pounds of long hay), 5 pounds of baled hay, or 10 pounds of silage dry matter containing 40 to 60 percent on the top two boxes of the Penn State Particle Separator unit. These adjustments should adjust fiber levels.

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- Manage rumen turnover by slowing down rapidly fermentable pasture fiber by adding some long forage to the diet. Processing grains can change the rate and site of starch fermentation while by-product feeds (such as wheat midds, soy hulls, or corn gluten feed) can dilute starch levels in grain mixtures.

Managing Dry Matter Intake

Optimizing dry matter intake is another key factor in successful pasture-based feeding systems and programs. Energy is the first limit nutrient for milk yield, milk components, and reproduction in high producing cows. Dry matter intake (energy) can be limiting to 50 pounds of 4% fat corrected milk. New Zealand researchers report cows can consume about four pounds of pasture dry matter per hour of aggressive or active grazing. Six to eight hours are the normal daily grazing times. If higher levels of milk production are desired, additional dry matter will be needed. Dairy managers have three choices: additional forage (such as corn silage), more grain, and/or a partial TMR. To enhance pasture dry matter intake, pasture can be cut and allowed to partially wilt, allowing for great dry matter consumption. Grazing activity (distance walked and slope) will require more energy (can represent 4 to 5 pounds of milk energy used for walking).

Methods to achieve higher dry matter intake (if this is economical and is your goal) will require supplemental feeds that complement pasture nutrients and do not substitute for low-priced pasture nutrient sources.

- Cows under 50 pounds of 4% fat corrected milk may support this milk yield with high quality pasture only.

- Cows producing over 50 pounds of 4% fat corrected milk will require more energy, usually gained from concentrate and silage sources (energy is limiting).

- Cows producing over 70 pounds of 4% fat corrected milk will need more energy, added rumen undegraded protein (such as heat-treated soy meal), and supplemental fat (energy and amino acids are limiting at this level of production).

Adding a buffer (such as sodium bicarbonate) can increase dry matter intake by stabilizing rumen pH (adding 0.3 to 0.5 pounds per cow per day to the grain mixture or partial TMR). Buffers can reduce concentrate intake at higher levels. To improve pasture intake, offering cows a fresh allocation (new paddock or moving an electric wire) every 12 to 24 hours is a recommended procedure.

One approach to estimate pasture intake is to calculate the amount of pasture dry matter based on NDF intake. Wisconsin workers report dairy cows will consume 1.2 percent of the cow's body weight as total NDF. Using this guideline with high quality pasture (40% NDF), a 1000-pound Jersey cow could eat 12 pounds of total NDF or 30 pounds of pasture dry matter (12 pounds divided by 0.40 which is 40% NDF in pasture expressed as a decimal). As forage NDF increases (pasture quality drops), pasture dry matter also declines reduces energy intake.

Feed Sorting and Selection

Pasture provides another challenge as cows can selectively graze legumes and/or grasses available and different plant parts (leaves or stems) leading to undesirable rumen pH and fermentation characteristics. If supplemental feeds are offered, control intake to maintain uniform consumption with adequate bunk space for feed access or along a hot wire in the pasture. One example would be to offer supplemental feed (corn silage, urea, minerals, molasses, and ear corn) prior to milking with adequate bunks which allows all cows to eat similar amounts of this partial TMR (PMR) before they milk.

For dairy cows, pastures should be clipped after each rotation to control weeds and unpalatable pasture (stems and plants going to seed). Some dairy managers will follow the lactating cows with dry cows or heifers to consume the lower quality pasture dry matter.

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Effective Fiber

Based on New Zealand and Ireland data, the effective pasture NDF ranges from 35 to 40 percent. Chemical NDF pasture levels can be low at 35% NDF (U.S. forages range from 40 to 55%). New Zealand worker recommend a minimum of 15 to 17% effective NDF based on pasture (38% grass NDF times 40% effective NDF). If lush pasture contains lower NDF values (new pasture, clovers, or selective grazing), rumen pH and feed digestibility can be less than optimal. If fermentable carbohydrates are fed with these pasture qualities (such as corn or barley grain), effective NDF levels need to be raised to 18 to 20% from hay, by-product feeds, and/or straw. Estimating effective NDF is difficult and labs do not routinely offer tests. The Penn State Forage Separator Box is used to estimate effective particle length for silages and Total Mixed Rations (TMR) (percent of feed particles in the top two boxes). If effective NDF is marginal, dairy managers may observe the following characteristics.

- Low milk components, especially milk fat (drop of 0.3 to 0.5 percentage points)
- Loose manure or low fecal scores (less than 3 on a 1 to 5 range)
- Lameness and abnormal hoof growth patterns
- Free choice consumption of sodium bicarbonate
- Licking or eating of dirt
- Lack of cud chewing

Economics of Pasture-Based Feeding Systems

The profitability of pasture-based intensive pasture-based systems is one factor that appeals to dairy managers. Table 1 lists university field studies comparing grazing and non-grazing farms.

Table 1. Profitability of grazing expressed as dollars of net farm income ($NFI) per cow and comparative dollar advantage of the grazing herds.

State (year)	Non-grazing	Grazing	Difference
	-------------$NFI/cow-----------------		
New York (2000)	294	310	+ 16
Great lakes (2000)	223	395	+172
Maryland (1996-2000)	367	660	+293
Wisconsin (1999)	290	331	+ 41
New York (2001)	496	555	+ 59

New York workers monitored 58 grazing herds (85 cows per herd) and 105 non-grazing herds (83 cows per herds) from 1996 to 2001. The following differences were reported:

- 1,008 pounds less milk per cow for the grazing herds
- Net farm income per cow was $71 higher for the grazing herds
- Veterinary and medicine costs were $13 less per cow for the grazing herds
- Machinery costs were $62 per cow lower for the grazing herds
- Investment per cow was $937 less per cow for the grazing herd.

These studies indicate that pasture-based systems can be economically competitive, but milk production declines must be minimized, milk cow nutrient needs must be met, and managers must avoid large investments in facilities and equipment. Dairy managers also report less hoof and leg problems, lower culling rates, and extra replacement heifers that can be sold. Dairy managers have three nutrient approaches with a pasture-based systems.

- Approach 1. Supplement 2 to 4 pounds of grain (New Zealand system) or 10 percent of the total ration dry matter. Potential milk yield could be 30 to 50 pounds of milk per cow per day or 12,000 to 15,000 pounds of milk per cow annually.

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- Approach 2. Supplement 2 to 5 pounds of forage dry matter (corn silage or hay) and feed one pound of grain for each 5 pounds or 30 percent of ration dry matter. Potential milk yield could be 40 to 60 pounds of milk per cow per day or 15,000 to 17,000 pounds of milk per cow annually.

- Approach 3. Supplement 50 percent of the dry matter from PMR and 50 percent of the dry matter from pasture. Potential milk yield could be 60 to 80 pounds of milk per cow per day or 17,000 to 20,000 pound of milk per cow annually.

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