

Intensive Rotational Grazing in the Dairy Industry

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Introduction

Pastures had been a significant feature of the American landscape for centuries, and were used as the major source of nutrients for dairy cows. Many studies in the early 1900's focused on agronomic and pasture productivity, pasture management, animal responses, and economic factors (Fales *et al*, 1992), and scientists in the United States were considered leaders in pasture research and education. The movement away from pasture systems toward "confined" systems began in the 50's and was caused by many economic, political, and technological factors. Research and education programs related to pasture declined dramatically, and pasture use declined in Pennsylvania from about 170 days per year in the early 1950's to 64 days (mainly exercise lots) in 1990. Pasture systems based on early US research were adopted widely in various countries of Europe and in New Zealand, and these countries are now considered the world leaders in intensive pasture systems.

Interest in Pasture Today

Dairy producers have been experiencing a severe cost-price squeeze since the early 1980's with relatively stable milk prices and increasing input costs. This economic climate has made it increasingly difficult for small to medium size farms to be competitive or expand. Well managed pasture systems offer an opportunity to reduce costs during the pasture season, thus economic pressures are the major driving force behind the movement among dairy farmers primarily in the Northeast and Upper Midwest, to increase the utilization of pasture by dairy cows. Because the economic viability and survival of small family dairy farms are most often in jeopardy, the adoption of intensive pasture systems has been primarily by smaller dairy producers. In a survey of PA dairy producers, 53 milking cows was the average herd size of "pasture" farms (Parker *et al*, 1993).

Some of the interest in intensive rotational grazing came from a book entitled "Grass Productivity" (Voisin, 1959), that clearly stated the principles for "ra-

tional grazing" or what we often call "intensive rotational grazing (IRG)." By the early to mid 1980's early adopters were putting together grazing systems, based on Voisin's principles, which stressed matching pasture growth with the feed demands of livestock. This approach is facilitated today by an array of low-cost, easy-to-use fencing and watering systems, which allow a system to be easily modified as needed due to seasonal changes in pasture availability. These systems typically consist of several paddocks with cows rotated between paddocks. In the spring, cows may be rotated between paddocks as frequently as 10-14 days and in the summer, the rotation may be 21 to 35 days. The rotation and paddock system depend primarily on pasture growth and availability, but also on the grasses/legume mixtures in each pasture system.

Use of Pasture Today

While it is becoming clear that adoption of a pasture system would significantly benefit many dairy farmers, some have been reluctant to start a management system with which they have no experience. In a survey of 147 dairy farmers in Pennsylvania (Parker *et al*, 1993) pasture-based dairy farms had approximately 4% lower milk production per cow than confinement systems (16,800 vs 17,590 lb/cow/year), however 5% of the pasture farms exceeded 20,000 lb/cow/year, indicating that high levels of milk production can be achieved with pastures. Costs per cow were lower per year for the pastured cows, due primarily to reductions in purchased feed, fertilizer, and machinery.

A recent study indicated that 29% of 1,200 Pennsylvania dairy producers surveyed use pasture as a major source of forage during the grazing season, and about 16 percent use an IRG system (Gripp *et al*, 1993). This survey also suggests that the use of pasture will increase in the future with 18% of all survey respondents indicating they intend to increase their use of pasture within the next five years. This interest and adoption of pasture systems in other states, particularly the Northeast and North Central regions, appears to paral-

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lel the situation in Pennsylvania.

Grazing Economics

The recent decreases in profit margins for dairy farms have forced farmers to examine alternative production systems. The use of IRG offers the opportunity for significant reductions in total feed costs and other costs during the pasture season. Several whole-farm budgeting studies have indicated that the use of pasture can increase returns per cow from \$85 to \$168. (Emmick and Toomer, 1991; Parker *et al*, 1992). These increased returns result primarily from reductions in feed costs while cows are on pasture. Using a mid-point in this range of about \$125 per cow, a 60-cow dairy could see increased profits of about \$7,500. Other costs likely decrease including crop and machinery expenses, fuel, fertilizer, labor and bedding costs. Reduced labor requirements in the cropping program and manure handling may result in the labor being used to better manage cows, young stock, or even increase herd size, and can further increase the profit per cow.

Pasture Quality and Nutrition

Two of the most serious challenges identified with pasture systems were the lack of confidence in the ability of pastures to consistently provide high quality forage and the absence of information about feeding management (including ration formulation and estimating feed intake) necessary to maintain high milk production on pasture (Parker *et al*, 1993). Confined feeding systems allow for known quantities and qualities of forages and nutritionally balanced rations to be offered year round. Nutrient analysis of large quantities of stored silages along with weigh mix wagons and scales provide the opportunity to accurately formulate and deliver rations to consistently meet the nutrient needs of the cow and to know the dry matter intake. In contrast, the amount of pasture or herbage available varies throughout the growing season and is influenced by composition of pasture, climate, and a host of management factors. Pasture availability and nutrient composition change frequently during the growing season, and average nutrient composition of typical pastures in Table 1. These values are a composite of research studies at Penn State and those of Rayburn (1991). Routine forage testing and monitoring of composition is needed.

Despite changing composition of pasture, the same basic principles of nutrition and ration formulation apply to pasture feeding systems as to stored feeding programs. The Nutrient Requirements for Dairy Cattle (1989) is still the scientific base to develop feeding programs with pasture as well as with stored feed. From the nutritionists standpoint, the challenge is how to best

provide a nutritionally balanced ration with pasture as the primary forage source. The main concerns and questions asked by nutritionists relate to estimating pasture quality and dry matter intake, the amount of concentrate mix to be fed, and the composition of the concentrate mix. The basic information needed to properly balance rations for cows under intensive grazing is the same as for traditional confined feeding programs; namely, total daily nutrient requirements based on body weight, age, milk production, milk composition, and activity; estimated pasture quality; estimated quantity of pasture available; and expected total and pasture dry matter intake. These principles were reviewed (Muller, 1993).

Herbage from well-managed pastures should be sufficient to maintain 35 to 45 pounds of milk per day with little or no supplemental protein and energy. This production level may be higher with legume and grass/legume pastures than with mostly grass pastures. Grasses generally are higher in fiber and support lower dry matter intake than legumes. Since most cows produce above this production level, supplemental feed (energy) is needed to achieve maximum milk production and profit. Dairy producers need to feed the correct quantity of supplements which contain the proper nutrients and feedstuffs. With the availability and relatively low prices of many grains and by-products in relation to milk prices, dairy producers can justify feeding supplements in an attempt to obtain the genetic potential from their dairy cows. With the price of milk ranging from 1.3 to 2.0 times higher than the price of supplemental grain on a per pound basis, clearly supplemental grain feeding is needed and will be profitable with most pasture based systems.

Energy

Energy is the most limiting nutrient for profitable milk production and normal reproductive performances when pastures are the major source of forage. The non fiber carbohydrate (NFC) of grass pastures tends to be low (15 to 20% of DM) compared to a total ration needs of about 35% for high producing cows (Table 1), thus NFC supplementation from grain is needed. The NFC is a major source of energy for the cow. Grazing cows have higher levels of activity than cows in confinement, and need additional energy for this activity. Cows under grazing conditions often have lower body condition compared to cows under confined feeding, suggesting the need for more energy. Thus, the body condition of the cows in addition to the milk production level must be considered when establishing the amount of grain to be fed.

The amount of grain fed can have long term effects on energy balance and in turn on milk production, body weight and condition changes, and on reproduc-

Table 1. Average Nutrient Composition for Pasture

Nutrient	PASTURE												Sor-Sud Past; 40 inches	Brassicas	Small Grain Pasture
	Grass			Legume			Mixed Mostly Grass			Mixed Mostly Legumes					
	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall			
DM %	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	22.0	18.0	20.0
CP, %	21.0	19.0	22.0	25.0	22.0	25.0	22.0	21.0	23.0	23.0	21.0	24.0	14.0	25.0	18.0
UIP, % of CP	18.0	30.0	26.0	18.0	20.0	18.0	18.0	27.0	24.0	18.0	23.0	21.0	38.0	31.0	24.0
Sol. P, % of CP	50.0	30.0	40.0	37.0	30.0	46.0	46.0	30.0	42.0	40.0	30.0	44.0	32.0	34.0	67.0
ADF, %	26.0	33.0	28.0	25.0	30.0	26.0	26.0	32.0	27.0	25.0	31.0	27.0	41.0	28.0	40.0
NDF, %	48.0	54.0	50.0	36.0	41.0	36.0	46.0	50.0	46.0	45.0	43.0	43.0	62.0	30.0	59.0
TDN, %	70.0	64.0	68.0	71.0	66.0	69.0	70.0	66.0	74.0	70.0	66.0	70.0	63.0	80.0	65.0
NE, Mcal/lb	.76	.72	.76	.75	.70	.75	.75	.71	.76	.75	.70	.75	.65	.80	.58
NSC, %	18	15	18	23	20	23	19	16	19	21	18	21	12	28	16
Ca, %	.70	.70	.80	1.30	1.30	1.50	.90	.90	1.00	1.10	1.00	1.30	.50	1.61	0.57
P, %	.31	.31	.33	.30	.30	.33	.31	.31	.33	.30	.30	.33	.30	0.34	0.32
Mg, %	.14	.17	.20	.19	.21	.24	.15	.19	.21	.17	.19	.22	.30	.30	0.20
K, %	3.20	2.10	2.75	3.50	3.00	3.30	3.30	2.40	2.95	3.30	2.70	3.10	2.60	2.78	2.85
S, %	.16	.19	.22	.20	.23	.26	.17	.20	.23	.18	.21	.24	.12	.29	0.25
Mn, ppm	80	80	80	56	56	56	73	73	73	62	62	62	68	52	63
Cu, ppm	5	6	7	7	8	9	7	8	9	7	8	9	9	17	8
Zn, ppm	26	26	26	26	26	26	26	26	26	26	26	26	34	36	29
Fe, ppm	146	146	146	194	194	194	205	205	205	186	186	186	268	93	315
Vit A, IU/lb	40000	40000	40000	40000	40000	40000	40000	40000	40000	40000	40000	40000	340000		30000
Vit D, IU/lb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vit E, IU/lb	250	250	250	250	250	250	250	250	250	250	250	250	204	0	25
Fat, %	4.9	4.9	4.9	4.3	4.3	4.3	4.7	4.7	4.7	4.5	4.5	4.5	3.1	4.2	3.6
Ash, %	10.0	10.0	11.0	12.0	11.0	12.0	11.0	11.0	12.0	12.0	12.0	14.0	9.8	10	8.3

tive performance. Generally, the response in milk production to concentrate feeding is about 1 pound of milk for every pound of concentrate fed when early lactation cows have adequate available pasture. Feeding concentrates at a rate of 1 pound to 4 or 5 pounds of milk is usually adequate for high producing cows grazing high quality grass pasture (Hoffman *et al*, 1993). As availability of pasture decreases, additional forage and possibly additional grain may be needed. As quality of pasture decreases, higher amounts of grain will be needed. Cows milking 35 to 45 lb per day that have adequate body condition may require little or no grain when grazing high quality pastures. Several different grains that are high in energy can help meet the energy needs of the cow, depending on relative costs. Shelled corn is one of the highest energy grains and a good source of NFC, and is often the lowest cost source of energy.

Protein

The total protein content of good quality pasture is usually high with proper grazing management (Table 1) sometimes exceeding 25% in spring or late fall. However, 65 to 80% of the protein in high quality pasture is degradable in the rumen leaving 20 to 35% of the total forage protein to escape the rumen and reach the small intestine (Holden, 1993). This level of degradable protein is higher than the 60 to 65% recommended by NRC. Typically, concentrate mixtures containing 12 to 14% crude protein are adequate, however, supplementation with a higher undegradable intake protein (UIP) source

such as distillers or brewers grains, roasted soybeans, animal protein, or other high UIP sources may be beneficial for high producing cows. Some studies have reported a benefit to supplementing with higher UIP. The best way to fully utilize the highly degradable protein in pasture is to provide the proper amounts of energy from shelled corn, barley, and other grains high in NFC. Matching of energy and protein in the rumen can lead to more optimal fermentation and greater nutrient utilization, and maximize microbial protein production.

Minerals

Minerals are often deficient compared to the nutrient requirements (NRC, 1989), particularly with grass based pasture. Phosphorus, calcium, magnesium, copper, zinc, and selenium are often deficient in pasture compared to the needs of the lactating cow. Thus, forage testing and supplemental minerals are frequently needed. Supplemental minerals should be provided in the concentrate mix rather than free choice to ensure adequate intake for each cow. In particular, supplemental magnesium can reduce the risk of grass tetany with spring pastures. Concentration of minerals in the grain mix needs to be adjusted accordingly if the amount of grain fed is reduced.

Supplemental Forage

Many dairy farmers who have adopted a grazing system feed varying amounts of additional forage. When the quantity of available pasture is limited, particularly

during summer, dairy producers will need to feed additional forage. Some dairy producers decide to feed supplemental forage in an attempt to obtain higher milk production and improve body condition. Often supplemental forage is fed with the expectation of "maintaining" milk fat test. Feeding some additional forage as a replacement for some of the pasture offers more "control" over the feeding program than pasture alone. Frequently, a combination of grass/or hay crop silage and corn silage is fed with grain as a "partial" TMR and appears to work well and may be a better way to feed grain than the twice daily slug feeding. Many dairy producers feed small amounts of dry hay. Hay will likely decrease the fast rate of passage that normally exists on pastures and add some needed fiber to high quality pastures. Good nutritional advice is needed to balance the total ration when additional forages are fed.

Animal Health Concerns

As with any change in a feeding program, adjusting the cow's rumen from stored forage-based feeding programs to pasture-based rations in the spring should be done gradually, probably over a 2 week period, to reduce the risk of digestive upsets. Supplemental magnesium is needed to minimize the risk of grass tetany. Bloat is a problem when hungry cows are turned into lush, legume pastures. From a nutritional standpoint, the risk of bloat can be reduced by feeding dry forage prior to turning to pasture and by utilizing mixtures of grasses and legumes. Parasite control and prevention is needed with pasture systems. Deworming before cows are put on pasture in the spring and deworming 1 or 2 other times are usually recommended.

Many dairy producers report decreased culling (perhaps 15% less), improved herd health, and improved heat detection and herd reproductive performance with pasture systems. One study (Goldberg *et al*, 1992) reported improved milk quality and lower SCC with pasture systems. More documentation of these on-farm observations are needed, but any or all of these would contribute to even greater profits with a pasture system.

Conclusion

As stated by a well known grassland researcher, "one of the challenges of utilizing pasture efficiently is knowing how to supplement grazing cattle properly for maximum milk production throughout the grazing season." The highly sophisticated knowledge and research does not exist with high producing cows under grazing systems compared to confined feeding systems. The continual changing of pasture quantity and quality during the grazing season, the inability to accurately measure DMI, the potentially poor utilization of protein in pas-

tures, the "slug" feeding of grain, and other problems make the art and science of supplemental feeding with pasture a challenge. Supplemental feeding of grain is needed under most conditions to maximize cow performance and profit, particularly with high producing cows in early lactation. Grain supplements should provide high levels of energy, and additional undegradable protein in the grain mix may be beneficial. Periodic measurements of pasture availability and quality, sound feed programming, and good management using the current available information is a must in order to maximize profit and minimize feed costs. Clearly, more research and information is needed on all aspects of pasture management with high producing dairy cows.

There are two additional points not discussed that are important with the movement "back to pasture." First many dairy farmers comment on the reduced stress and improved lifestyle and quality of life with a pasture system. Second, there is increasing interest and some adoption of seasonal calving, similar to the New Zealanders, by dairy producers who adopt a grazing system. The latter is related to improved lifestyle.

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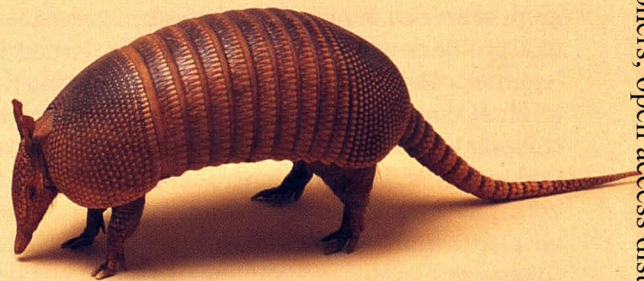
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