

A Survey of Total Mixed Ration Use on Pasture-based Dairy Farms in New York and Pennsylvania

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Background

Feeding dairy cows on pasture challenges nutritionists and producers, which can include variations in milk production due to changing environmental conditions, difficulty in estimating and budgeting pasture availability, inaccurate estimation of total and pasture DMI, and changing pasture quality throughout the grazing season (). These challenges may be partially overcome by feeding a total mixed ration (TMR) with pasture. A TMR provides the advantages of providing a more uniform ration throughout the year (including the grazing season), more accurate monitoring of pasture and total DMI, less chance of rumen digestive problems as when concentrates are slug fed, and improved milk production, milk fat, and milk protein (). Many dairy producers in the Northeast and Midwest US have the knowledge and equipment for TMR feeding systems due to prior history as a confinement farm or because this system is used during the non-grazing months.

Research that evaluates a TMR in a pasture-based system is very limited. A handful of studies compared milk production of cows consuming pasture only (no supplements) versus confined cows fed a TMR (;), pasture plus concentrate versus TMR in confinement (), or TMR plus pasture versus TMR in confinement () and all found that the confined TMR-fed cows produced significantly more milk than the pastured cows. However, these early studies were either short-term studies of 4 to 6 wk or long-term studies that did not include a partial TMR treatment. Including a TMR in a pasture-based system resulted in greater milk yield and improved amounts of milk fat and milk protein when compared to pasture plus concentrate (). An economic analysis () reported that a TMR fed in confinement generated the greatest income over feed and feeding costs compared with a pasture plus concentrate or a pasture plus TMR system. However, this study did not incorporate all expenses related to milk production, including milking labor, parlor costs, and environmental concerns, and it has been recognized that under some situations (such as high feed costs and low milk prices), pasture-based systems may be more profitable than the confinement TMR systems. Using a whole-farm simulation model, Soder and Rotz (2003) showed that utilizing pasture plus TMR (when compared with pasture plus concentrate and TMR in confinement) was a viable feeding strategy for maintaining milk production while being economically and environmentally sustainable.

More interest is being expressed in using a TMR with grazing dairy cows to maintain or improve milk production, particularly as herd size increases with land base remaining constant. Questions have arisen regarding feeding management and formulation with a TMR in pasture-based systems. We conducted a survey to collect information on the use of a TMR on thirteen pasture-based dairy farms in New York and Pennsylvania to monitor TMR and pasture nutrient content and summarize what and how decisions are being made in relation to TMR formulation throughout the grazing season.

Data Collected

A total of thirteen dairy herds (6 in New York, 7 in Pennsylvania) participated in this survey. Farm visits occurred to each farm approximately every 4-5 weeks from May through September, 2004. A personal interview was conducted during the first visit for background

information on the farm. During each visit, fresh TMR and pasture samples were collected. The TMR and pasture samples were analyzed for nutrient content. Milk production records were collected. DHIA records were collected on the farms that are members of DHIA (8 farms). A follow-up survey was sent to producers at the end of the grazing season.

Results

Table 1 describes the general management of the herds. Five of the herds were all (or nearly all) purebred Holstein, 7 farms were mixed breed (primarily Holstein and Jersey, either reported as having both purebred Holsteins and Jerseys or as Holstein x Jersey crossbreds, with other minor breeds reported with lower frequency), and 1 farm contained all purebred Jerseys.

Table 1. General farm information.

	N ¹	Average	Range	SD ²
Herd size	13	136	48 - 295	66.8
Cow Breed				
Holstein ³	5	---	---	---
Jersey	1	---	---	---
Holstein + Jersey ⁴	7	---	---	---
Milk per cow, lb/d	13	59.2	40.5 – 85.6	10.8
Milk Fat, %	13	3.78	2.90-5.11	0.41
Milk Protein, %	13	3.09	2.72-3.52	0.21

¹Number of producers that responded.

²Standard deviation.

³Holstein was the predominant breed reported- most Holstein farms also had either a few Jersey cows, or a few Holstein-crossbred cows

⁴Farms either had both Holsteins and Jerseys, or Holstein/Jersey crosses.

Land ownership and use varied widely among farms (Table 2). Most farms produced most, if not all, of the forage used on the farm, however, grain and protein crop production varied, with many farms purchasing some or all concentrate/protein sources fed on the farm. Labor averaged 2.9 full-time equivalents per farm. None of the herds were completely seasonal, although several were partially seasonal in that they calved groups of cows several times per year as opposed to random year-round calving.

Because reasons to convert to a grazing system vary widely and are often made for reasons in addition to economics, the participating producers were surveyed concerning their philosophies and experiences with grazing dairy cows (Table 3). Most of the producers were very enthusiastic when discussing why they graze and what they enjoy the most about grazing. Years of grazing experienced ranged from 2 to 25 years, with two graziers having >20 years experience and two graziers having <5 years experience. Two of the herds were certified organic farms. Nine of the herds were enrolled in DHIA, two of the farms used BST routinely (one additional herd mentioned sporadic BST use). Economic-driven reasons were the most

Table 2. Land and labor information.

	N ¹	Average	Range	SD ²
Land (acres)				
Owned	13	395	0 - 1200	304
Rented	13	210	20- 499	146
Total		605	237 - 1400	316

Crops (acres)				
Permanent pasture	13	138	35 - 351	99
Alfalfa	8	121	17 - 249	76
Grass (hay/silage)	10	178	49 - 499	122
Corn (silage)	12	128	27 - 450	107
Corn (grain)	3	22	99 - 30	89
Rye, wheat	1	49	---	---
Wheat, soybeans	1	40	---	---
Barley	1	59	---	---
Soybeans	1	151	---	---
Total Cropland	13	605	238 - 1400	355
Full-time equivalent employees	13	2.9	1 - 6	1.57

¹Number of producers that responded.

²Standard deviation.

frequently-mentioned reasons to switch to grazing, however, other less traditional reasons were reported, including improved quality of life, the positive perception of cows outside on pasture, and environmental concerns. By far, the most mentioned gratification from grazing was seeing the cows on pasture. Several of the producers also mentioned that non-farming neighbors responded positively to seeing the cows on pasture as well. Improved herd health was a close second response. Improved economics was mentioned as a most enjoyed benefit by 4 of the producers. Disease/leg problems and pasture management were tied as the top two challenges with grazing dairy cows. It was interesting to note that making a profit was only directly mentioned by one producer as a challenge to grazing dairy cows, although it certainly drives many decisions on most farms.

The number of permanent paddocks ranged from 2 to 38 per farm, with an average size of 15 paddocks. Size of permanent paddocks varied widely within and across farms, ranging from 1.5 acres to 60 acres. In general, the larger the paddock size, the fewer permanent paddocks on a farm. It appeared that most farms permanently fenced large fields, then used temporary fences to subdivide pastures as necessary. This permitted flexibility in sizing paddocks based upon forage availability, current herd size, and forage intake requirements.

Nine herds responded that cows may be removed from pasture prematurely prior to milking due to adverse weather conditions (heat or rain), two herds were free to return to the barn at any time, and only one herd said that cows remained on pasture for the set amount of time, regardless of conditions. Cows were moved to a new section of pasture twice a day, predominantly after milking, on eight of the farms. Four of the farms moved cows to new pasture once a day, while one farm moved cows once a week. The distance walked to pasture from the barn for nine of the farms was 0.5 miles or less (one way), with four farms reporting distances of > 0.5 miles (greatest distance was 0.8 miles) for some of their most distant pastures.

Table 3. Responses to grazing-related questions¹

Item	N ²	Item	N ²
Reason(s) you started grazing		Biggest challenge with grazing	
Greater profit	9	Disease/leg problems	4
Improved animal health	6	Pasture management	4
Trouble growing crops	3	Milk quality/productivity	3
Like cows outside	3	Weather	2

Lower capital expense	3	Finding labor	2
Lower labor requirements	3	Maintaining laneways	2
Subsidy payments	1	Fly control	1
Environmental concerns	1	Fencing	1
		Making a profit	1
		Breeding	1
What do you enjoy most about grazing?		Primary herd health issues	
Seeing cows on grass	9	Foot/leg problems	11
Herd Health	6	Mastitis	6
Economics	4	Retained placenta	4
Lower labor requirements	4	Displaced abomasum	3
Quality of life (humans)	2	Foot warts	2
Improved milk quality	1	Milk fever	2
		Reproductive issues	2

¹Producers were free to list as many reasons as they liked.

²Number of producers that responded.

For the most part, cows were moved to new pastures on a routine basis (often after each milking). If cows ran out of grass during any grazing session, they would either be given access to new pasture, or they would be brought to the barn and fed TMR. Sizing paddock was usually done by ‘eyeball’ - that is, previous experience taught producers approximately how much standing forage was in each paddock. One producer was using a rising plate meter for estimating available forage.

Nine farms reported that fertilizer (in addition to manure) was used on their pastures, while four farms reported no fertilizer use. Eight farms reported soil testing on a regular basis.

TMR ingredients and TMR and pasture nutrient composition varied widely across farms (Tables 4, 5, 6). The number of times the TMR changed throughout the grazing season ranged from 1 to 5+, with the most common answer being twice during the grazing season. The season of the year dominated as the reason TMR formulation changed followed closely by pasture quality/availability. Six of the farms reported monitoring feed refusal in the bunk as a means to determine how much TMR to feed, but it also gave them clues regarding what changes were needed in the TMR. While nearly all farms frequently forage tested their stored forages, few did any pasture testing, even though pasture dominated forage intake during the grazing season. Half of the herds had access to TMR prior to milking while the other half had access after milking (with the exception of one herd that was fed TMR during milking). Timing of TMR feeding may have an impact on pasture intake and grazing behavior of the cows once turned back onto pasture, as research has shown that previous meal can have an influence on diet selection.

Table 4. Ingredients used in the TMR during the grazing season, number of farms using each ingredient, and changes in ingredient composition during the grazing season.

Ingredient	N ¹	Change during grazing season
Corn silage	12	Often decreased or removed during peak pasture growth
Grass silage	3	Decreased or removed, often 1:1 for pasture DM
Baleage/haylage	12	Decreased or removed, often 1:1 for pasture DM
Green chop	1	Fed in spring to help transition cows onto pasture
Rumen bypass fat	1	Discontinued once cows were on full pasture
Roasted soybeans	8	Increased in fall when cows were removed from pasture
Soybean meal	8	Decreased in spring, sometimes increased in middle of summer as forage quality declined
Soy hulls	1	Added in mid-summer
Peas:sunflower	1	Added in mid-summer
Ground corn	5	Remained relatively constant
Steam-flaked corn	1	Remained relatively constant
High-moisture shelled corn	1	Remained relatively constant
Corn gluten feed	2	Decreased or eliminated on full pasture
Wheat	1	Added during autumn grazing
Wheat midds	1	Decreased during summer grazing
Oats	1	Increased as fall grazing decreased
Barley	2	Remained relatively constant
Whole cottonseed	1	Remained relatively constant
Straw	2	Added during spring grazing, decreased or eliminated during summer grazing
Molasses	2	Remained relatively constant
Vitamin/mineral pack	13	Insufficient detail to accurately depict individual mineral ration changes

¹Number of producers that responded.

Conclusions

Flexibility is key in utilizing a TMR on pasture-based operations- flexibility in ingredients used in a TMR to keep costs down, meet nutrient demands, and maintain satisfactory milk production levels, and flexibility on the part of producers and nutritionists in reacting to changes in environment, pasture quality/quantity, feed prices, and animals. The basic principles of nutrition still apply- monitor DMI, forage to concentrate ratios, and milk production.

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Table 5. Nutrient composition of pasture and TMR samples summarized across all farms and seasons.

	Pasture			TMR		
	Mean	Range	SD ¹	Mean	Range	SD ¹
DM, %	18.1	12.2 - 29.4	3.51	43.4	27.1 - 65.1	15.8
CP, %	25.0	15.6 - 33.0	2.54	14.8	8.4 - 26.8	1.73
ADF, %	26.5	18.1 - 28.1	3.31	21.9	13.4 - 31.7	3.20
NDF, %	44.6	33.3 - 58.9	8.53	36.3	23.6 - 49.5	4.43
NE _L , mg/lb	0.66	0.56 - 0.74	0.08	0.74	0.66 - 0.79	0.02
Ca, %	0.77	0.37 - 1.19	0.18	0.96	0.33 - 1.59	0.17
P, %	0.43	0.22 - 0.58	0.07	0.45	0.27 - 0.70	0.05
Mg, %	0.24	0.13 - 0.38	0.06	0.33	0.17 - 0.63	0.06
K, %	3.19	1.69 - 4.26	0.60	1.47	0.82 - 3.32	0.28
Na, %	0.04	0.00 - 0.29	0.03	0.45	0.00 - 1.03	0.16
S, %	0.32	0.17 - 0.46	0.06	0.22	0.10 - 0.34	0.04

¹Standard deviation.

Table 6. TMR information

	N ¹		N ¹
# TMR changes during grazing season		# times/yr TMR sampled	
1-2	8	0	7
3-4	2	1-2	6
5+	3	# times stored feeds sampled	
Reasons for TMR formulation changes		0	1
Season	9	1-2	0
Pasture quality/availability	8	3+	10
Monitoring refusals	6	Every bunk/bag change	2
Heat stress	4	# times/yr pastures sampled	
How fast TMR is consumed	2	0	9
Decrease in milk fat	1	1-2	2
Screening manure for fiber & CHO	1	3+	2
Doesn't change much	1	When do cows have access to TMR	
How often are TMR bunks cleaned out?		Before milking	6
Rarely/never	3	During milking	1
Once a day	6	After milking	6
Every other day	2		
Once a week	1		
Once every two weeks	1		

¹Number of producers that responded.