ROTATIONAL GRAZING WITH DAIRY HEIFERS ON WICST:

a. Pasture and Heifer Productivity

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INTRODUCTION

Whereas more and more of the milk stream is coming from large dairies with more than 1000 animal units (1 AU=1000 lb cow), managed (rotational) grazing is an increasingly important part of the landscape. In a recent study by PATS, researchers reported that managed grazing farms consistently generated more farm income and had lower costs than confinement farms in spite of less milk per cow produced (Krigel and McNair, 2005). Managed grazing is now practiced on 22% of the states' farms with another 21% of dairy farms using some pasture for the milk cow ration. Farmers in the driftless area of Wisconsin have the highest use of grazing (49-74%), primarily on marginal land and south-central WI also has a significant number of dairymen using managed grazing at 26-35% (Kriegl and McNair, 2005). Average farm size for dairy farms using managed grazing in Wisconsin is 245 acres. In this report, we look at the productivity of the grazed paddocks between 1993 to 2004 at Arlington, and 1992-1995 at Lakeland.

MATERIALS AND METHODS

Background

Pastures were established at the Lakeland Agricultural Complex (LAC) and the Arlington Agricultural Research Station (ARS) in 1990. Initially, species included red clover (*Trifolium pratense*), smooth bromegrass (*Bromus inermis*) and timothy (*Phleum pratense*); later, orchardgrass (*Dactylis glomerata*), perennial ryegrass (*Lolium perenne*) and reed canarygrass (*Phalaris arundinacea*) were also included (see Table 1 for seeding dates and rates). At LAC, the forage was mechanically harvested in 1991 and grazing began in 1992. At ARS, severe winterkill of the grasses required reseeding in 1992. Slow establishment due to drought delayed grazing there until the spring of 1993. Red clover was seeded (frost seeded at LAC and drilled at ARS) into the pastures on alternative years through 1995. Thereafter, red clover was seeded at a reduced rate when deemed necessary. Two of the paddocks at LAC (reps 1 and 4) were tilled and reseeded in August of 1996 to repair severe trampling damage, which occurred during the wet weather earlier that summer. The fall seeding of 1996 there failed and there was more reseeding in the fall of 1997. As a result, no grazing or mechanical harvest occurred on the plots at LAC in 1997. The WICST trial ended at LAC after the 2002 growing season.

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Table 1. WICST pasture seeding dates and rates.

	Arlington Ag Research Station			Lakeland Agricultural Complex		
Year	Date	Species	(lb/acre)	Date	Species	(lb/acre)
1990	23-Apr	'Marathon' red clover	7.0	30-May	'Marathon' red clover	6.1
		'Badger' smooth bromegrass	8.0		'Badger' smooth bromegrass	3.0
		'Toro' timothy	4.0		'Toro' timothy	3.5
1992	30-Apr	Orchardgrass (early)	6.0	-	-	-
		'Badger' smooth bromegrass	12.0			
		'Toro' timothy	6.0			
	31-Jul	Orchardgrass (early)	4.5			
1993	09-Apr	'Arlington' red clover	12.0	07-Apr	'Arlington' red clover	20.0
1995	17-Mar	'Arlington' red clover	15.0	24-Mar	'Arlington' red clover	18.0
1996	26-Apr	'Arlington' red clover	6.0	09-Mar	'Arlington' red clover*	18.0
				22-Aug	'Arlington' red clover**	6.0
					timothy	4.0
					perennial ryegrass	3.0
1997	05-Apr	'Arlington' red clover	6.0	21-Aug	reed canarygrass	8.0
					Orchardgrass (early)	3.0
					'Arlington' red clover	8.0
1998	-	-	-	30-Mar	'Arlington' red clover***	15.0
2001	13-April	'Arlington' red clover	12.0	26-Mar	Arlington' red clover	6.0
2003	02-April	'Arlington' red clover	8.0	-	-	-

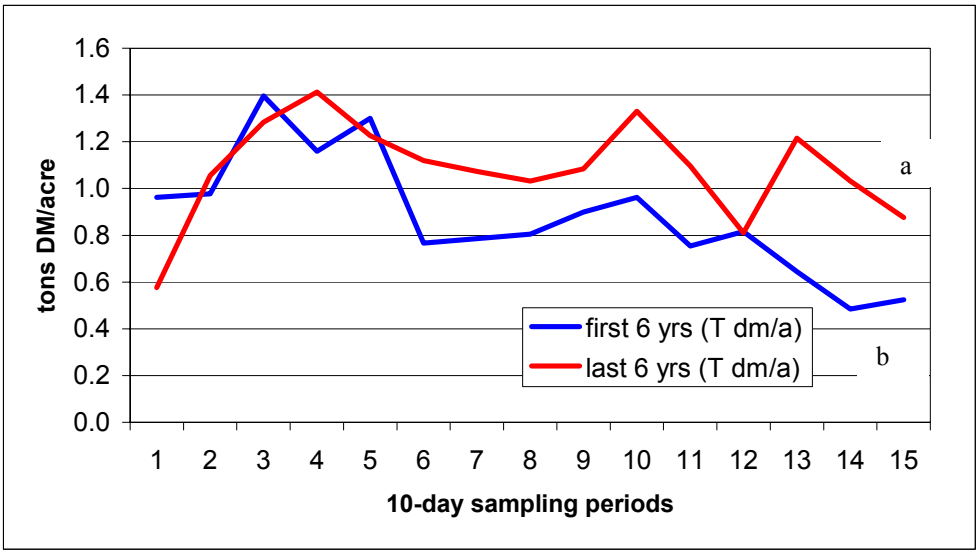
* Seeded with no-till drill; otherwise broadcast seeded except for drilling with 1990 establishment.

* * reps 1 and 2 *** Heavy seeding due to poor pasture conditions

Pasture Management

Throughout the history of the trial, dairy heifers were cycled 5-6 times per season through the four pasture plots at each site. Three grazing management strategies have been used over the 15 years of WICST (see WICST 9th Report, p. 21). The most recent, effective and practical was stocking four-to-five heifers on the plots and treating them as a cohort. This has resulted in some haying in the early spring, but the paddocks appear to be in better health (Fig. 1). Grazing pressure is adjusted throughout the season as the rate of forage growth changes. For example, in the hot, dry summer months, when forage regrowth has slowed, heifers will be given a larger area or moved through the paddock at an increased rate to maintain intake and body condition. If necessary, supplemental hay will be fed to allow adequate pasture rest and regrowth. The disadvantage of this "cohort" system is that there are not 4 replicate plots per year, each with its individual forage productivity and animal weight gain, but instead, a single result. However, years (1993-2004) replace replicates in the analysis of variance of heifer performance.

Fig. 1. Dry matter production on pasture plots at Arlington from 1993-98 (first 6 yrs) vs. 1999-04 (last 6 yrs).



In both 2003 and 2004, 5 heifers at approximately 500# each were placed on the 2.8 acres of pasture for a stocking rate of 1.8 animals/acre. Heifers moved through each paddock in about a-week-to-9 days, allowing each paddock to recover for about 24 days. Since the initiation of the trial pasture *yield* or more correctly *available forage or herbage mass* has been estimated approximately weekly from three to four random quadrats ($0.25m^2$) placed in the next area that animals would be moved to, clipped to ground level (i.e. 1 to 2-in. stubble). This information was graphed by pooling the harvest quadrat data from the 11 years at Arlington. Each point represents the mean of 4-12 sampling dates that fell within the indicated 10-day period across the season. In 2004, we initiated a second measure of productivity, by establishing an exclusion area in each pasture plot, which we mechanically harvested based on a haying schedule (data found in the paper '*WICST Forage Systems Comparison: Milk Models and Economics*' within this technical report).

Forage was dried (in 60°C oven for at least 48 hr) and forage availability is expressed on a dry matter basis. Samples were sent to the UW Soil and Plant Analysis Lab (SPAL) for quality analysis where NIRS was used to estimate crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF). Relative feed value (RFV) was calculated from NDF and ADF for each sample. Recently available from SPAL is RFQ (relative forage quality), which more accurately predicts quality than RFV because it uses fiber digestibility as an indicator verses just the amount of fiber present. This improvement is especially important for graziers as their paddocks are primarily grasses that have a higher digestible fiber than many legumes.

Herbicide. The plots are regularly scouted and spot-sprayed for thistle (Canada and bull) using stinger in a backpack sprayer (7ml of stinger/gal water). In 2003 about 0.25 gallons were used in the four plots (2.8a). In 2004 about twice that quantity of spray was used (0.5 gallons). Typically, thistles have been found along the fenceline where the mower can't reach.

Clipping. Since 2000, the heifer stocking density has remained constant and therefore excess

spring forage growth has been mechanically harvested as hay, which on a real farm would be used for winter feed or during forage shortages during the growing season. Generally, 2 plots each season are harvested as hay of mediocre forage quality; occasionally a good fall (1994, 1995) allowed an additional hay harvest from one of the paddocks (Tables 2 & 3). Mechanical clipping with a rotary mower (to about 4" stubble height) following a grazing episode has frequently been done through mid-July to remove seed heads and keep weeds in check thus improving the pasture stand and quality.

Nutrient management. Nitrogen fertilizer was not added in either 2003 or 2004. It was very dry in 2003 and timing fertilizer application with rainfall proved to be impossible. In 2004, there was so much rainfall and thus lush pasture growth that N fertilizer was unnecessary. Early spring applications of 50 lb N/a were administered at Arlington in 1993, 1994, 1996, and 2000, and in 1993 at Lakeland. In 2004, soil test P and K levels in replicates # 1 and 2 are still 'excessively high'. Rep 2 (plot 207) has historically tested excessively high in STK (388 ppm), probably due to its proximity to the old field road from the dairy barn. However, in replicates #3 and 4, STK is drawing near the replacement category (STK=115) and should start receiving K fertilizer to maintain levels.

Heifer Management

Grazing details for years prior to 2003 have been reported in each of the previous WICST technical reports (2nd-9th).

2003. Five heifers were shrunk, weighed and placed on pasture from May 7th and removed September 24th (139 days on pasture). Five control animals of similar size were weighed at the same time and remained in confinement. Due to a drought during the summer months, pasture grass growth was minimal in August so supplemental hay was fed for 33 days for a total of 1020 lbs (*as fed)*. The cattle were removed earlier than normal from the plots due to lack of feed. Two pounds of grain was fed each day to each heifer.

*2004***.** Five heifers were shrunk, weighed and placed on pasture from April 27th until October 11th (167 days on pasture). Another 5 control animals (confinement) were weighed (recently moved and housed at Marshfield). Heifers cycled through the plots 5 times this season. Ample rainfall, excellent water holding capacity of the soil, and cooler than average temperatures all contributed to excellent forage production. No supplemental hay was fed, but grain was again fed at 2 lb/hd/day throughout the season.

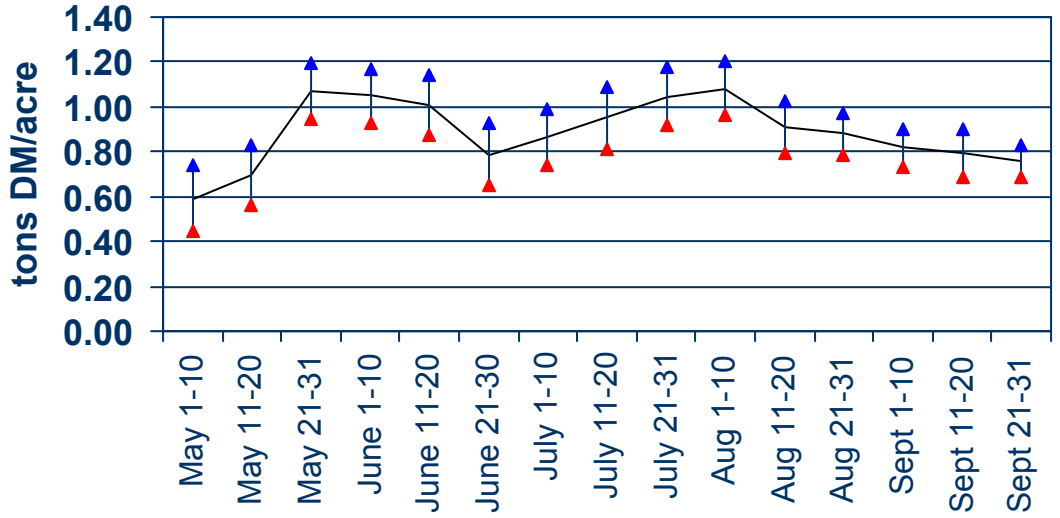
RESULTS AND DISCUSSION

Long-term Productivity.

Since the pasture plots were established, they have produced well with about 0.8 to 1.0 tons of available dry matter/acre at Arlington as the heifers moved to new grass, and 0.6 to 1.0 tons at Lakeland (Fig. 2 & 3). The growth curves at each site suggest that our stocking rate is about right so that a relatively constant supply of forage is available in each cycle. At ARS, the growth distribution was a bit more even than at LAC although both sites experienced the 'summer slump', or reduced forage production in late June and July. The flat lay of the paddocks at ARS allows most of the rainfall to infiltrate instead of running off and the excellent water holding

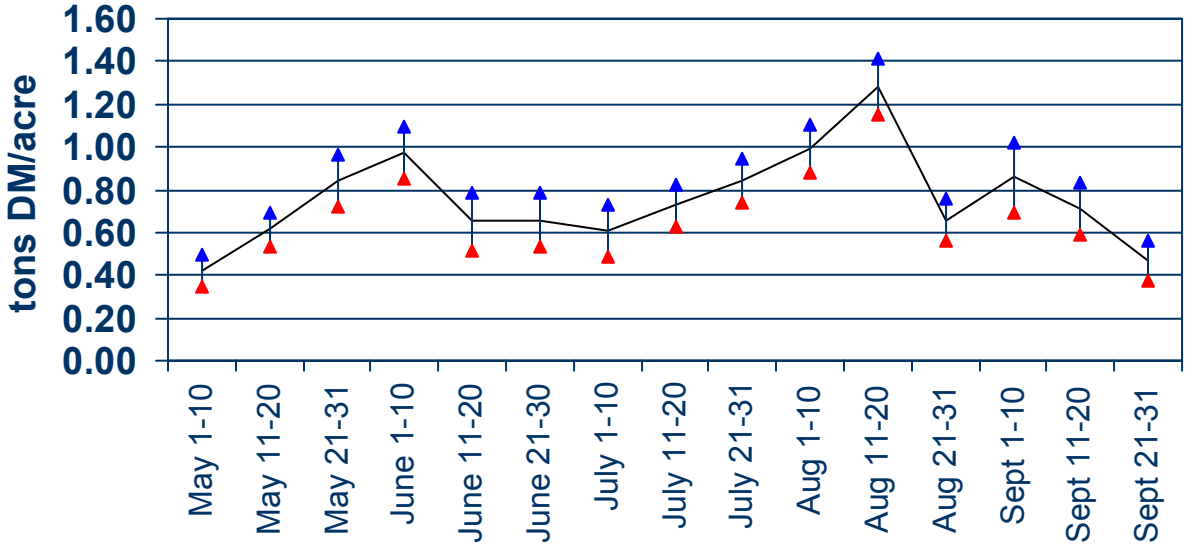
capacity of the soil are partial explanations for the sustained production during the dry summer months. At LAC, reduced summer yields were, in large part due to the fact that the paddocks are on some slope, the soils have slower infiltration rates and during several years, there has been hotter, drier summer weather at this site.

Fig 2. Pasture forage availability at Arlington over the duration of the trial (the line is the mean for each sample period with 90% confidence interval around each mean).



1 Data from 1993-2004 except no yield data for 1996.

Fig 3. Pasture forage availability at Lakeland during the first four years of the trial (the line is the mean for each sample period with 90% confidence interval around each mean).



1 Data from 1992-1995.

Table 2. Mechanical hay harvested on pasture plots over the course of the trial at ARS.

Year[1]	Date	Yield (tons DM/a)	Plot #	Crude Protein (%)	RFV
1993	June 11	0.54	112,302,405	13.8	90
1994	May 31	1.08	All 4 plots[2]	13.3	103
	October 21	1.10	All 4 plots[2]	16.7	125
1995	June 5	0.38	All 4 plots[2]	12.1	101
	October 9	0.99	All 4 plots[2]	16.9	93
1997	June 14	1.43	405	-	-
1998	May 12	1.68	302	19.4	145
2000	May 16	1.15	207	18.1	120
	June 6	1.68	302	9.6	82
2001	May 25	1.52	207	-	-
	June 30	1.04	405	10.7	89
2002	May 6	1.20	207	-	-
	May 16	0.94	405	18.7	132
	June 11	0.23	405	15.5	108
2003	June 24	2.15	405	12.9	102
2004	May 25	1.75	302	14.0	115

[1] No hay harvested in 1996 or 1999. [2] Only partial plot was taken as hay while the rest was grazed.

Table 3. Mechanical hay harvested on pasture plots over the course of the trial at LAC.

Year[1]	Date	Yield (tons DM/a)	Plot #	Crude Protein (% of DM)	RFV[2]
1992	May 30	1.43	104,314,408	16.5	136
1994	June 16	0.39	All 4 plots[2]	12.1	99
1995	May 31	0.28	All 4 plots[2]	11.6	79
	June 23	0.32	104, 314	15.4	90
2000	June 20	1.59	408	16.6	-
2001	July 9	0.75	408	6.6	84
2002	June 9	1.28	408	13.9	102

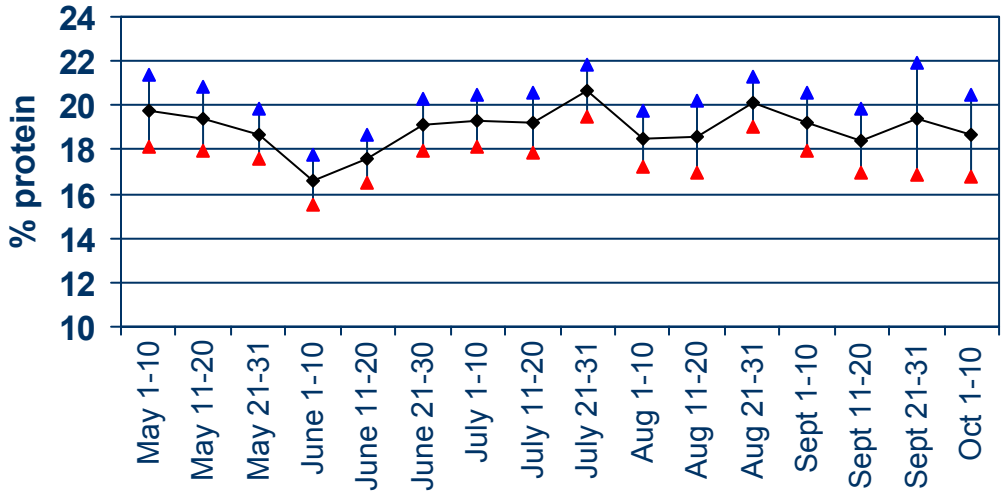
[1] No hay harvested in 1993, 1996-1999. [2] Only partial plot was taken as hay while the rest was grazed.
[2] RFV of 100 = full bloom alfalfa

Long-term Quality

Forage quality has been very good with protein levels fairly steady within the season. Average crude protein was 18.4% across sites and peaked at 21% when grass regrowth was leafy and legumes were prevalent (Figs. 4 and 5). Generally, protein levels dropped as low as 14% during mid-June as grasses matured. The forage quality in the first week on June is significantly lower than in early May or later in the summer when the grasses are predominately leaves.

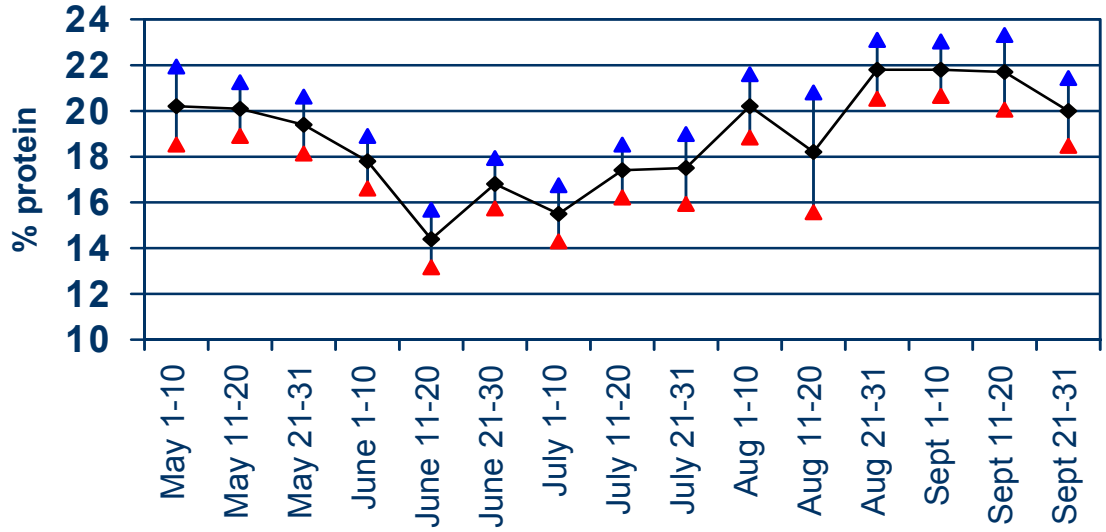
Relative feed value, averaged 123 across sites and years ranging from 100 to 160 (data not shown). (This number underestimates the quality of grass-based forage and in the future the RFQ analysis will be used). Arlington tended to have higher quality grass than LAC at most sampling points perhaps due to a more favorable environment at ARS or better plot management. A RFV between 115 and 130 is considered appropriate for growing heifers between 12 and 18 months like those used in the study.

Fig 4. Pasture crude protein at Arlington over the duration of the trial (the line is the mean for each sample period with 90% confidence interval around each mean).



1 Data from 1993-2004 except no yield data for 1996.

Fig. 5. Pasture crude protein at Lakeland during the first four years of the trial (the line is the mean for each sample period with 90% confidence interval around each mean).



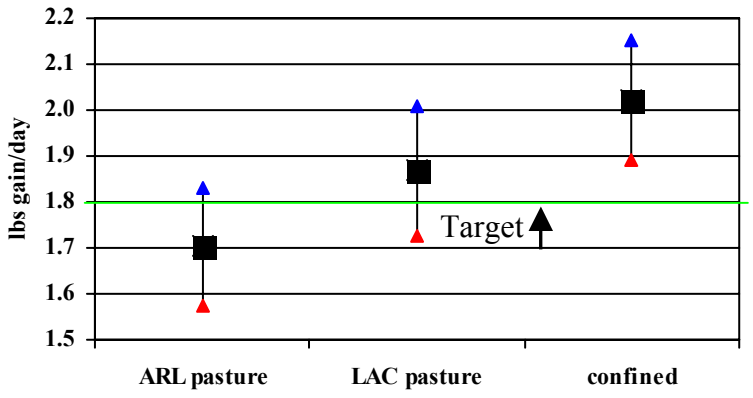
1 Data from 1992-1995.

Heifer performance

Using years as our replication factor for heifer performance, we had 69 animals on the grazing treatment and 65 animals on the confinement treatment at ARL (12 years of data). Fifty-four animals were on pasture at LAC over the duration of the trial (7 years of data). Using 1.8 lb/day weight gain target, grazing at both sites was not statistically different from the goal as shown by the 90% confidence intervals in Fig. 6. However, the mean of 1.7 lb/hd/d is at the low end of performance and it seems that our minimal grain supplementation will continue to be necessary to provide energy. There was a difference between the confinement group and the pasture group

at ARL with the confinement group having significantly more body condition. This can be explained by their high-energy ration and less exercise compared to the pasture group. In general, confinement animals gained 2.2 lb/d or about 20% faster rate than the heifers on pasture. This is in agreement with a study by Tobert and Linn (2002) who found that feedlot heifers gained 23% more weight per day than pastured heifers. The daily ration fed to the confinement group on per heifer basis is typically 11 # alfalfa haylage (18% CP, 63% DM), 5 # corn silage (7% CP, 38% DM) and 5 # of corn-soybean meal-oat mix (16% CP, 90% DM).

Fig 6. Heifer performance under managed grazing compared to confinement with 90% confidence interval around each mean.



CONCLUSION

On the excellent soils at Arlington and good soils at Lakeland, intensive rotational grazing with modest corn supplementation permits dairy heifers to gain weight at close to the recommended 1.8 lbs/head/day. The economics of the conventional alfalfa based hay vs. rotational grazing is presented in the paper '*WICST Forage Systems Comparison: Milk Models and Economics*' within this technical report. Pastured heifers, harvesting their own forage and spreading their manure can substantially reduce labor and feeding costs compared to confinement. However, one must remember that heifers are only on pasture 6 months of the year, which means stored feed must be on hand for winter feeding and extra labor must be added for manure management and some type of housing or shelter should be available against wind and rain.

LITERATURE CITED

Kriegl, T., and R. McNair. 2005. Pastures of plenty: Financial performance of Wisconsin grazing dairy farms. PATS. UW-Madison, February 2005.

Tobert and Linn. Agri-view newspaper article, June 12, 2003.