

WICST FORAGE SYSTEMS COMPARISON:

a. Production, Milk Models and Gross Margins

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INTRODUCTION

Forages play a major role in Wisconsin agriculture. Over 3 million acres of Wisconsin cropland are in alfalfa, grass and clover hay and pasture, similar to the acreage in corn production (WI Ag Stats, 2004). They play a major role in dairy and beef rations as well as horse diets, providing 50 to 100% of the dry matter intake. Furthermore, cropping systems that include forages and manure result in better corn yields vs. strictly cash-grain systems (WICST data not shown). Additional benefits come from the perennial characteristic of forages such as permanent ground cover and thus little soil erosion, expanded wildlife habitat, and aesthetic beauty of a varied landscape. This paper summarizes the three forage systems of WICST comparing forage yield and quality, milk production and gross margins.

MATERIALS AND METHODS

Historical trial data are presented from both the Arlington Research Station (ARL) and Lakeland Ag Complex (LAC) through 2002. There is no data beyond 2002 for LAC as WICST was no longer conducted at that site. System four (CS4) is a high input forage ration with 3 years of alfalfa followed by one year of corn. The alfalfa is sole seeded and herbicides are used to control weeds. Dairy manure is applied with a slinger spreader at the rate of 20 tons/acre before and after the corn phase. During the alfalfa phases, the established alfalfa is on an intensive cutting schedule with 4 cuts to be taken before Sept 15. System five (CS5) is a chemical free system of alfalfa seeded with oats and peas, a production year of alfalfa, followed by a year of corn. Dairy manure is spread at a rate of 15 tons/acre before and after the corn phase. The last cut of the plowdown alfalfa in CS5 is taken during late September to promote winterkill. The pasture (CS6) is a management-intensive rotational grazing system using dairy heifers to harvest their forage and spread their manure. Starting in 2004, exclusion areas (10' x 20') were set up in each pasture plot and mechanically harvested on a haying schedule for a yield comparison to the mechanically harvested alfalfa plots in CS4 and CS5. For more details on the grazing system, see 'Rotational Grazing with Dairy Heifers on WICST: b. Pasture and Heifer Productivity' in this report.

Forage quality was analyzed by UW Soil and Plant Analysis Lab using NIRS technology. In the last few years, relative forage quality (RFQ) has been used, which more accurately reflects the feeding value than relative feed value (RFV) when the forage contains a lot of grass that has a more readily digestible fiber fraction. Milk91 (Howard et al, 1991) was used to summarize 1992-2002 data and Milk2000 (Shaver et al, 2000) was used for 2003 and 2004 where digestibility values were included in the forage analysis reports. MILK91 uses the forage analysis (crude protein, acid detergent fiber (ADF), and neutral detergent fiber (NDF)) to calculate an approximation of a balanced ration using National Research Council (NRC) values. MILK2000 uses forage analyses (crude protein, NDF, *in vitro* NDF digestibility, starch, and non-

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fiber carbohydrate) to estimate energy content and DM intake to predict milk production per ton of forage DM.

The economic analysis is based on the concept of gross margins. Gross margins equal the dollars available to cover the costs of capital, land, and the operator's labor and management once the variable cost of production (seed, fertilizer, chemical, fuel, repairs, etc.) have been paid. Gross margins were calculated using Agriculture Budgeting Calculation Software (ABCS) (Frank, 2000). We would estimate that a dairy farmer would need approximately \$35-\$40 per acre to cover labor and management, \$80 to \$140 per acre for rent, and approximately \$40-\$60 per acre to cover the depreciation and interest cost associated with machinery and drying facilities owned on the farm. This adds up to approximately \$155 to \$240 per acre (or on average ~ \$200/acre) to be covered by gross margins. Therefore, our hypothetical the break-even point is ~ \$200/acre. However, \$200/acre is probably an over estimate for CS6 because of the less capital, depreciation, labor, etc. associated with this system vs. the mechanically harvested systems.

Gross revenue for CS4 and CS5 is based on the actual yield and market price based on forage quality or Relative Feed Value (RFV) during the forage phases, and grain prices during the corn phase. For example, RFV of 140 is used as the base since it is the minimal quality necessary for early lactation, high producing dairy cows (Undersander et al., 1992). This 140 RFV was assigned a price of \$80 per ton of dry matter and any deviations in RFV from 140 were used to adjust the forage price by adding or subtracting \$1 per RFV point. Each cutting from each plot were summed to give an annual gross margin estimate. The machinery complement was dimensioned for a 150-acre farm for both systems

The Stocker Enterprise Budgets for Grass-based Systems (Schuster et al 2001) was used as a model to estimate gross margins for the pasture system (CS6). An informal survey and recent newspaper articles revealed that custom grazing heifer raisers are getting from \$0.85 to \$1.50 per head per day (Agriview, Aug. 18, 2005). The price differential reflects who pays for supplemental feeding, breeding and vet costs. In our analysis, heifer income was based on a rate of \$1.18/hd/d (average of \$0.85 and \$1.50) because we charged supplemental feed to the system but not vet or breeding costs. Farm size was fixed at 150 acres. Heifer expenses (supplemental feed, minerals, labor) and pasture expenses (reseeding, fertilizer, fuel, custom haying, etc.) were then deducted from heifer income. Stocking density was about 1.2 Animal Units/acre for the grazing months (i.e. average heifer weight over season was ~ 650 lbs * 5 head; grazing area of 2.8 acres; 1000 lbs live weight = 1 Animal Unit). It should be realized that the gross margins analysis for CS6 only pertain to the time spent on pasture and not during the off-season when cattle must be fed stored feed. Three difference scenarios are presented to show the effect on grazing GMs when days on pasture, cost of grain supplement, and amount of grain fed are varied.

RESULTS

HAY PRODUCTION

New Seeding. Forage production in the new seedings has differed between systems and years. In 2003, direct seeded alfalfa phase of CS4 produced significantly higher yields and quality than the oat-pea-alfalfa seeding in CS5 (Table 1). This can be explained because 3 cuts were taken from CS4 vs. just 1 cut taken in CS5. Weeds were a problem in that year in CS5 seeding and the

later cuts were mostly weeds and therefore removed and disposed of. Although lower quality than CS4, forage from the seeding year of CS5 produced forage suitable for many classes of livestock including far-off dry cows, unbred heifers, beef cows, horses and other livestock at maintenance nutritional requirements. Due to high potassium in the CS5 forage, particularly the oatlage, it has limited value as a sole-source forage for the transition diet of dry cows because of problems such as milk fever associated with high potassium diets.

Unlike 2003, in 2004, CS4 alfalfa seeding produced significantly less yield (albeit higher quality forage) than the CS5 oat-pea-alfalfa seeding (Table 1). Both systems were harvested two times but record rainfall (3x the norm for May) likely reduced seedling vigor by hastening root disease in the sole-seeded alfalfa. At the same time, the oats and peas in CS5 responded favorably to high moisture and produced over 2 ton/acre of forage. Pasture forage was not compared since there is not a newly seeded phase in that system.

	System	Yield (T dm/a)	RFV	RFQ	Protein %
2003	CS4 (c- a -a-a)	2.91a*	186a	208a	22.4a
	CS5 (c- o/p/a -a)	2.30a	112b	147b	16.7b
2004	CS4 (c- a -a-a)	1.85y	166y	172y	21.0y
	CS5 (c- o/p/a -a)	4.35z	107z	145z	13.9z

*Different letters within column for each year are statistically different at $p < 0.01$

Established Alfalfa. In 2003, alfalfa yield produced in CS4 was significantly lower than in CS5 (Table 2). Though, CS5 alfalfa was lower in forage quality than CS4 alfalfa, it was still very good quality even for high producing dairy cows. Protein levels were all above the minimum of 16.5% recommended for lactating dairy cows (NRC of dairy, 2001).

In 2004, forage yields were similar across systems (Table 2). With plenty of rainfall and soil moisture this spring, established forages thrived. Four cuts were taken from CS4 and 3 cuts from CS5 and the pasture. Impressively, pasture quality was better than the alfalfa in CS5 and it could have been higher if it were harvested on a grazing vs. a haying schedule.

	System	Yield (T dm/a)	RFV	RFQ	Protein %
2003 [‡]	CS4 (c-a- a -a) A1	4.83b*	166a	186a	21.1a
	CS4 (c-a-a- a) A2	3.37c	162a	181ab	19.8b
	CS5 (c-o/p/a- a) A1	5.94a	150c	173b	19.6b
2004 [§]	CS4 (c-a- a -a) A1	5.08z	157a	175a	22.5a
	CS4 (c-a-a- a) A2	5.15z	155a	173a	21.9a
	CS5 (c-o/p/a- a) A1	4.88z	110c	127c	17.2c
	CS6 (pasture)	5.48z	132b	156b	19.4b

*Different letters within column for each year are statistically different at $p < 0.01$

[‡] CS4 2nd yr hay was only cut 3 times vs. other systems which were cut 4 times.

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ESTIMATED MILK PRODUCTION

Estimated milk production is a function of dry matter production and quality. Milk production in 2003 was higher for CS4 seeding vs. CS5 seeding due to higher yield and quality (Table 3). In the established plots, milk production was similar between systems except that the final year of CS4 alfalfa was lower because only 3 cuts were taken vs 4 cuts in the other plots.

In 2004, greater yield with average quality produced 2.5 times more milk from CS5 oats-peas-alf than the pure alfalfa seeding in CS4 (Table 3). In the established phases, one less cut in CS5 resulted in lower milk production compared to CS4. Excellent pasture quality and yields produced abundant milk.

	2003	2004
	Milk production (lb/acre)	Milk production (lb/acre)
CS4 new alf seeding	9,162 _x	5,444 _z
CS5 oat/alf seeding	7,052 _y	13,809 _y
CS4 1 st prod yr of hay	14,093 _a	15,543 _a
CS4 2 nd prod yr of hay	10,368 _b	15,803 _a
CS5 1 st prod yr of hay	17,378 _a	13,599 _b
CS6 12 th yr of pasture	N/a [‡]	16,752 _a

*Different letters within column for each year are statistically different at p<0.01

[‡] No hay enclosure data in 2003.

Looking at the forage data over the course of the trial, results from the MILK91 analysis showed no significant differences between systems within each site (Table 4).

	Milk production (lb/acre)	
	ARL (through 2002)	LAC (through 1998)
CS4 direct seeded alfalfa	6,150	4,740
CS5 oats/peas/alfalfa [‡]	6,200 NS*	4,350 NS
CS4 Hay 1 vs.	9,740	8,380
CS5 Hay 1 [§]	10,460 NS	8,810 NS
CS4 Hay 1	9,590	8,390
CS4 Hay 2 [¶]	8,860 NS	8,470 NS

*NS= not significant at p<0.10; linear contrasts are for each site (LSMeans)

[‡] 1990 first year of data; no data for 1991 and 1993 because oats were harvested as grain.

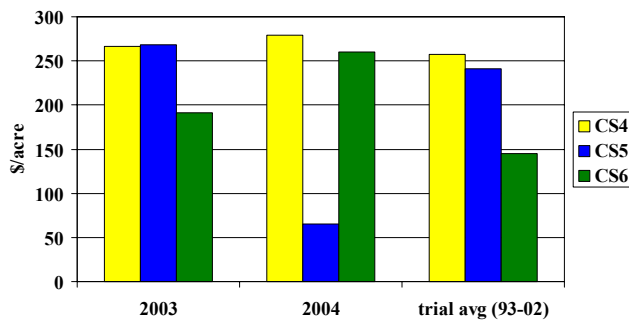
[§] 1991-first year of data.

[¶] 1992- first year of data.

GROSS MARGINS

Integrating forage yield and quality not only serves to estimate milk production, but it also is the basis to determine gross revenue and therefore gross margins. Figure 1 shows the gross margins in 2003 and 2004 and the trial average for the 3 forage systems. In 2003, gross margins were about equal between CS4 and CS5 averaging \$267/acre. However, due to the droughty summer of 2003, supplemental hay had to be fed to heifers for about a month thus reducing CS6 gross margin to \$191/acre. However, all three systems were at or above the long-term trial mean in 2003. In 2004, the failure of replanted corn stand in CS5 reduced gross margins to just over \$50/acre. The pasture was as profitable as the high-input alfalfa system of CS4 since less capital (machinery, interest, depreciation, etc.) and labor are required in the grazing system. For more information on the calculation of the pasture gross margins, see the WICST 9th Technical Report (2003) on page 35.

Fig. 1. 2003 & 2004 forage system gross margins vs. 10-yr trial mean at ARL



SCENARIOS THAT EFFECT GM OF GRAZING

Days on Pasture. The average number of days on pasture at Arlington is 135, well short of a full growing season. Table 5 shows the effect on GM by keeping the heifers on pasture for more days of the year. A producer can make about \$1.70/day for each day beyond 140 days. Maximizing days on pasture reduces overall yearly feeding costs and manure handling. However, wind and rain protection should be provided if heifers are going to be out on pasture in April or late October when cold, driving rain can negatively impact heifer performance. Further, shade should be available to help alleviate heat stress in the summer.

# days on pasture	Removal date	Gross margin per acre
140	Sept 17	\$182
150	Sept 27	\$199
160	Oct 7	\$216
170	Oct 17	\$233
180	Oct 27	\$250

assumptions: \$1.18/hd/d, 2 # grain/hd/d @ \$0.087/lb, 1 hr labor/d @ \$10/hr, no hay fed

Cost of grain. Another factor that affects GM is the cost of supplemental grain. Grain cost can vary depending on the source of corn. If a grazier has access to corn at close to the costs of production, then the concentrate and mineral mix (including mill charge) is about \$0.087/lb. However, if the corn must be purchased, then the cost of grain mix increases to \$0.15 to 0.20/lb, depending on market price. In WICST Technical Report #9 (2000 and 2001), the annual purchase price for corn was used for the years 1992-2002. If we assume 170 days on pasture, \$1.18/hd/d income, 1 hr labor/d @ \$10/hr, and 2 lbs grain fed per hd per day using \$0.087/lb and \$0.175/lb, gross margins increase from \$180 to \$233/acre by using the less expensive grain. It would be hard to justify paying higher grain rates if the income was less than \$1.18/hd/day. If cheaper corn could not be found, then the grower might think about reducing the amount fed by focusing on feeding at times of high energy needs such as early spring when the weather can be cold and wet.

Amount of grain fed. Table 6 shows the effect of reducing the amount of grain fed from 100%, which is 2 lb/hd/day all season. For example, assuming 170 days on pasture, the 50% reduction rate would equal feeding 2 lb/hd/d for all of May and June and 25 days in October, the most obvious times that heifers would need supplemental energy.

Table 6. Effect of grain supplementation* on GM.

Grain fed	Gross margin (per acre)
100%	\$233
75%	\$246
50%*	\$259
25%	\$273

* grain held at \$0.087/pound

CONCLUSION

Forages are an important component of dairy based agriculture. WICST data has shown that both chemical free forage production (CS5), as well as rotational grazing (CS6) are both highly productive systems with suitable quality forage for many classes of livestock. The alternative systems on WICST could successfully be included on any livestock farm as milk production was shown to be very similar between systems. Good productivity and reduced inputs have made these alternative systems economically competitive with the high input, pure alfalfa system (CS4). Comparing scenarios shows the importance of keeping the animals on the paddocks for a full 170 days and assuring a source of inexpensive corn. Reducing the amount or timing of corn fed to the animals will become a priority if heifer weight gains begin to surpass the target 1.8 lbs/day.

CITATIONS

Agri-view Newspaper. Aug. 18, 2005. 'Dairy' section. "Jaeger happy Raising Replacement Heifers on Grass. By Ron Johnson. Vol. 31 No. 33.

Frank, G., and R. Gregory. 2000. ABCS, v. 7.1. Center for Dairy Profitability, Dairy Sci. Dept. UW-Madison.

WICST 10th Technical Report

Hedtcke, J., and J. Posner (eds). 2003. WICST 9th Technical Report, 2001& 2002.

Howard T., R. Shaver, and D. Undersander. 1991. Milk91 for Combining Forage Yield and Quality into a Single Term. <http://www.uwex.edu/ces/forage/pubs/milkac.htm>

Nutrient Requirements of Dairy Cattle, 2001. National Academy Press. Washington D.C.

Shaver R., D. Undersander, E. Schwab, P. Hoffman, J. Lauer, D. Combs, and J. Coors. 2000. MILK2000: Combining Yield and Quality into a Single Term. <http://www.uwex.edu/ces/forage/pubs/milk2000.htm>

Schuster, D., D. Undersander, D. Schaefer, R. Klemme, M. Siemens and L. Smith. 2001. Stocker Enterprise Budgets for Grass-based Systems UW-Extension publication A3718

Undersander, D., R. Hintz, T. Howard, M. Hutjens, L. Kilmer, J. Linn, N. Martin, and R. Shaver. 1992. Alfalfa for dairy animals: Revised edition. Produced by Certified Alfalfa Seed Council, Inc, Davis, CA.

WI Agricultural Statistic Service (DATCP, USDA), 2004.