

Impact of alfalfa and fertilizer on pastures:

Cow-Calf Productivity and Forage Quality

Introduction

Forage quality and cow-calf productivity are strongly linked. By using high quality grass pastures, one can increase the animal gain per acre and/or gain per head.

Research Study

A four-year study was conducted at the Agriculture and Agri-Food Canada Research Centre in Brandon, MB in collaboration with the University of Manitoba's Department of Animal Science. The goal of the study was to determine the effect of adding alfalfa and/or fertilizer on the productivity and forage quality of grass-based pastures and the resulting impact on cow-calf productivity.

Table 1. Pasture Types and Fertilizer Treatments Used in the Study

1) Meadow bromegrass No added fertilizer	3) Meadow bromegrass + Alfalfa No added fertilizer
2) Meadow bromegrass + Fertilizer	4) Meadow bromegrass + Alfalfa + Fertilizer

In the spring of 1994, pastures were established on a Souris fine sandy loam. The study used rotational grazing on four combinations of pasture type and fertilizer management. There were two different pasture types (100% grass or mixed alfalfa/grass) and two different fertilizer treatments (no fertilizer, or spring fertilization to full soil test recommendation levels). This resulted in a total of four treatments, shown in Table 1.

The grass-only pastures were seeded with 10 lb/acre meadow 'Paddock' bromegrass. The mixed alfalfa/grass pastures were seeded with 7 lb/acre 'Paddock' meadow bromegrass and 3 lb/acre 'Spredor II' alfalfa. Starting in 1995, fertilizer was surface-applied as a dry blend prior to grazing each spring. The concentration of each nutrient in the blend was based on soil samples collected the previous fall.

Pastures were rotationally grazed by lactating beef cows and stocking rates were adjusted to provide the same amount of forage for all cattle. Forage quality was determined when the cows entered and exited the pastures.

Study Results

Pasture Productivity

The alfalfa content in the mixed pastures decreased by approximately 50% during the four-year study. Alfalfa content was initially 80% (by weight) of the stand, but by the fourth year, the alfalfa content was only 40% of the stand.

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Table 2 shows the forage yield of the different pasture and fertilizer treatments in tons/ac of forage dry matter. Figure 1 shows the pasture yields converted to bales per acre.

Averaged over the four years of the study, fertilized grass-only pastures yielded 0.9 tons/acre more than unfertilized grass-only pastures, doubling the yield. Using a combination of alfalfa in the pasture mix plus fertilization improved yield by 0.8 tons/acre compared to unfertilized grass-only pastures. The small yield differences between the fertilized grass-only pastures and unfertilized alfalfa-grass pastures, and between the unfertilized alfalfa-grass pastures and unfertilized grass-only pastures, were not large enough to be significant.

Forage Quality

Forage quality is affected by many different variables including fertility, pasture type, weather conditions, and grazing management. Adding alfalfa or fertilizer to grass-based pastures had variable effects on forage quality.

Table 3 shows the average forage quality for the different pastures between 1995 and 1997 (forage quality was not measured in 1998). The most important difference to note is that unfertilized grass pastures consistently had the lowest level of crude protein (7%). A 1400 lb beef cow, five months after calving, producing 11 lbs of milk per day, requires at least 8.3% crude protein (Source: National Research Council, 1996). As a result, unfertilized grass-only pastures did not meet the nutritional requirements of lactating beef cows.

Unfertilized grass-only pastures also had high levels of fibre and low levels of total digestible nutrients (TDN) compared to pastures with added alfalfa or fertilizer.

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Cow Performance

The cows' forage intake was very similar for all pasture types (Table 4). Despite some differences in forage quality, cow weight gain or loss was similar when grazing alfalfa-grass pastures and fertilized grass-only pastures.

Table 2. Forage Yield (Tons Dry Matter per Acre) of the 4 Pasture Treatments

Year	Grass-only Unfertilized	Grass-only Fertilized	Alfalfa-grass Unfertilized	Alfalfa-grass Fertilized
	----- Tons dry matter per acre -----			
1995	0.9	1.5	1.3	1.4
1996	1.0	2.1	1.5	1.8
1997	0.8	1.3	1.2	1.3
1998	0.8	2.1	1.6	2.4
Average	0.9	1.8	1.4	1.7

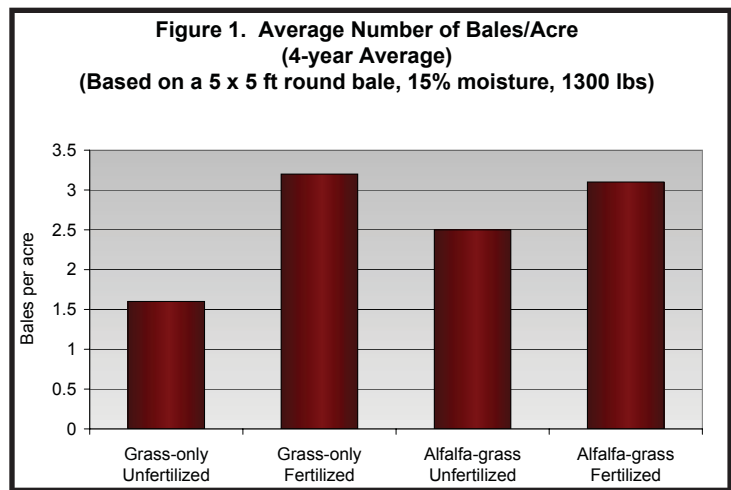


Table 3. Quality of Forage Samples (% Dry Matter)

	Grass-only Unfertilized	Grass-only Fertilized	Alfalfa-grass Unfertilized	Alfalfa-grass Fertilized
Crude Protein (CP)	7%	9%	10%	11%
Neutral Detergent Fibre (NDF)	67%	68%	59%	60%
Acid Detergent Fibre (ADF)	43%	41%	42%	40%
Total Digestible Nutrients (TDN)*	55%	57%	56%	58%

*ADF was used to estimate TDN.

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The average cow weight changes were small and ranged from a gain of 0.23 lb/day for the cows grazing the fertilized grass-only pastures to a loss of 0.16 lb/day for the cows on the unfertilized grass-only pastures. Lactating beef cows grazing either of the unfertilized pastures lost body weight.

Calf Performance

Calf performance was improved by adding alfalfa, fertilizer, or both, to grass-

only pastures. Table 5 shows that the calf gain per acre was greatest for fertilized grass-only pastures, followed by fertilized alfalfa-grass pastures. Although lower than the fertilized pastures, unfertilized alfalfa-grass pastures also showed improvements in calf gain per acre over unfertilized grass-only pastures. The 1998 values are not included in Table 5 because information on milk production and forage quality was not collected in 1998.

Calf average daily gain (ADG) was lower for the unfertilized grass-only pasture compared to all the other treatments, probably due to the high fibre content of the forage from this pasture.

Cost-Effectiveness of Fertilizing Pastures

The pastures that were fertilized resulted in increased financial risk.

Fertilization was only cost-effective when pastures received an abundance of rainfall during the grazing season.

Unfertilized alfalfa-grass pastures were cost-effective because there was no fertilizer expense.

Table 6 shows the additional carrying capacity (measured as cow grazing days per acre) resulting from adding alfalfa and/or fertilizer to unfertilized grass-only pastures. To calculate this, the cow-days per acre for the unfertilized grass-only pasture were subtracted from the cow-days per acre for each of the improved pastures.

Incorporating alfalfa into grass pastures without the application of fertilizer increased cow-days per acre by 28%. The forage quality in unfertilized alfalfa-grass pastures met the nutritional requirements of lactating beef cows, without any fertilizer expense. The main concern that farmers have about including alfalfa in their pastures is the risk of bloat. However, it should be noted that during the four-year experiment, of the 180 cows that grazed the alfalfa-grass pastures, none experienced bloat, even when the alfalfa was 80% of the stand. Management of grazing alfalfa is the key to reducing the risk of bloat.

Table 4. Cow Dry Matter Intake

	Grass-only Unfertilized	Grass-only Fertilized	Alfalfa-grass Unfertilized	Alfalfa-grass Fertilized
Cow dry matter intake (% of body weight)	2.5%	2.3%	2.4%	2.3%
Cow dry matter intake (lb/day)	30.4	29.8	28.7	28.2

Table 5. Calf Average Daily Gain (ADG) and Gain Per Acre (1995-1997)

	Grass-only Unfertilized	Grass-only Fertilized	Alfalfa-grass Unfertilized	Alfalfa-grass Fertilized
Calf Gain (lb/acre)	115	183	141	160
Calf Average Daily Gain (lb/day)	2.3	2.4	2.4	2.4

Table 6. Additional Cow-Days per Acre Produced by Adding Fertilizer and/or Alfalfa to Unfertilized Grass-only Pastures

Year	Grass-only Fertilized	Alfalfa-grass Unfertilized	Alfalfa-grass Fertilized
	Additional cow-days per acre compared to unfertilized grass-only pastures		
1995	16	9	12
1996	32	0	15
1997	27	15	20
1998	57	37	74
Average	33	15	30

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Table 7. Cost of Fertilizer per Additional Cow-Day/Acre Produced by Adding Fertilizer and/or Alfalfa to Unfertilized /Grass-only Pastures (Spring 2007 Prices)

Year	Grass-only Fertilized	Alfalfa-grass Unfertilized	Alfalfa-grass Fertilized
	Fertilizer cost per additional cow-day/acre compared to unfertilized grass-only pastures		
1995	\$3.70	\$0	\$2.60
1996	\$2.04	\$0	\$1.58
1997	\$2.34	\$0	\$0.66
1998	\$0.89	\$0	\$0.56
Weighted Average	\$1.80	\$0	\$0.91

Fertilizing grass pastures or adding both alfalfa and fertilizer increased cow-days per acre by 60%. The forage quality in fertilized pastures also met the nutritional requirements for lactating cows.

Table 7 shows the cost of each additional cow-day per acre produced by adding either fertilizer or alfalfa, or both, to unfertilized grass-only pastures. Fertilizer prices are for spring 2007 (\$0.50/lb N, \$0.38/lb P, \$0.22/lb K, \$0.34/lb S), plus the cost of custom broadcasting granular fertilizer (\$5.25/acre). The weighted average shown in Table 7 takes into account the year-to-year variation in fertilizer costs

and cow-days per acre. The weighted average was calculated in the following way: first, the cost of fertilizer for each year was added together to determine the total cost. Then the total fertilizer cost was divided by the total increase in cow-days per acre between 1995 and 1998.

Conclusion & Recommendations

Adding alfalfa, fertilizer, or both to meadow bromegrass pastures increased calf average daily gain (ADG) when compared to unfertilized meadow bromegrass-only pastures. Compared to unfertilized grass-only pastures, fertilized grass-only pastures showed the most dramatic improvement in forage yield, resulting in the greatest increase in total calf weight gain per acre. Fertilizing meadow bromegrass pastures was therefore the most productive strategy as measured by calf gain per acre. However, using alfalfa to supply nitrogen instead of fertilizer also improves calf productivity without the financial risk associated with uncertain calf prices and production-limiting moisture conditions.

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Editor/Design: Corie Arbuckle, Corie Communications.

Sources:

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* This technical bulletin is part of a series that have been developed as a result of this collaborative study.