The Effect of Winter Cattle Feeding Systems on Soil Nutrients, Forage Growth, Animal Performance, and Economics

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Introduction

Beef cattle producers in Western Canada compete at an economic disadvantage relative to other regions in North America due to high winter feeding costs. Our ability to compete with these regions may relate to how effectively we can reduce these costs by managing manure nutrients, machinery use and fuel/fertilizer consumption more efficiently yet still maintain acceptable levels of beef cattle production. Producers have been responding to these issues by moving from traditional wintering systems in which the cattle are kept in pens and the manure is hauled out to those in which the cattle are fed in the field and the nutrients stay in place.

A key factor in managing manure nutrients is that cattle keep little of the nutrients in their feed and conventional intensive methods of managing beef cattle are generally poor at capturing what is expelled. For example Bierman et al. (1999) found that of the total nitrogen fed to feedlot steers only 9 to 10% was retained in the animals. Of the huge amount of N excreted, only 9 to 19% was removed in the manure when the pens were cleaned out. Most of the losses were assumed to be from volatilization of urine ammonia.

In this trial extensive and intensive cattle feeding systems were compared for their effects on pasture nutrient distribution, forage growth, animal performance, and economics. In the extensive system cattle were fed on the pasture itself by either bale processing or bale grazing methods and the manure was deposited directly. In the intensive system cattle were fed in the yard and an equivalent amount of manure per acre was spread on the pasture in either a raw or composted state. Measurements were taken of soil nutrient levels, residue levels, pasture forage growth, cattle weight and condition, feed consumption, and economic factors.

Materials and Methods

The trial was started in the fall of 2003 and was conducted at the Termuende Research farm in east central Saskatchewan, near the town of Lanigan. Two 2 hectare winter feeding areas were laid out with electric fence in an old pasture of Russian wild-rye grass (Figure 1). A geothermal winter watering system was dug in and placed in the center of the two feeding areas. Alternating hay and straw bales were set out in the west area in preparation for winter feeding by bale grazing, while the east area was left empty in preparation for winter feeding with a bale processor. The area of the winter feeding areas was calculated to result in the cows applying 67.3 tonnes/ha of manure on the pasture over the winter.

A replicated site for spreading manure and compost on the pasture was set up at the same time. This consisted of raw manure, compost and check strips 30m long by 5m wide and arranged side by side in a replicated complete block design. All sites were sampled for background nutrient levels. Raw manure was then spread at 67.3 tonnes/ha while compost was spread at 22.4 tonnes/ha.

Sixty-four cattle were brought onto the pasture on November 22nd after being weighed and condition scored. They were kept there until the end of March, and were weighed each month. Feed use and the time and equipment used feeding were noted. Thirty-six cattle were also fed November to March in the intensive drylot in the Termuende farm yard, with the same measurements taken.

In the spring all sites were sampled for soil and residue nutrient levels. Forage growth was measured in the summer and fall.

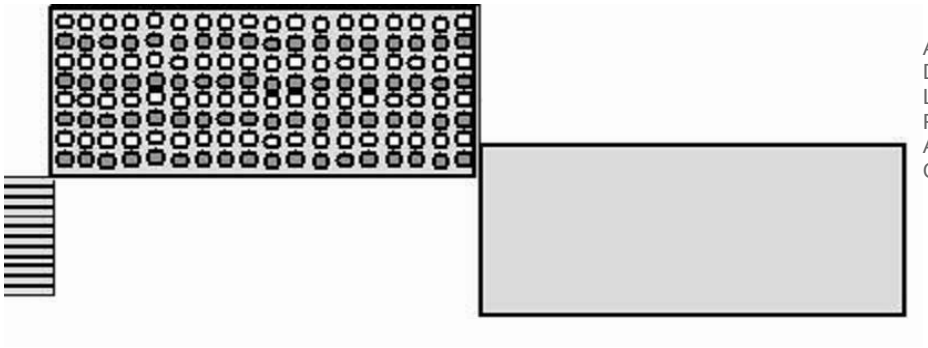

Figure 1. Diagram of trial site at the beginning, showing (from left to right): the replicated strips for spread raw manure, compost, and check treatments; the bale grazing winter feeding area with alternating hay and straw bales in place; the central waterer; and the bale processing feeding area.

Results and Discussion

Soil inorganic N levels (Table 1, Figure 2) were noted for large increases in the spring where the cattle were wintered and very small increases where manure or compost was spread. K levels showed the same types of increases and similar patterns. The large gain in nutrient capture to on pasture winter feeding was surprising considering the amount of manure per hectare was calculated to have been the same.

Table 1. Soil Inorganic Nitrogen Levels Spring 2004 in the 0-6 inch depth, lbs/acre

	Mean	% of Check	Range	
			Low	High
	N03 N plus NH4 N			
Bale Processing	166.6 a	375	13.2	558.5
Bale Grazing	130.6 b	295	11.1	483.8
Spread Composted	50.9 c	115	32.8	51.9
Spread Raw	40.1 c	90	8.7	53.4
Check	44.3 c	100	13.7	51.7
LSD .10, 32.1 lbs/acre				

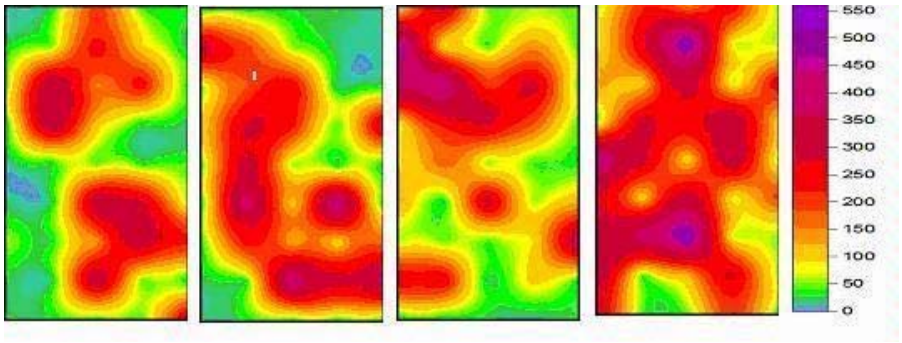

Figure 2. Soil inorganic N patterns from intensively soil sampled 40 ft X 66 ft areas on the winter feeding sites. From left to right, bale grazing west, bale grazing east, bale processing west, bale processing east. The sample area dimensions were calculated to enclose one straw and one hay bale on the bale grazing.

Forage growth was increased in all treatments as compared to the check (Table 2). Growth in the spread manure areas was early and even, with the composted manure giving a noticeable gain over the raw manure. Where the cattle were fed growth was later due to heavier residue but stronger and held its quality much later in the year, however there were gaps in grass growth where the hay and straw residue were excessively heavy as the Russian Wild Rye (a bunchgrass) showed limited ability to grow through the heaviest residue. Forage protein content almost doubled where the cattle were fed on the field. Despite the problems with the less than ideal grass species selected, yield under the pasture feeding systems still was significantly higher than that of the spread manure treatments.

Table 2. Total forage yield and quality in the season following the treatments, two cuts taken.

	Dry Matter Yield		Protein Content		Protein Yield	
	lbs/acre	% of check	%	% of check	kg/ha	% of check
Bale Processing	4206 a	297	18.5	181	650	488
Bale Grazing	3319 b	235	17.2	169	499	375
Spread Composted	2460 c	174	7.9	77	180	135
Spread Raw	2085 c	147	10.6	104	204	153
Check	1414 d	100	10.2	100	133	100
LSD .10, 625 lbs/acre						

Cattle weigth and condition changes were small and were not significant between the cattle in both pasture feeding treatments and those in the yard.

Table 3. Cattle Weight Change

	Weight Nov	Weight Feb	Change
	lbs	lbs	lbs
Bale Processing (Nov 17/18 to Feb 22)	1394.4	1441.8	47.4
Bale Grazing (Nov 17/18 to Feb 22)	1400.1	1464.5	64.4
Dry Lot (Nov 3/4 to Feb 4)	1308.9	1335.8	26.9

Economic calculations favoured infield feeding. Feed costs were similar between the systems but infield feeding had savings in machinery use and manure handling costs, and gains in pasture productivity.

Table 4. Cost Breakdown of the Different Feeding Systems ($/cow/day)

	Bale Grazing	Bale Processing	Dry lot (raw)	Dry Lot (compost)
Feed and bedding	1.22	1.19	1.19	1.19
Machinery	.03	.12	.22	.22
Manure Removal	0	0	.03	.13
Total	1.24	1.31	1.44	1.54
Manpower	.07	.04	.04	.04
Total	1.31	1.35	1.48	1.58
Pature Growth	.22	.31	.06	.09
Final Total	1.09	1.04	1.42	1.49

Conclusions

There were significant benefits to winter feeding cattle directly on pasture in this trial, including much greater capture of N and K and reduced equipment use.