Nutrient cycling in winter grazing cattle on pasture; three years following bale grazing.

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Introduction and background:

Perennial pastures are typically low in fertility which results in reduced productivity. On the other hand manure from livestock over wintering in confinement is nutrient rich and expensive to apply to fields. Bale grazing forage to cattle directly on fields/pastures during the winter time offers the opportunity to add much needed fertility to perennial pastures and reduces manure disposal costs related to over wintering cattle in confinement. Bale grazing allows livestock to return a large proportion of the nutrients they consume directly to the landscape where they are fed. It reduces feeding time and costs normally associated with feeding livestock in confinement during the winter months as well as saves on the manure removal costs to the operation. Manure and feed leftovers contain valuable nutrients that become available over time to annual or perennial crops which improves forage productivity and quality.

This project started before bale grazing was applied in 2007 with funding from the Covering New Ground (CNG) program and the Pembina Valley Conservation District (PVCD). In 2008, funding was provided by the Livestock Stewardship Initiative (LSI) program and the PVCD. In 2009 and 2010, funding was provided by the Agricultural Sustainability Initiative (ASI) and the PVCD. This project was designed to measure and to monitor the soil nutrient levels of ten differently and independently managed bale grazing sites.

Methodology:

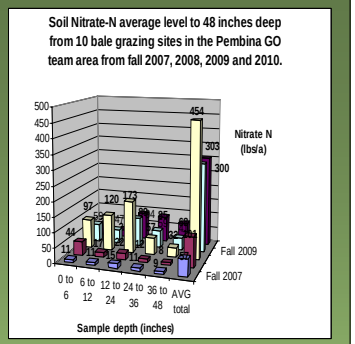
The ten established perennial pasture sites involved in this project were initially soil sampled to a depth of 48 inches in the fall of 2007 to determine the nutrient level of each pasture before bale grazing. Each cooperator bale grazed their herd in the fall 2007 to early winter 2008. In the summer of 2008, October 2008 and October of 2009 each site was soil sampled to 48 inches depth to compare to the earlier soil sample results. In 2007 and 2008, six core samples were taken at each site to form a composite sample for each sampling depth. In 2009 and 2010, ten sub-samples were collected at each site, within the bale grazed zone, to form a composite sample. Bale grazed sites varied in size from 3 to 14 acres. Each site belonged to a different owner and was managed independently from the others.

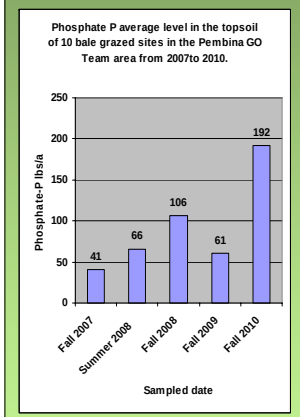
Forage samples were hand clipped in the bale grazed green zones and compared to samples collected in-between or away from the bale grazed zones to compare feed quality.

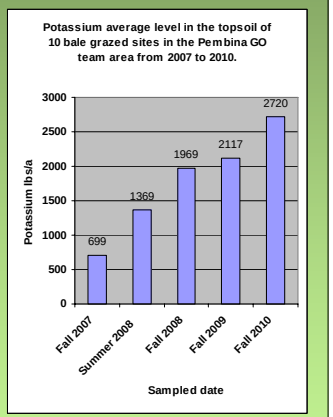
Soil nutrient trends

Table 3- Summary of soil analysis results from bale grazing sites sampled in the Pembina GO Team area

	Fall 2010	Fall 2009	Fall 2008	Summer 2008	Fall 2007
	Average n=8	Average n=10	Average n=10	Average n=10	Average n=10
Nitrate-N (inches)	lbs/a	lbs/a	lbs/a	lbs/a	lbs/a
0 to 6	37	59	97	44	11
6 to 12	24	47	120	17	11
12 to 24	89	94	173	22	15
24 to 36	85	59	57	12	11
36 to 48	68	41	32	8	9
	303	300	454	101	57
Phosphate-P (0 to 6 inches)					
ppm	79	31	53	33	20
lbs/a	159	61	106	66	41
Potassium (0 to 6 inches)					
lbs/a	2376	2117	1969	1369	699
Sulfate-S (inches)	lbs/a	lbs/a	lbs/a	lbs/a	lbs/a
0 to 6	65	192	127	136	225
6 to 12	292	601	334	319	644
12 to 24	1187	2143	1760	1389	2604
24 to 36	1304	2127	2086	2050	1999
36 to 48	1458	2120	1920	2251	1484
	4306	7183	6227	6145	6957
Topsoil OM (%)	5.81	7.09	6.76	5.94	6.37
Topsoil pH	7.69	7.61	7.54	7.83	7.45
Top soil EC (ds/m)	0.33	0.55	0.56	0.5	0.53







Soil nutrient summary and analysis:

All sites investigated were bale grazed once in winter 2008 on established perennial forage stands. Only one of the sites was bale grazed before while all the others were bale grazed for the first time. Site size varied from 3 acres to 14 acres. Bale density varied from 2 to 56 bales per acre; all round bales. 10 sites were investigated from 2007 to 2009 which dropped to 8 sites in 2010 due to a change of land management practice on two of the sites.

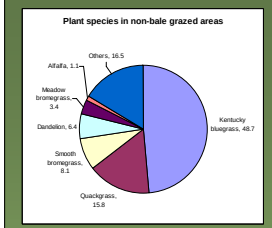
The soil samples were collected in the fall time inside the greener zone created by the bale grazing effect.

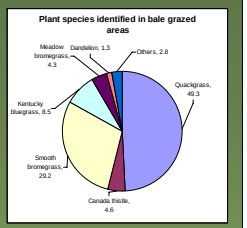
Nitrogen, phosphorus and potassium soil nutrient levels increased dramatically in the top four feet of the soil profile within one year after bale grazing. Those Nutrients remain elevated in the soil profile but seem to be stabilizing or dropping after the second and third year of forage growth and harvest either as hayed or pastured.

Residual nitrogen appeared to be moving through the soil profile but has remained mostly within the top four foot depth three years after bale grazing. 2010 was a higher than normal for seasonal rainfall.

Due to the rapid increase in soil nutrients after bale grazing, bale grazing should not be done on the same site until nutrient levels drop and forage productivity slowed. Soil testing should be done regularly on bale grazed sites to monitor the residual nutrient levels in years following bale grazing.

Plant species trends

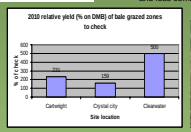




The non-bale grazed sites had more species diversity and were dominated by Kentucky bluegrass. There were an average of 9 species per site

On bale grazed sites, species diversity decreases and has an average of 6 species per site. Quackgrass was the most dominant grass or on some sites smooth bromegrass. Kentucky bluegrass completely disappears or is a less dominant species after bale grazing. Canada thistle is more prevalent on bale grazed sites (5 sites) and less common on non-bale grazed sites (2 sites)

Plant identification and analysis provided by Jane Thornton, Range and Pasture specialist, MAFRI



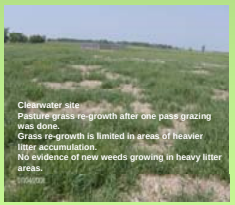
Bale grazing near Clearwater, Manitoba

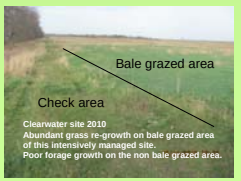
2007 site setup in Clearwater, Manitoba:

Site location	**Clearwater West**
Area bale grazed	**13 acres**
# bales set out	**728 large rnd**
# bales /acre:	**56**
# heads grazed:	**200**
# days grazed:	**150**
Soil type	**Sandy loam**
Ag Capability	**4M**

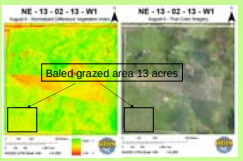
This site is part of a 160 acre parcel of land subdivided into numerous paddocks for rotation grazing in the summer time. In 2010 this site was grazed once in the fall.

Above, Clearwater site 2010:
Lush forage growth during the summer



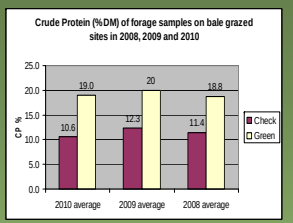


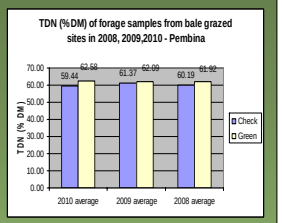
Aerial imagery of the site in 2010:

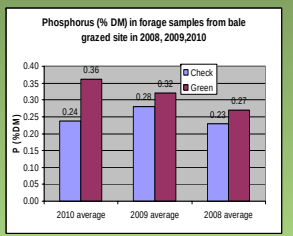


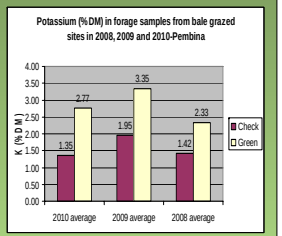
Forage quality in Bale Grazing systems

Nutrients from forage fed to cattle on pasture are returned to the pasture in the form of urine, feces and feed litter. Plant growth responds very rapidly to improved soil fertility resulting in increased forage quantity and quality. Feed analysis results from forage samples collected on 7 of the 10 sites monitored in this project are summarized in the graphs below. Crude protein and potassium increased the most compared to the check areas. Total Digestible Nutrients (TDN) and phosphorus increased slightly compared to the check areas.









Forage summary and observations

Bale grazing was considered as very beneficiary by all cooperators involved in this project. They all continue the practice at a comparable level or on a larger scale.

Forage yield was measured on some sites in 2010. Forage yield was consistently higher on the bale grazed areas compared to the check. Relative dry matter (DM) yield ranged from 159% of check to over 500 % of the check area.

Sites with the highest bale densities had more uniform plant growth across the pasture area.

Three years after bale grazing was applied, pasture growth, protein level and potassium content remain elevated in plants sampled in the bale grazed, greener zones, compared to the check. TDN and phosphorus remained almost unchanged in the greener zones compared to the check.

Feed litter and manure accumulated most where a bale was grazed and tended to delay forage re-growth the first year after bale grazing was done. Sometimes heavy litter cover prevented plant re-growth completely but only on a very small area. In 2010, those heavy residue areas are not visible anymore being completely covered by plant growth.

Little to no new weed growth appeared on the bale grazed areas after the first year of bale grazing. Weeds already present tended to benefit from the added nutrients and grew larger initially (dandelions at one site). After three year of bale grazing, established perennial grasses have taken over and dominate those areas.

The plant population in the green zones is changing after bale grazing was applied; only a couple of grass species (brome grass and quack grass) tend to dominate the area bale grazed as compared to a broader variety of plant species in the check areas. Similar findings in the 2009 and 2010 surveys.

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