Manitoba
Agriculture, Food
and Rural Initiatives

Manitoba Beef Review

Volume 4, Issue 1 *MAFRI - Animal Industry Branch* *Spring 2004*

Using limit fed straw based rations to reduce methane emission, manure quantity and cost of production in a wintering cow/calf herd

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Background:

Drought cycles run their course ever since we have known agriculture and nature to exist. This usually means less pasture and higher prices for feed and at times unreasonable distances to haul hay or straw. Therefore, at times it is logical to limit feed roughages in conjunction with grains/concentrate feeds if grains are at the low of their price cycle. Never before, though, did producers have to face both drought and effects of BSE. With the crisis in 2003, producers were unable to sell excess stock without taking a big loss, all the while trying to deal with drought. The mandate under Green House Gas Mitigation suggests that substituting poor quality roughage with high energy feeds can aid in the reduction of methane emitted from beef cows. Previous research and data collected by the University of Alberta and Alberta Agriculture, Food and Rural Development has shown that roughage content in beef cow rations can be reduced to as little as 0.5% of the bodyweight of cows when fed in conjunction with corn grain. A simple ration analysis last fall with costs of roughage versus concentrate feeds suggested that studies conducted in Alberta were a direct fit for the situation Manitoba producers were facing. Combining high energy feeds with limited amounts of straw can reduce methane, manure production and lead to improved efficiencies of feed utilization. Our objective was to demonstrate this technology in two Manitoba cow herds.

Methods:

The study was conducted with two herds near Rivers, Manitoba. British crossbred cows in 2nd trimester (Figure 1, 2) were weighed and their body condition was determined at the start (December 12, 2003) and end (February 17, 2004) of test. The ration was balanced to increase the weight of cows (Cowbytes ration management software, Alberta Agriculture, Food and Rural Development). Grain screening pellet and straw consumption was recorded. Cows were fed twice daily with a Bale King bale processor equipped with a grain tank (Figure 1). Grain pellets were formulated to meet the cows' dietary needs based on NRC 1996 recommendations.

Results and Discussion:

Cattle weights and body condition scores rose an average of 26 lbs and 0.26, respectively (Table 1). Based on nutritional analysis of feeds (Table 2), and cowbytes ration analysis, this increase in gain was predicted to be 0.3 lbs/day, equivalent to 22 lbs over the course of the study. Throughout the feeding period cows received 11.8 lbs of straw and 13.3 lbs of grain pellets on a dry basis at a cost of $1.23/day. Straw and grain pellet dry matter consumption was 0.93% and 1.04% of the bodyweight of cows, respectively. The resulting methane production per cow was estimated to be 381 l with manure production estimated at 10.5 lbs dry matter (using Cowbytes ration formulation program). Alternatively, to achieve the same rate of gain with more straw, cattle could also have been fed 15.2 lbs straw and 12.4 lbs grain pellets on a dry basis, the cost also being $1.23/day. Interestingly, methane production would rise to 409 l/day and manure production would increase to 12.4 lbs dry matter.

Management methods differ when changing to this type of feeding system. Adapting cattle onto restricted amounts of roughage while increasing the amount of grains fed should be done gradually. At the onset of the study, the whole ration was fed to cows at once and with rising temperatures in December several cows had to be treated for acidosis, one of which died. Subsequent to this event the cows were fed straw and grain twice daily. Creating an appropriate rumen environment is critical and amount of fines in grain supplement and its processing index need to be scrutinized such that effects of acidosis are minimized. The cows physical condition, age and aggression governed feed consumption and precautions had to be taken to ensure equal access to concentrate feeds for cows (Figures 1, 2). Older cows were slower coming to grain and likely missed the first 2 to 3 lbs of consumption. Other cows likely received 16 to 18 lbs of pellet. Overall on a group of 100 cows based on observation, it can be expected that 15 cows will perform above and 15 cows below average. Also, of 100 cows initially selected, 5 to 6 cows may fail to adapt and will need to be kept separate. Feed waste of grain and straw was estimated to be below 5% (Figure 3). Considering the nutritional quality (Table 2) of the straw and that feed was placed on open fields with snow cover this was exceptional. The physical capacity of cows consuming the types of feeds provided lies in the range of 2.4 to 2.6% of the animals weight in dry matter feed consumption. In this study, cattle were fed at approximately 2% of their weight. This will inevitably reduce gut fill, creating a more 'hollow' and empty appearance in cows. Cows also tend to more aggressive at time of feeding and it is recommended to have good fences and other feeds to not be in visible range of cattle.

Conclusions:

There appears to be no end in the things a cow can adapt to. This study showed that practical steps can be taken on farm to reduce Green House Gas without drastic changes to routine feeding and management practices. It is important to split feed grains when exceeding 8 lbs daily and processing of grains should be done to avoid fines as much as possible. Cowbytes software was very accurate in predicting the outcome of the experiment. Not all cattle will adapt to this type of program and need to be observed closely for any digestive problems. When reducing feed for cows below 2% of body weight, two things are noteworthy: Reduced waste along with reduced gut fill in cows. The appearance of cattle is different, albeit this did not affect their health.

Table 1. Body condition and weight gain of cows limit fed with straw and a grain pellet supplement

Group A		
Date	Weight (lbs)	Body condition (1-9)
4/12/2003	1273	4.26
17/2/2003	1298	4.74
Net gain (74 days)	25	0.48
Daily gain	0.33	
Group B		
Date	Weight (lbs)	Body condition (1-9)
4/12/2003	1250	4.49
17/2/2003	1277	4.52
Net gain	27	0.03
Daily gain	0.36	

Table 2. Nutritional composition of straw and grain screening pellets

	Oat straw	Grain pellet
Crude Protein (%)	2.8	13
TDN (%)	37.8	81
Calcium (%)	0.25	0.72
Phosphorus (%)	0.04	0.33
Potassium (%)	2.07	0.22
Magnesium (%)	0.14	0.14
Cu (ppm)	4.1	39.6
Mn (ppm)	3.6	75.1
Zn (ppm)	7.8	151.0
Vitamin A (kiu/kg)		32.3
Vitamin D3 (kiu/kg)		3.2
Vitamin E (ie/kg)		11.6
Monensin sodium (mg/kg)		33

Figure 1: Twice daily grain feeding to cows

Figure 2: British crossbred cows consuming grain – straw in back

Figure 3: Virtually no waste of straw component of ration

Information to On-Farm Cattle Composting

Van Doan, M.Sc, Provincial Livestock Environment Engineer, EIT

Unfortunately cows die. With death comes the choice of disposal method. Composting is an environmentally sound disposal practice when done properly. Ok, ok. I know what some of you are thinking, "I already have a great and cheap disposal method. I just drag the carcasses into the bush and within a few days the coyotes have disposed of them for me." Well, besides the legalities of it all, it is just not a good idea. Intentionally feeding coyotes means that they are only going to get bigger and stronger, more food means more coyotes. Also, when pasture season comes and your cows are contently eating away, a large coyote that you have been feeding may just decide to kill one of your calves for supper. Anyhow, the point of this article is not to lecture you, but to provide information on composting cattle mortalities if you should choose to do it.

Why compost

First of all, why should farmers compost mortalities? To name a few reasons, composting can be done at any time of the year, it kills pathogens, and it offers immediate disposal of all sizes of carcasses. In addition, composting is a relatively low cost, labour, and management process. Finally, it is just "neat" to see an entire carcass virtually disappear.

Composting

Composting is a controlled aerobic process in which bacteria, fungi, and other microorganisms convert organic material into a stable humus-like product. Since microorganisms do most of the work, you must provide the best environment for them to live. To provide the best habitat for microorganisms the following is required:

(1) Good carbon to nitrogen (C:N) ratio. Animal carcasses are high in nitrogen so you must add large amounts of carbon. A C:N of 20:1 – 40:1 is reasonable, the preferred range is 25:1 – 30:1.
(2) Adequate moisture. Microorganisms need water to move around and transport nutrients. A moisture content of 40 – 65% is reasonable, the preferred range is 50 – 60%.
(3) Good aeration. Composting is an aerobic process, which means the microorganisms need air to compost properly. Oxygen levels should be maintained above 5%. The target range is about 5-15%.
(4) Controlled temperatures. The warmer the pile, the faster the microorganisms work. Temperatures between 43-65 °C (110-150°F) are acceptable, but anything above 70°C (158°F) is too hot for the microorganisms to survive. The preferred range is 54-60°C (130-140°F). Temperatures maintained above 55°C (130°F) for 3 consecutive days kills pathogens.

The above four factors in combination are the key to making microorganisms happy and work hard. If you can achieve these things, then composting will be possible.

Starting a windrow compost pile

The compost pile must be at least 100 m away from any surface watercourse, sinkholes, springs, or wells. Depending on your soil conditions, a concrete pad or plastic liner may be required. Begin by creating a base with straw, sawdust, woodchips or any other good carbon source. Make sure that the base at least 60 cm (2 ft) thick and is large enough to allow for 60 cm (2 ft) of clearance around the carcass. Next, lay the carcass flat on top of the base (on its back or side). For larger mortalities (greater than 300 lbs) it is necessary to lance the rumen to prevent bloating and possible explosions, as well as give microorganisms quicker access in order to compost faster. Finally, completely cover the carcass with the carbon source so there is at least 60 cm (2 ft) of material surrounding the entire carcass. A 60 cm (2 ft) cover will insulate the composting material from the outside temperatures, provide the necessary carbon source, reduce odour, and absorb liquids. A fence should also be placed around the compost pile to ensure that no dogs, coyotes, rats, etc. can get into the compost pile.

The composting process

Unlike manure composting, mortality composting does not require frequent turning. A mortality composting pile may only need to be turned once. There are two main stages or heat cylces in mortality composting, primary and secondary. The primary stage starts once the compost pile is constructed. The primary stage takes approximately 3 to 6 months and should be monitored daily. Since microbial activity is directly related to heat, temperature is a good indicator whether or not the compost pile is working properly. Once the temperature reaches 55°C (130°F) and stays above this temperature for at least one week and then drops, the pile is ready to be turned. The primary compost pile should be turned onto a 60 cm (2ft) layer of amendment to absorb any liquids.

After the pile is turned the secondary stage of the composting process begins. Secondary composting time is similar to primary composting time (3 to 6 months). Again, the temperature should be monitored daily. Once the temperature reaches 55°C (130°F) and stays above this temperature for at least one week and then drops, composting may be finished. Finished compost should be dark, humus-like with no signs of flesh. If there is still flesh in the compost pile, it is necessary to turn the pile again and let it go through another heat cycle. Bones that remain in the compost will be very brittle and can be crushed or removed and added to a new composting pile or buried.

Hog Manure & Grassland Systems: Best Management Practices Will Improve Environmental Sustainability and Production

By Heather Froebe, Livestock Specialist, Eastern Region, MAFRI

An abundance of hog manure and pastures that need nutrients is a great description of Southeast Manitoba. Seems logical to apply hog manure to these pastures, but what is the best way? That is exactly what the University of Manitoba will be finding out.

A research/demonstration site has been established that will enable project partners including local forage/livestock producers, industry partners, provincial organizations and researchers to work together to identify these Best Management Practices. Eastern Regional staff from MAFRI have a huge involvement with the establishment of this site and we will ensure that these Best Management Practices are rapidly and effectively communicated to producers, so they can be implemented on-farm.

Pasture productivity and animal performance can be improved economically with the application of hog manure. However, the advantages and disadvantages of this practice in terms of environmental sustainability, in relation to pasture productivity and animal performance requires exploration. This project started in the fall of 2003 and will run until the fall of 2006.

The project site will consist of 12 rotational grazing paddocks, with a control (no hog manure applied) and two hog manure applications times; spring and a split spring/fall application. A harvested forage system will be examined along with the grazed system to provide the opportunity to explore the benefits associated with accelerated removal of excess nutrients from the grassland system in the form of hay.

Overall, the proposed project will use a systems-based approach to identify a series of Best Management Practices that will:
Improve the productivity of grassland pasture systems by increasing forage quality and yield;
Improve digestion efficiency and reduce methane emissions associated with grazing;
Develop systems to reduce nitrous oxide emissions associated with application of hog manure on grassland;
Optimize nutrient (N and P) and water utilization, thereby improving soil and water quality;
Develop systems to minimize potential cycling of potentially harmful bacteria, thereby improving water quality and health of animals;
Provide an avenue for several sectors of industry to work together to establish a coordinated approach to nutrient and land utilization;
Establish a recognized demonstration/evaluation site, which will enable producers to observe how the Best Management Practices can be implemented to improve the economic and environmental sustainability of their operations.

What is unique about this project is the teamwork between the University of Manitoba (Animal Science, Soil Science and Food Science), Hytek, Manitoba Pork Council, Manitoba Cattle Producers Association, Manitoba Milk Producers, Manitoba Forage Council, Stuartburn Piney Agricultural Development Association, Manitoba Agriculture, Food and Rural Initiatives, Manitoba Conservation, Water Stewardship, and Prairie Farm Rehabilitation Administration.

Other financial contributors are the Greenhouse Gas Mitigation Fund (Dairy Farmers of Canada, Canadian Cattlemen's Association and Canadian Pork Council), Manitoba Rural Adaptation Council, Beef Cattle Research Council, Canadian Agri-Food Research Council, Sustainable Development Innovations Fund and the Manitoba Livestock Manure Management Initiative.

Evening Feeding of Beef Cattle During the Winter Shows Economic Promise

by Alma Kennedy and Julie Small

A number of recent studies suggest that cattle provided feed in the evening, rather than the morning, have improved productivity that could be of significant economic value to Prairie cattle feeders. This research has been coordinated by Dr. Alma Kennedy, Department of Animal Science, University of Manitoba. Her research collaborators included Agriculture and Agri-Food Canada scientists Dr. Julie Small, Dr. Tim McAllister, Dr. Karin Schwartzkopf-Genswein and Dr. Doug Veira and University of Alberta professor Dr. Bob Christopherson.

The Canada Alberta Beef Industry Development Fund (CABIDF) provided the majority of the funding for studies during two winters (1998/99 and 1999/00) which involved about 500 head of feeder cattle in Manitoba (Brandon and Glenlea) and Lethbridge, Alberta. Feeding cattle in the evening, as opposed to standard morning feeding, improved feeder cattle performance but the effect was not always found and the type of response was not consistently from location-to-location or from year-to-year. The varied results suggest that feed management and the weather influence the type of response found. Results seemed to depend on whether the cattle were fed *ad libitum* or were on a restricted feeding program.

No overall response to evening feeding was seen in the Lethbridge studies where the two winters were quite mild and the steers were fed *ad libitum* during finishing. With access to feed 24 hours a day, delivering feed in the evening didn't guarantee that the cattle would eat the feed at that time. In these two mild winters the evening-fed steers chose to eat in the morning, basically at the same time as the control steers in adjacent pens. Thus these steers were evening "fed" but practiced morning "feeding". It therefore is not surprising that there was no production response to evening feeding in the Lethbridge trials. In Year 2 there was a dramatic response to evening feeding in the first half of the study, a 28% increase in rate of gain. However, that advantage was lost during the second half of the trial. A different response might have been found if the weather had been colder.

The studies At the University of Manitoba's Glenlea farm included heifers either backgrounded and finished (Year 1) or backgrounded all winter (Year 2). In Year 1, during backgrounding (56 days), the mean ambient temperature was -14^{o}C and evening feeding improved growth rate by 10.1% and feed efficiency by 9%. However, these significant responses to evening feeding did not continue in the finishing phase and by the time of slaughter there were no differences between the morning and evening fed heifers. The mean ambient temperature was considerably warmer in the finishing phase (0.5^{o} C). There was no effect of evening feeding on the performance of backgrounded heifers during Year 2 at Glenlea.

In ruminants, the peak in rumen fermentation occurs a few hours after eating. In most cases, animals are fed in the morning or throughout the day, which means that this extra heat from digestion is available in the day when it is least needed by winter-exposed animals. It was hoped that feeding in the evening would provide warmth to the animal's body during the cold winter nights and that this would trick the animals' brain thermoregulatory center into thinking that the winter was milder. The body then, would perceive less need to develop metabolic acclimatization which is an energy wasteful adaptation to cold winter conditions. The research group suspected that the size of the nightly dip in body temperature informed the brain as to the need to cold-acclimatize. With evening feeding it was hoped that the size of the nightly dip in body temperature would be minimized.

Based on these theories, we expected that the benefits of evening feeding would be minimal during mild winters or during the milder part of a particular winter. Results from the Lethbridge and Glenlea studies supported this hypothesis to some extent.
That there is an interaction between feed management and the nature of the thermal environment was suggested by the results found at Brandon. In Year 1, steers were progeny of Continental (Gelbvieh n = 55, Simmental n = 52) and British (Red Angus n = 20, Hereford n = 17) sire breeds, and either ½ Simmental x ½ Hereford, ½ Simmental x ½ Red Angus, or Composite (¼ Simmental ¼ Charolais $^{1}/16$ Limousin $^{7}/16$ British) dams. In Years 2 all steers were progeny of Gelbvieh sires, and were either from the Brandon Research Center herd, of which 63% were one of two sires (Gunsmoke n = 98 and New Day n = 28) used for a single timed insemination of ½ Gelbvieh, ¼ Simmental x ¼ Hereford, and Composite dams, and the remainder progeny of Gelbvieh bulls (n = 84), or purchased (n = 62) locally from a producer with cattle of similar genetics and phenotype.

In Year 1 (n = 144) and Year 2 (n = 128) heifers per treatment were assigned to morning or evening feeding of an 80% concentrate, 20% forage total mixed ration. In Year 1, steers were fed at 2.5% body weight on a dry matter basis from November 9 (0 d) until they reached finished condition (6 to 8 mm back fat) for processing in the spring (March to May). This level of feeding was planned to ensure that the steers consumed most of the daily ration in either the day (morning fed) or night-time (evening fed). In Year 2, feed was offered such that bunks contained 10% feed refusal (orts) at 12 h, and 0% orts ("slick-bunk") by 24 h post-feeding. Such limit feeding is a common type of beef feed bunk management. The amount of feed provided to each pen and the number of animals per pen was recorded daily. In Year 1, feed increments were made weekly based on biweekly average pen weights, however, after 84 d, it was necessary to reduce the amount of feed to maintain consumption at the designated times. In Years 2 and 3, to maintain slick-bunk management, feed was increased or decreased 0.5 kg per animal based on the 12 h observation of orts.

Figure 1. Steers in Brandon were fed in Year 2 to achieve 10% orts at 12 hours (photo at left) and a slick bunk at 24 h (photo at right).

Mean ambient temperature in Year 1 did not differ from the 30 year average but, in Year 2, mean ambient temperature was 4°C above the 30 year average. In Year 1, evening fed steers finished14 d earlier than morning feed steers and evening feeding increased the ultrasonic backfat by 23% by the end of the trial. There was no improvement in rate of gain in Year 1; the evening fed steers began laying down backfat earlier which led to earlier slaughter dates based on and ultrasonic backfat target of 6 to 8 mm. In Year 2, evening feeding significantly improved average end of test body weight (3%), daily gain (12%) and feed conversion (6%) and reduced cost of gain by 5%. Evening feeding reduced the cost of gain primarily because of improved rate of body weight gain on the same amount of feed. That the effect of evening feeding on daily gain and feed conversion were only seen in the milderYear 2, suggests that feed management may have been an important contributing factor. However, the mechanisms involved are unclear.

The level of feed restriction was greater in Year 1 than Year 2 but under both feeding regimes there was improved performance of the steers with evening feeding . It is interesting that the type of the improvement differed between years. In Year 1 we found earlier fattening and in Year 2 we found increased gain and efficiency. It is possible that the effect on subcutaneous fat is more pronounced in colder winters when the level of cold-acclimatization would be high. Both responses suggest that evening feeding caused a reduction in metabolic use of energy of the steers in the winter and support the hypothesis that evening feeding reduced metabolic acclimatization. The two study years differed in climatic conditions and the type of restricted feeding employed to ensure that the steers ate at the desired time of day. Further studies are required in order to understand the interactions between climate, feed management and time of feeding. Limit feeding requires that bunk space is sufficient for all steers in a pen to feed at the same time. Since feeding at night is likely less convenient for most feedlot operators, we need to find out what management factors produce consistent results before making a clear recommendations for various management systems.

Figure 2. Morning and evening fed steers are in alternate pens – The figures show feeding behaviour at 10 A. M. for morning or evening once-a-day slick-bunk feeding

Welcome Maureen Cousins, the New Communications Coordinator for MCPA

Melinda German, MAFRI – Beef Cow/Calf Specialist

Recently I had the pleasure of meeting Maureen, the new communications coordinator for MCPA. Maureen brings a wealth of knowledge and talent to her new job and we look forward to working on several upcoming projects. If you would like to contact Maureen she can be reached at (204)772-4542 or at mcpa.com@mts.net

Maureen was raised on a dairy farm southwest of Portage la Prairie. She is familiar with agricultural issues and with the legislative process. Maureen worked as a journalist and as a freelance writer, and she has extensive research experience. She has a Bachelor of Arts Specialist degree from Brandon University and a Master of Arts degree from the University of Manitoba.