Influence of Feedlot Manure Type and Bedding Application on Feed Barley Agronomy and the Environment

Jim Miller¹, Bruce Beasley¹, Craig Drury², Frank Larney¹, and Xiying Hao¹

¹Agriculture and Agri-Food Canada, Lethbridge, Alberta
²Agriculture and Agri-Food Canada, Harrow, Ontario
Corresponding author: jim.miller@agr.gc.ca; 403-317-2219

Key Points
• The influence of application of feedlot manure type (composted vs. stockpiled), bedding material (wood-chips vs. straw), and application rate (13, 39, 77 Mg ha⁻¹) on feed barley agronomy, leaching, soil physical and chemical properties, and surface runoff, was studied at a long-term (since 1998) field experiment on a clay loam soil at Lethbridge.
• Manure type, bedding material, and application rate may be possible BMPs to manage agronomic and environmental aspects of feed barley production. Producers shifting from land application of stockpiled to composted manure application, or from straw to wood-chip bedding, should not experience any reduction in feed barley yields.

Introduction
Stockpiling (SM) of fresh feedlot manure where it is temporarily stored in stockpiles or stacks either inside or outside feedlot pens is a common practice in western Canada feedlots. Composting (CM) of feedlot manure has also increased as a viable option for handling the large volumes of manure generated by Alberta’s beef cattle feedlot industry. Although straw (ST) is the most common bedding material used in feedlots, the use of wood-chips (WD) has increased since the 1990s due to restrictions on incineration of wood residuals by the forest industry. The impact of long-term application of feedlot manure with CM vs. SM with WD or ST bedding treatments has not been studied.

Methods
The long-term field experiment was initiated in the fall 1998 on a clay loam Orthic Dark Brown Chernozemic soil at Lethbridge, Alberta. Details of the randomized complete block experimental design and all treatments with four replicates have been previously reported (Miller et al. 2009). The 12 amendment treatments included a complete factorial arrangement of two manure types (stockpiled and composted beef cattle manure), two bedding materials (unchopped barley straw and wood-chips), and three application rates (13, 39, and 77 Mg ha⁻¹ yr⁻¹, dry-weight basis). A unamended control (CON) treatment and an inorganic mineral fertilizer treatment (IN) were also included in the study, resulting in a total of 14 treatments. The material and methods used for agronomic studies (Miller et al. 2009; 2015b), vertical transport and leaching potential studies (Miller et al. 2011; 2013a; 2013b; 2013c), and soil physical and chemical property studies (Miller et al. 2012a; 2012b; 2014a; 2014b; Sharifi et al. 2014) have been previously reported.

Results and Discussion
Long-term application of CM or use of WD bedding resulted in similar dry matter yields, nutrient uptake, and feed quality compared to SM or use of ST bedding. There was no evidence of decreased crop yields due to N immobilization from WD and was attributed to high inherent N already in the soil and the low concentration of WD in the manure (4 parts manure:1 part wood-chips). Vertical transport and leaching potential of soluble salts, total elements, and metals were generally greater for CM compared to SM, but was similar for residual N and P. Vertical transport and leaching potential of water-soluble organic C and N fractions was generally greater for ST than WD. Cumulative denitrification for surface soil was greater for SM than CM, but daily denitrification was similar for WD and ST. Manure application increased wind
erodible fraction of soil and was attributed to increased organic matter making the soil aggregates more friable. Cumulative N deficits after 12 yr occurred for CON (-1140 kg N ha⁻¹) and IN (-678 kg N ha⁻¹), and an N surplus for amended treatments (689 to 12,200 kg N ha⁻¹). The N balance after 7 and 12 yr was lower for CM-WD than CM-ST, SM-ST, and SM-WD at 39 and 77 Mg ha⁻¹ rates. Application of SM and ST increased readily available and intermediate mineralizable N, and rate of N turn-over (k), compared with CM and WD.

References

Unit conversion
1 megagram (Mg) = 1000 kilogram (kg) = 1 tonne