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

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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

Miller, J.J., Beasley, B.W., and Drury, C.F. 2013a. Transport of residual soluble salts and total sulfur through intact soil cores amended with fresh or composted beef cattle feedlot manure for nine years. Compost Sci. Util. **21**: 22-33.

Miller, J.J., Beasley, B.W., and Drury, C.F. 2013b. Transport of metals (Al, Fe) and trace elements (Cu, Mo, Ni, and Zn) through intact soil cores amended with fresh or composted beef cattle manure for nine years. Compost Sci. Utiliz. **21**: 99-109.

Miller, J.J., Beasley, B.W., Drury, C.F., Larney, F.J., and Hao, X. 2013c. Transport of residual nitrogen and carbon through intact soil cores amended with stockpiled feedlot manure with wood-chip or straw bedding. J. Environ. Qual. **42**: 1881-1888.

Miller, J.J., Beasley, B.W., Drury, C.F., Larney, F.J., and Hao, X. 2014a. Nitrogen budgets following land application of composted or stockpiled feedlot manure containing wood-chips or straw bedding to barley silage for 12 Years. Compost Sci. Utiliz. **22**: 57-67.

Miller, J.J., Beasley, B.W., Drury, C.F., Hao, X., and Larney, F.J. 2014b. Soil properties following long-term application of stockpiled feedlot manure containing straw or wood-chip bedding under barley silage production. Can. J. Soil Sci. 94: 389-402.

Miller, J.J., Beasley, B.W., Drury, C.F., Larney, F.J., and Hao, X. 2015a. Influence of long-term (9 yr) composted and stockpiled feedlot manure application on selected soil physical properties of a clay loam soil in southern Alberta, Compost Sci. Utiliz. **23**: 1-10.

Miller, J.J., Beasley, B.W., Drury, C.F., Larney, F.J., and Hao, X. 2015b. Influence of long-term application of manure type and bedding on yield, protein, fiber, and energy value of irrigated feed barley. Agron. J. **107**: 121-128.

Miller, J.J., Beasley, B.W., Drury, C.F., and Zebarth, B.J. 2009. Barley yield and nutrient uptake for soil amended with fresh and composted cattle manure. Agron. J. **101**: 1047-1057.

Miller, J.J., Beasley, B.W., Drury, C.F., and Zebarth, B.J. 2011. Transport of residual nutrients through intact soil cores amended with fresh or composted beef cattle manure for nine years. Compost Sci. Utiliz. **19**: 267-278.

Miller, J.J., Beasley, B.W., Drury, C.F., and Zebarth, B.J. 2012a. Denitrification during the growing season as influenced by long-term application of composted versus fresh feedlot manure. Can. J. Soil Sci. **92**: 865-882.

Miller, J.J., Bremer, E., Beasley, B.W., Drury, C.F., Zebarth, B.J., and Larney, F.J. 2012b. Long-term effect of fresh and composted cattle manure on the size and nutrient composition of dry-sieved soil aggregates. Can. J. Soil Sci. **92**: 673-683.

Sharifi, M., Zebarth, B., Miller, J., Burton, D., and Grant, C. 2014. Soil nitrogen mineralization in a soil with long-term history of fresh and composted manure containing straw or wood-chip bedding. Nutr. Cycl. Agroecosys. **99**: 63-78.

Unit conversion

1 megagram (Mg) = 1000 kiolgrams (kg) = 1 tonne