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DIGGING INTO RESEARCH

Short term legacy effects of feedlot manure

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Research was conducted in southern Alberta to look at the effects of long term feedlot manure application on irrigated barley yield, macronutrient supply, earthworm abundance, and water extractable carbon in a clay loam soil. Two to 3 years after manure application was stopped, barley silage yield was similar to an inorganic fertilizer control treatment.

In a study conducted in southern Alberta, feedlot manure amendments were first applied in 1998, and then annually applied in the fall of each year for 17 years until the last application in 2014. The feedlot manure treatments consisted of stockpiled or composted manure of straw or wood chips, and three manure rates of 5.8, 17.4 and 34.4 tons/acre dry basis (13, 39, and 77 tonne/ha). There was also an inorganic fertilizer treatment of 89 lbs. N/acre + 15 lbs. P/acre (100 kg N/ha + 17 kg P/ha), and an unfertilized control treatment. The application of amendments was first discontinued in 2015, but fertilizer was still annually applied for the inorganic treatment.

The study period was 2 to 3 years after the last manure application in 2014, and the results are reflective of the legacy effects of manure measured several years after the last manure application.

Barley silage yield was not significantly different

In the second and third year (2016–2017) after discontinuing manure applications, barley silage yield was measured, and soil nutrient supply was measured with plant root simulator (PRS®) probes.

There were no significant ($P > 0.05$) treatment effects of manure type, bedding, rate, or interaction effects on dry matter barley yields in 2016 and 2017. Yields ranged from 2.676 tons/acre (6.0 tonnes/ha) to 4.059 tons/acre (9.1 tonnes/ha) over the two years.

The research suggests that soil nutrient supply from manure was sufficient for maximum barley yield in the unfertilized treatment for the 2 years of this study.

Soil nutrient supply varied

Significant differences in macronutrient supply occurred 2 to 3 years after the last application. Manure rate generally increased soil nutrient supply. Soil N and P supply were 40%–59% lower for composted straw manure than the other three manure type- bedding treatments. Soil N and P supply were 26%–53% greater for stockpiled than composted manure. This indicated that composting generally had variable effects on soil N and P supply compared with stockpiled manure.

At the two highest manure rates, soil K supply was 60% to 106% greater for straw than wood chip bedding. Soil S supply was the opposite with 40% to 174% greater for wood chip than straw bedding.

For the four manure type-bedding treatments, the N and P supply in the soil at 5.8 tons/acre rate (agronomically N-based) was most suitable for supplying adequate levels of these soil nutrients. In comparison, the N and P supply at 17.4 and 34.4 tons/acre rates (excess rates) were significantly greater than the fertilized control, suggesting the potential for environmental losses of these nutrients.

Earthworm populations unaffected

In 2017 and 2018, 3 to 4 years after the discontinuation of manure applications, soils were sampled to a 7.8 inch (20 cm) depth for earthworms. The *Aporrectodea* genus was the dominant earthworm identified. Earthworm abundance was similar for amended, unamended, and inorganic fertilizer treatments.

Based on the findings, long-term application of feedlot beef cattle manure to a clay loam soil will likely not significantly increase earthworm abundance. Similar soil water content, manure-induced soil salinity, chemicals in the manure, and other factors may have contributed to the lack of increase in earthworm populations.

Increased risk of leaching

The water-extractable organic carbon (WEOC) in soil is important because its readily degraded compounds may influence biological, chemical, and physical processes in soil, transport of metals and pesticides, mineral weathering, greenhouse gas production, C balance, and water quality

Soil samples were taken from six depths down to 5 feet (0–0.15, 0.15–0.30, 0.30–0.60, 0.60–0.90, 0.90–1.20, and 1.20–1.50 m) in the fall of 2016. This sampling was 2 years after the last manure application

The total WEOC mass was 14%–20% greater for composted straw than composted wood chips, stockpiled straw, and stockpiled wood chips. WEOC was 16%–22% greater for composted than stockpiled manure at the 17.4 and 34.4 tons/acre rates.

The 34.4 tons/acre rate of the four manure type-bedding treatments had significantly greater (by 37%–527%) concentrations of WEOC at the six depths compared with other treatments.

Overall, the researchers felt that a shift by feedlot producers from more traditional to less common manure management practices such as stockpiled to composted manure and straw to wood chip bedding will likely have no or little effect on WEOC in the soil. However, higher application rates have the strongest effect and increased accumulation and redistribution of WEOC in the soil, which may increase the leaching potential.

Miller, J.J., Beasley, B.W., Bremer, E., Drury, C.F., Larney, F.J., Hao, X., and Chanasyk, D.S. 2019. Short-Term Legacy Effects of Feedlot Manure Amendments on Irrigated Barley Yield and Soil Macronutrient Supply. Can. J. Plant Sci. **99**: 100–115. https://doi.org/10.1139/cjss-2018-0064.

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