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Relative effects of anaerobically-digested and conventional liquid swine manure, and N fertilizer on crop yield and greenhouse gas emissions

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ABSTRACT

Anaerobic digestion is a promising technology that could provide an option for managing animal waste with reduced greenhouse gas emissions. A three-year (2006-2008) field experiment was conducted at Star City, Saskatchewan, Canada, to compare the effects of land-applied anaerobically digested swine manure (ADSM), conventionally treated swine manure (CTSM) and N fertilizer on grain yield of barley, applied N use efficiency (ANUE, kg · grain · kg^{-1} of applied N · ha^{-1}), ammonia (NH_3) volatilization and nitrous oxide (N_2O) emissions. Treatments included spring and autumn applications of CTSM and ADSM at a 1x rate (10,000 and 7150 L · ha^{-1}, respectively) applied every year, a 3x rate (30,000 and 21,450 L · ha^{-1}, respectively) applied once at the beginning of the experiment, plus a treatment receiving commercial fertilizer (UAN at 60 kg · N · ha^{-1} · yr^{-1}) and a zero-N control. There was a significant grain yield response of barley to applied N in all three years. The ANUE of ADSM or CTSM applied once at the 3x rate were lower than annual applications at the 1x rate (grain yield by 595 kg · ha^{-1} and NFUE by 6 kg · grain · kg^{-1} of applied N · ha^{-1}). On average, agronomic performance of ADSM was similar to CTSM. The APNU of N fertilizer was greater than the 3x rate but lower than the 1x rate of ADSM or CTSM. Ammonia loss from ADSM was similar to CTSM, except for much higher loss of NH_3-N from CTSM at the 3x rate applied in the autumn (8100 g · N · ha^{-1}) compared to the other treatments (1100 - 2600 g · N · ha^{-1}). The percentage of applied N lost as N_2O gas was generally higher for treatments receiving CTSM (4.0%) compared to ADSM (1.4%). In conclusion, the findings suggest that ADSM is equal or slightly better than CTSM in terms of agronomic performance, but has lower environmental impact.

KEYWORDS

Ammonia Volatilization; Anaerobic Digestion; Barley Yield; Nitrogen Fertilizer Use Efficiency; Nitrous Oxide; Swine Manure

Cite this paper

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