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Short-term influence of anaerobically-digested and conventional swine manure, and N fertilizer on organic C and N, and available nutrients in two contrasting soils

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ABSTRACT

A three-year (2006-2008) field experiment was conducted at Swift Current and Star City in Saskatchewan to determine the short-term influence of land-applied anaerobically digested swine manure (ADSM), conventionally treated swine manure (CTSM) and N fertilizer on total organic C (TOC), total organic N (TON), light fraction organic C (LFOC), light fraction organic N (LFON) and pH in the 0 - 7.5 and 7.5 - 15 cm soil layers, and ammonium-N, nitrate-N, extractable P, exchangeable K and sulphate-S in the 0 - 15, 15 - 30, 30 - 60, 60 - 90 and 90 - 120 cm soil layers. Treatments included spring and autumn applications of CTSM and ADSM at a 1x rate (10,000 and 7150 L ha⁻¹, respectively) applied each 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 no effect of swine manure rate, type and application time on soil pH. Mass of TOC and TON in the 15 cm soil layer increased significantly with swine manure application compared to the control, mainly at the Swift Current site, with greater increases from 3x rate than 1x rate (by 2.21 Mg C ha⁻¹ and 0.167 Mg N ha⁻¹). Compared to the control, mass of LFOC and LFON in the 15 cm soil layer increased with swine manure application at sites, with greater increases from 3x rate than 1x rate (by 287 kg C ha⁻¹ and 26 kg N ha⁻¹ at Star City, and by 194 kg C ha⁻¹ and 19 kg N ha⁻¹ at Swift Current). Mass of TOC and TON in soil layer was tended to be greater with ADSM than CTSM, but mass of LFOC and LFON in soil was greater with CTSM than ADSM. Mass of TOC, TON, LFOC and LFON in soil also increased with annual N fertilizer application compared to the control (by 3.2 Mg C ha⁻¹ for TOC, 0.195 Mg N ha⁻¹ for TON, 708 kg C ha⁻¹ for LFOC and 45 kg N ha⁻¹ for LFON). In conclusion, our findings suggest that the quantity and quality of organic C and N in soil can be affected by swine manure rate and type, and N fertilization even after three years, most likely by influencing inputs of C and N through crop residue, and improve soil quality.

KEYWORDS

Anaerobic Digestion; Available N; P, K and S; Organic C and N; Soil; Swine Manure

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