

Applying compost in conventional and no-tillage systems under corn silage and soybean production

JOANN K. WHALEN

Department of Natural Resource Sciences, Macdonald Campus, McGill University, 21 111 Lakeshore Road, Ste-Anne-de-Bellevue, QC H9X 3V9
Email: joann.whalen@mcgill.ca

Key words: composted cattle manure, corn silage, soybean, tillage

Introduction

No-tillage (NT) systems are characterized by an absence of tillage (seeds are directly planted with minimal soil disturbance). NT systems are not very common in Quebec, although they have the potential to reduce fuel costs, prevent soil erosion and conserve soil organic matter on farms. More than 75% of the arable land in Quebec is tilled, generally by plowing in the fall and harrowing in the spring. A conventional tillage (CT) system is compatible with the production of field crops on heavy clay soils that are often wet and slow to warm in the spring. Agricultural fields that receive fresh manure (solid and liquid) are often cultivated within days of the manure application, to reduce the nutrient loss and odors emitted from these materials. Although liquid manure could be injected into a NT system, there is little information about applying solid manure to a NT system. One possibility is to use well-decomposed solid manure, or manure compost, as a soil amendment and fertilizer source in NT systems. The objective of this work was to determine if the application of composted manure, either left on the soil surface in NT systems or incorporated in CT systems, would provide enough fertilizer nutrients for the production of corn silage and soybeans.

Methods

This study was conducted at the Research Farm of McGill University in Ste-Anne-de-Bellevue, Quebec. The site was a CT system under corn production for at least 6 years before the initiation of this study. The soil was a Chicot sandy-loam (Humic Gleysol) with 15.4 g organic C kg⁻¹, pH 6.1 and a P saturation (P/Al ratio) of 11.1% when the study began. The experiment was designed with factorial combinations of three crop rotations (corn-corn: CC, soybean-corn: CS and corn-soybean: CS) and tillage (NT and CT) in the main plots. Each plot was split into four, and subplots received 0, 15, 30 and 45 tonnes (wet weight) ha⁻¹ of composted cattle manure. The highest compost application rate supplied a P input that was equivalent (approximately) to the total P requirements of the corn crop. Supplemental inorganic N, P and K fertilizers were added to each plot, to ensure that these nutrients were in ample supply for corn and soybean production. The yield of corn silage and soybeans was measured during a five-year period, from 2000 to 2004, inclusive.

Results

Corn silage yields were between 8 and 21 tonnes (dry matter) ha⁻¹, depending on the growing season. The difference in corn silage yield due to tillage practices was apparent within 2 years of initiating NT practices. During the period 2002-2004, plots under continuous corn production (CC) always had a higher yield when a CT system was used than the NT system. In the plots with a corn-soybean rotation (CS), the corn silage yield was greater in the CT system than the NT system in two of three years during the same period (Fig. 1).

Soybean yields were between 0.5 and 2.7 tonnes (dry matter) ha⁻¹, depending on the growing season. We observed higher soybean yields in the CT system than the NT system in three of the five years of this study (Fig. 2).

There was no difference in the production of corn silage or soybeans due to the quantity of compost applied, in either CT or NT system. This suggests that the compost applications, with supplemental inorganic NPK fertilizers, provided sufficient fertilizer nutrients for corn silage and soybean production.

Conclusions

Five years of yield monitoring indicated a trend of higher corn silage and soybean yields in CT than NT systems, maybe because inadequate seedbed preparation led to rooting constraints in the NT system. Soil fertility at the site was already very good at the beginning of the study, which meant that leaving compost on the soil surface (NT system) or mixing compost with the soil (CT system) were equally effective fertilizer strategies. There was no difference in yield between subplots that received no compost (0 tonnes ha^{-1}) and the highest compost application rate (45 tonnes ha^{-1}), although the former received only inorganic NPK fertilizers and the latter received a small input of supplemental inorganic NPK fertilizers (most of the nutrients were supplied by the compost). We have previously found that compost applications, in combination with NT and CT tillage, has important consequences for soil aggregation and stability (Whalen et al., 2003) as well as the storage of organic C, N and P (Jiao et al., 2004 ; Jiao et al., 2006), but there was no effect of compost applications on the yield of corn silage and soybean in this study.

References

- Jiao, Y., Hendershot, W.H. and Whalen, J.K. 2004. Agricultural practices influence dissolved nutrients leaching through intact soil cores. *Soil Science Society of America Journal* 68, 2058-2068.
- Jiao, Y., Whalen, J.K., and Hendershot, W.H. 2006. No-tillage and manure applications increase aggregation and improve nutrient retention in a sandy-loam soil. *Geoderma* 134, 24-33.
- Whalen, J.K., Hu, Q., and Liu, A. 2003. Compost applications increase water-stable aggregates in conventional and no-tillage systems. *Soil Science Society of America Journal* 67, 1842-1847.

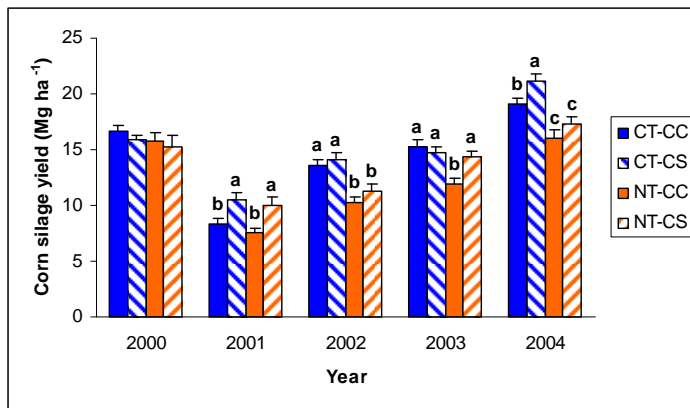


Fig. 1. Effect of tillage systems (no tillage : NT, conventional tillage : CT) and crop rotations (continuous corn : CC, corn-soybean : CS) on corn silage yield in Ste-Anne-de-Bellevue, 2000-2004.

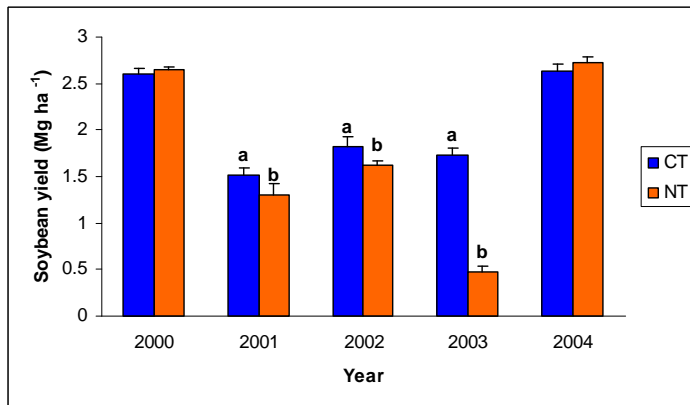


Fig. 2. Effect of tillage systems (no tillage : NT, conventional tillage : CT) on the yield of soybeans at Ste-Anne-de-Bellevue, 2000-2004.