Soil C and N Pools in Transitional Organic Field Crop and Vegetable Systems

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In this study, we report changes in soil carbon and nitrogen pools in Ohio's Field Crop Transition Experiment (FCTE) and Transitional Organic Tomato Cabbage Experiment (TOTCE). In the FCTE, results suggested higher total soil organic matter soil carbon (SOMSC) in the upper soil layers (15cm and 30cm) than lower layers (45cm) in both the transitional organic corn-soybean-oats-hay (TO) and conventional corn-soybean (C) systems. Compared to baseline SOMSC of 25024.5kg/ha, TO showed significant increase in SOMSC up to 33075 kg/ha compared to 31185 kg/ha in C. Total N increased from 3015kg/ha (baseline) to 3454 kg/ha in TO compared with 3293 kg/ha in C. In conjunction with SOMSC, particulate organic matter (POM), microbial biomass nitrogen and total nitrogen in the soil showed increasing trends in TO compared to C.

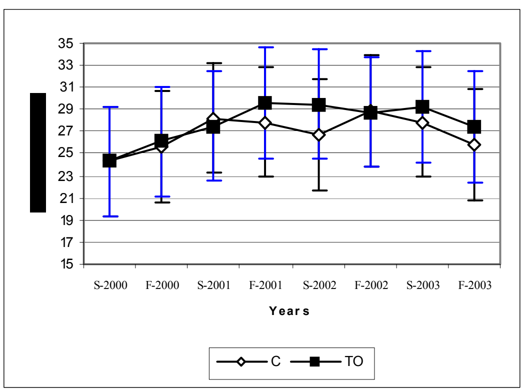

Fig. 1 Changes in SOMSC in the top 15cm soil in the FCTE.

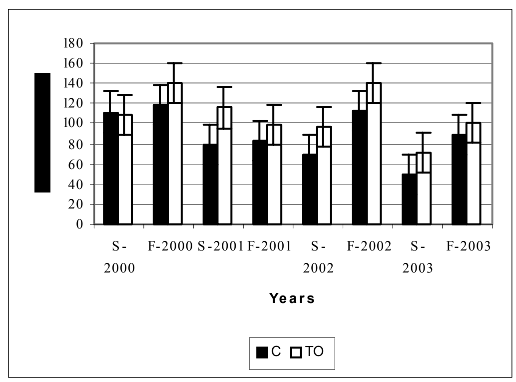

Fig. 2 . Microbial biomass nitrogen in the top 15 cm soil in the FCTE.

Principal component analysis (PCA) was used to examine correlations and variance between different soil parameters and climate characteristics. In TO, the first and second principal components could explain 49% and 28 % of the sampled variance. The loadings were all fairly large and highly positive for bulk density, SOMSC, POM, mineral associated organic matter, along with precipitation parameters. Negative loadings were found for most of the temperature parameters along with microbial biomass nitrogen. In contrast, the second and third components were dominated by climatic parameters (annual precipitation range, annual mean temperature, maximum and minimum temperature along with the precipitation in the wettest quarter). The first two principal components could together explain 77% of the sampled variance in TO. For C, although the trends in PCA loadings were similar to TO the intensities were different. C showed relatively high positive loadings for nitrate compared to TO.

In the Transitional Organic Tomato Cabbage Experiment, amendments in the tomato plots did not reduce ($p<0.05$) soil bulk density in Autumn 2001 or 2002. Organic matter content in soil was significantly higher in plots receiving raw manure compared to plots receiving composted manure or no amendment in Autumn 2001 ($p=0.003$), but not in Autumn 2002 (Table 3). Both raw and composted manure increased particulate organic matter in Autumn 2001 ($p=0.004$) and Autumn 2002 ($p=0.03$). Mineral associated organic matter increased ($p<0.05$) in plots amended with raw manure in Autumn 2001 only. Neither raw nor composted manure had any consistent effect on soil mineral-N (NH_4^+ and NO_3^-) (Table 1). Raw manure increased microbial biomass-N ($p=0.003$) and total mineralizable-N ($p=0.05$) and C ($p=0.02$) relative to the non-amended control and composted manure in Autumn 2001, but not in Autumn 2002. There were no significant differences in soil properties or microbial biomass-N in the plots before adding organic amendments in Spring 2001 and 2002.

Table 1. Effect of organic amendments on soil bulk density and various organic matter fractions.

	Bulk density	% Organic matter (OM)	% Particulate organic matter (0.05-2 mm)	% Mineral associated OM (<0.05 mm)
Spring 2001 (before adding organic amendments)				
Raw manure	1.53a	2.18a	0.51a	1.47a
Composted manure	1.51a	2.13a	0.48a	1.55a
Non-amended control	1.52a	2.06a	0.48a	1.42a
Autumn 2001 (after adding organic amendments)				
Raw manure	1.43a	2.24 a	0.57 a	1.66 a
Composted manure	1.45a	2.07 b	0.52 a	1.56 ab
Non-amended control	1.50a	1.97 b	0.40 b	1.53 b
Spring 2002 (before adding organic amendments)				
Raw manure	1.40a	2.15a	0.53a	1.59a
Composted manure	1.41a	2.19a	0.55a	1.62a
Non-amended control	1.41a	2.19a	0.55a	1.61a
Autumn 2002 (after adding organic amendments)				
Raw manure	1.32a	2.68a	0.57a	2.09a
Composted manure	1.31a	2.67a	0.59a	2.06a
Non-amended control	1.38a	2.65a	0.53b	2.10a

Publications Resulting From This Work

Prasad, K., McCartney, D. and Stinner, D. Short-term soil organic carbon and nutrient dynamics in transitional organic and conventional systems – results from field crop transition experiments. Submitted to Journal of Applied Soil Ecology.

Nahar, M. S., Grewal, P. S., Miller, S. A., Stinner, D., Stinner, B. R., Kleinhenz, M. D., Wszelaki, A. and Doohan, Doug. Differential effects of raw and composted manure on nematode community, and its indicative value for soil microbial, physical and chemical properties. Submitted to Journal of Applied Soil Ecology.