

## SUSTAINABLE ORGANIC VEGETABLE SYSTEMS: EVALUATING GREEN MANURE AND BIOWASTE COMPOSTS

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### ORGANIC VEGETABLE PRODUCTION

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Organic production systems rely largely on soil fertility for nutrient supply. Soil fertility in these systems can be maintained by management practices such as organic amendments (i.e. manure, compost), green manure, and rotating high and low nutrient-demanding crops. Market demand continues to increase for local and organic vegetables. At the same time, compost production in Canada has increased by more than 100% in six years, from 980 thousand tonnes in 2000 to more than 2.0 million tonnes in 2006 (Statistics Canada, 2006). Combining these trends provides a unique opportunity to develop a sustainable high-value organic vegetable production system that uses both green manures in the rotation and biowaste composts to improve soil fertility.

The sustainability of a cropping system is linked with productivity, quality, economics and environmental impacts. Limited information is available on productivity, soil nutrient availability and environmental impacts within organic cropping systems. This project was established to test the effects of biowaste composts combined with green manure on crop productivity, nutrient availability, soil quality and greenhouse gas emission in a 5-year high-value organic vegetable (potatoes, beans, and carrots) rotation.

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### METHODS

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This project was established at the Nova Scotia Agricultural College experimental site in Truro, NS in 2006. Four crop rotation sequences include:

- 1- Oats/Red Clover (O/RC) - Red Clover-Potato (P)-Oats/Red Clover - Carrots (C)
- 2- Oats/Red Clover - Red Clover - Potato - Beans/Buckwheat (B/Buck) - Carrots
- 3- Carrots - Peas/Oats/Vetch (PeOV) - Potato - Oats/Red Clover - Beans/Buckwheat
- 4- Beans/Buckwheat - Peas/Oats/Vetch - Potato - Oats/Red Clover - Carrots

Each rotation plot was divided into four sub-plots including control, mineral fertilizer, municipal food waste compost (12 Mg ha<sup>-1</sup> wet weight; DM=59%) and composted paper mill fibre (37 Mg ha<sup>-1</sup> wet weight; DM=33%). In 2008, soil samples were collected from 0-15 cm and 15-30 cm depth from the potato phase prior to planting, at tuber initiation stage, at tuber bulking stage and after harvest, and analyzed for mineral N concentration. Potato tuber yield, size distribution and defects were measured at harvest. The N supply rate was measured within control plots for O/RC and C-PeOV rotations from planting to 30 days after planting using Plant Root Simulator probes that were placed in the soil. Indicators of soil quality including microbial biomass, particulate organic C and N, and acid phosphatase activity were determined in soil samples collected at the tuber initiation stage. Greenhouse gas data were collected from 8<sup>th</sup> May to 4<sup>th</sup> December, 2008.

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### PRELIMINARY RESULTS

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Total potato tuber yields ranged from 32 to 40 Mg ha<sup>-1</sup>. Crop sequence in the first three years of the study did not have any effect on total tuber yields. Greater total tuber yields were found in the fertilized treatment compared with composted paper mill fibre and control, while the yield in municipal food waste compost was comparable (Fig. 1). Tuber size distribution was also influenced by amendment application but not crop sequence. Lower percentage of small size (38-51 cm) tubers was measured in fertilized compared with composted paper mill fibre and control treatments. Canada #1 size tubers (51-89 cm) were not affected by rotation or organic amendment.

Tuber wireworm damage was reduced by 74% after C-PeOV and B/Buck-PeOV compared with the O/RC-RC rotation. Amendment application did not have any effect on wireworm damage. In contrast, hollow hearth, discoloured holes in the center of tubers, was reduced by 50% when preceding crops were O/RC-RC compared with C-PeOV and B/Buck-PeOV and by 38% in control compared with composted paper mill fibre and municipal food waste compost.

Percentage of hollow heart in the fertilized treatment was intermediate.

Soil N supply measured by Plant Root Simulator (PRS) probes placed in the soil was 58% greater after O/RC-RC than after C-PeOV.

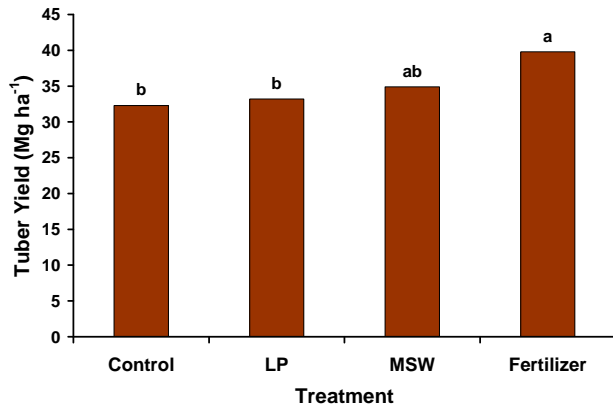


Fig. 1. Effect of control, mineral fertilizer, municipal food waste compost (MSW) and composted paper mill fibre (LP) on total potato tuber yield across all rotations.

The biologically active pool represents only a small fraction of total soil organic matter, but is often increased in organically managed soils, as revealed by microbial biomass measurements (Fließbach and Mäder, 1997). Soil microbial biomass carbon (MBC) was significantly higher in municipal food waste compost compared with composted paper mill fibre and fertilizer treatments (Fig 2). The MBC values were not affected by rotation sequences.

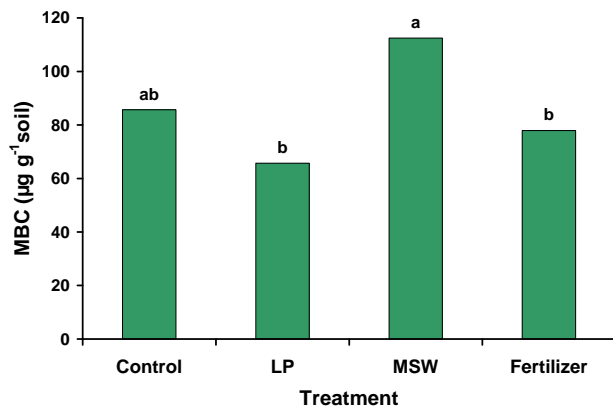


Fig. 2. Effect of control, mineral fertilizer, municipal food waste compost (MSW) and composted paper mill fibre (LP) on soil microbial biomass C (MBC) at tuber initiation stage across all rotations.

Soil acid phosphatase activity was significantly greater after O/RC-RC than after C/PeOV, whereas organic amendment did not have any effect on its activity.

## REFERENCES

Statistics Canada. 2006. Waste management industry survey: Business and government sectors. Catalogue no. 16F0023X.

Fließbach, A., and P. Mäder. 1997. Carbon source utilization by microbial communities in soils under organic and conventional farming practice. p. 109–120. *In* H. Insam and A. Rangger (ed.) Microbial communities: Functional versus structural approaches. Springer-Verlag, Berlin.

### THE BOTTOM LINE...

Green manure and off-farm biowaste composts can be used successfully in organic production of high value vegetable crops. These practices can improve soil nutrient bioavailability, reduce N losses to the environment, and sustain soil quality and productivity, while assuring comparable yields as with conventional production.

Sustainable crop production can be achieved through an optimum combination of organic practices that include organic amendments and crop rotations.

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## CREDITS

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