Application of Vermicompost Extract on Pak-Choi: Effects on Yield, Quality, and Soil Biological Properties

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Introduction

- Multiple studies have reported the effect of vermicompost tea on suppression of certain plant diseases (Edwards et al., 2006).
- Application of vermicompost extract (vermicompost tea) may improve plant health, yield and nutritive quality (Pant et al., 2009).
- Few studies have been conducted to determine the effect of vermicompost extract on soil biological properties.

Objectives

To evaluate the effects of vermicompost extract on plant growth, mineral nutrient concentration, phytonutrient content and soil biological properties.

Materials and methods

Experimental Design

- A greenhouse full factorial experiment was arranged in RCBD with 4 replications.
- Pak choi plants were grown in pots in either Oxisol, Mollisol or peat perlite. Green waste compost was incorporated into all pots to supply 150 kg/ha nitrogen.
- Three vermicompost teas (based on extraction methods), a mineral nutrient solution and water (control) were applied weekly for four times @150 mL per pot.

Vermicompost tea preparation

- Extracts were prepared with 3 different methods using 1:10 ratio (vol:vol) of chicken manure based vermicompost and water:

  (i) non-aerated (NCT), (ii) aerated (ACT), and (iii) aerated vermicompost tea with additives (ACTME).
- A mineral nutrient solution (MNS) equivalent to vermicompost extract in terms of NPK was prepared.

Analysis of phytonutrients and soil biological properties

- Total carotenoids, phenolics and glucosinolates were analyzed using standard protocol for each.
- Soil biological properties were evaluated based on dehydrogenase activity in soil and soil respiration.
- Data were analyzed with factorial ANOVA and Fisher Protected LSD Means using SAS.

Fig. 1 Phytonutrients analysis

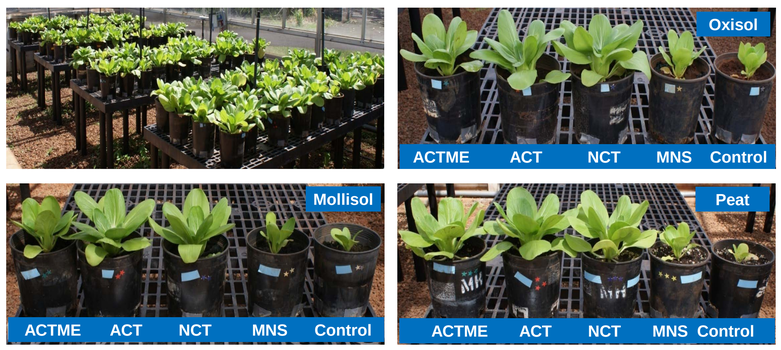

Figure 2. Experiment set up and plant growth across the treatments

Results

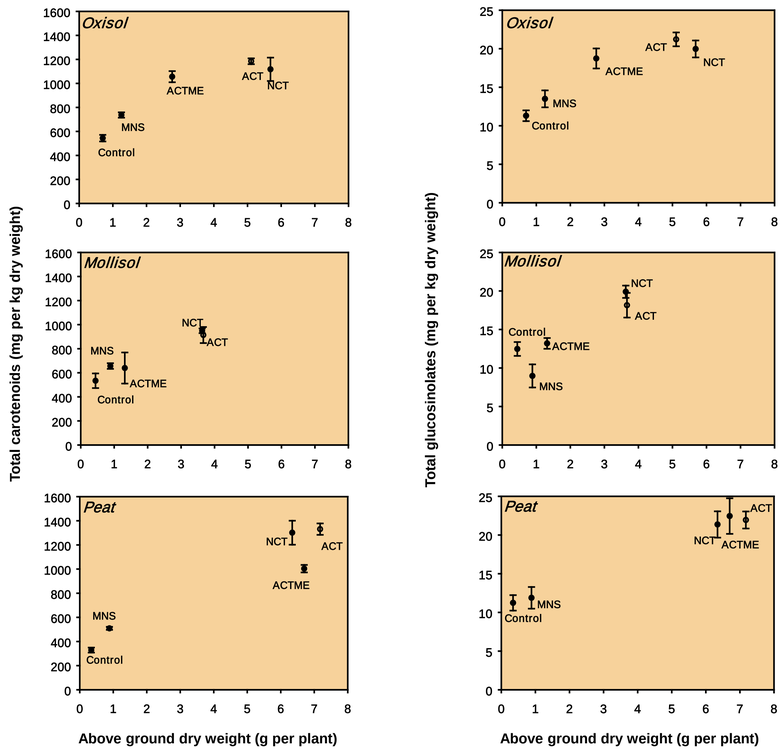

Fig 3. Above ground dry weight relative to total carotenoids and glucosinolates across the soil types

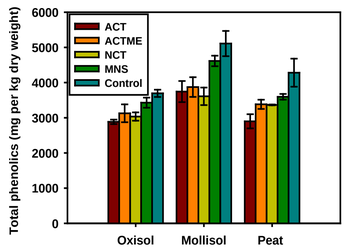

Fig 4. Treatment effects on total phenolics

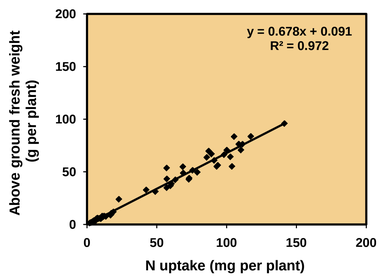

Fig 5. Above ground fresh weight relative to N uptake

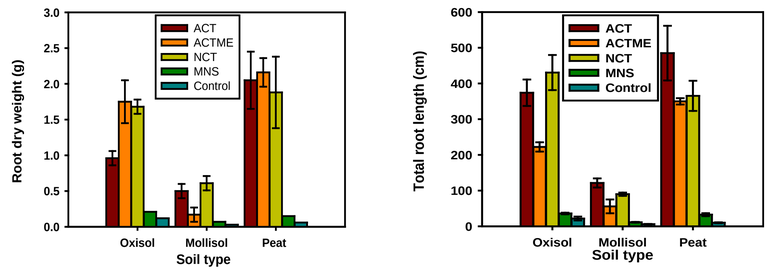

Fig 6. Root dry weight and total root length across the soil type

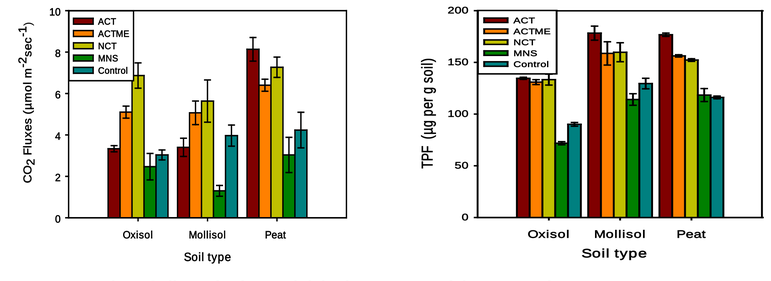

Fig 7. Soil respiration and dehydrogenase activity across the treatments

Results (cont.)

Chemical and microbial properties of vermicompost tea

- Dissolved oxygen was lower and pH and mineral nutrients were higher in ACTME compared with the other teas.
- All teas had higher microbial activity than control and MNS but microbial activity in tea did not differ with extraction method.

Effects on plant growth, mineral and phytonutrients

- Except ACTME in Mollisol, all vermicompost tea increased above ground fresh and dry weight, NPK plant $^{-1}$, total carotenoids and total glucosinolates compared to control and MNS across the soil types (Fig. 3).
- Total phenolic content was significantly lower in vermicompost tea treated plants compared to control and MNS across the soil types (Fig. 4).
- Strong correlation (R = 0.987) between aboveground fresh weight and nitrogen uptake by plants (Fig. 5).
- Vermicompost tea increased root biomass, total root length and root surface area compared to control and MNS(Fig. 6).

Effects on soil respiration and dehydrogenase activities

- Except ACT in Oxisol and Mollisol, all vermicompost tea increased microbial respiration, expressed as µmol CO_2 fluxes m^{-2} sec^{-1}, across the soil types (Fig. 7).
- Dehydrogenase activity of vermicompost extract treated soil (133 µg TPF g^{-1} soil) was approximately 45% higher than that of not treated soil (90 µg TPF g^{-1} soil).
- Moreover, the dehydrogenase activity was positively correlated (r = 0.64) with the soil respiration.

Conclusion

- Vermicompost tea enhanced plant production, mineral nutrient content, total carotenoids and total glucosinolates.
- Better root and shoot growth and enhanced N uptake by vermicompost tea treated plants over MNS treated plants suggests the possibility of microbial and hormonal effect along with the nutrient effect of the tea.
- Non significant effect of ACTME on plant production in Mollisol suggests that use of additives in vermicompost tea may not be appropriate to apply in heavy soil with poor drainage condition.
- The findings of this study suggest that vermicompost extract may be used to improve plant nutrient status and enhance soil biological properties in vegetable production.

References

1. Pant, A, TJK Radovich, NV Hue, ST Talcott, and KA Krenek (2009). Vermicompost extracts influence growth, mineral nutrients, phytonutrients and antioxidant activity in pak choi grown under vermicompost and chemical fertilizer. J Sci Food Agric 89:2383-2392.
2. Edwards, C A; Arancon, NQ; Greytak, S (2006). Effects of vermicompost teas on plant growth and disease. BioCycle 47(5):28-31.

Acknowledgements

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