Assessment of four compost types on the nematode population dynamics in the soil sown with okra

Olabiyi, T.I. and Oladeji, O.O.

Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria

ABSTRACT

Two parallel experiments were conducted at the Teaching and Research Farm, Ladoke Akintola University of Technology and Papa Aireke Farm, both at Ogbomoso, Nigeria, to assess the effect of four different compost types on the nematode population dynamics; the growth and yield of okra, sown into nematode infested soil. Each of the compost was prepared through Rapid Composting Technology with *Trichoderma harzianum* as decomposer, using Windrow method. The four compost types were neem based, cassava peel based, sawdust based and Tithonia based. Nematode susceptible okra variety (NHAe-84-1) was used as test plant. The compost was applied at the rate of 1ton/ha to the treated okra while the okra plants on the untreated soil served as the control. The experimental design was randomized complete block. Data collected included nematode root damage (root gall index), population of juvenile nematode in 10g root and the population dynamics of different nematodes species in the soil. Data were also collected on the plant height, number of leaf/plant, root length, number of pod/plant, pod weight, number of seed/pod of okra. Application of the composts significantly ($p<0.05$) enhanced plant height, number of leaf, root length, number of pod, pod weight and number of seed of okra. The result showed that the compost significantly ($p<0.05$) reduced the root damage (root gall index). The population of *Meloidogyne*, *Heterodera*, *Tylenchus*, *Tylenchulus* species (nematode population dynamics) in the soil treated with composts and of root knot nematode juveniles in the root were significantly reduced.

Keywords: nematode, compost, okra, population dynamics.

Corresponding author: t.olabiyi@yahoo.co.uk; tiolabiyi@lautech.edu.ng

INTRODUCTION

Okra, *Abelmoschus esculentus* L. Moench, belongs to the family Malvaceae. It is one of the highly nutritious vegetables usually eaten while the pod is green, tender and immature. It plays a significant role in human nutrition by providing carbohydrates, protein, fat, minerals and vitamins that is generally deficient in basic foods. It is an economically important vegetable crop grown in the tropical and sub-tropical parts of the world (Ariyo, 1993; Oyelade, *et al.* 2003). However, okra is susceptible to nematodes which, significantly reduced its growth and yield and could also cause 100% crop loss, if effective control measure is not put in place.

Nematodes are microscopic eelworms of nearly a hundred thousand species, capable of causing serious abnormality in a wide range of crops. It is a soil-borne pest that causes stunted and unproductive plants. When root knot nematodes (*Meloidogyne* species), for example, burrow into the roots they stimulate the development of root galls, which become swollen, warty, disfigured and knotty. Plant nematodes can be a real problem in sandy and calcareous soils. They invade growing plant roots and create visible blockages called galls, often described as root knots, which multiply in soil until they eventually destroy the okra.

Compost is an aerobically decomposed organic material derived from plant biomass and animal source. It is rich in available soil nutrients and often used in gardens, landscaping, horticulture and agricultural field crops, to build soil fertility. Physical and chemical properties of the soil are improved by the use of compost, which ultimately increases crop yield (Martens, 2000).

Composting is an effective tool for the management of municipal and agro-industrial wastes by converting raw materials into a stabilized form, destroying human and animal pathogens and recycling valuable plant nutrients (Lasaradi and Stentiford, 1996). In addition, compost amendments are generally found to improve soil quality, due to increased organic matter content and soil microbial populations (Chang, *et al*. 2007). It also exerts a suppressive activity on plant soil-borne pathogens and pests, including plant parasitic nematodes (Bailey and Lazarovits, 2003).

In the past, control of nematodes is primarily based on application of nematicides, but the withdrawal of most nematicides from the market had led to investigation of some sustainable alternative control strategies (Greco and Esmenjaud, 2004). Nematode suppression with compost amendments may involve different mechanisms, such as direct toxicity of degradation products, an increase of natural nematode-antagonist micro-organisms on the compost substrate or even the induction of systemic acquired resistance in plants (Stirling, 1991; Zhang *et al*. 2011).

The objectives of this research are to determine the nematode population dynamics as well as assess the growth and yield of okra, sown in nematode infested soil, treated with compost.

MATERIALS AND METHODS

Two parallel experiments were conducted during 2014 planting season at the Teaching and Research Farm, Ladoke Akintola University of Technology and Papa Aireke Farm, both at Ogbomoso, Nigeria, to assess the effect of four different compost types on the nematode population dynamics, the growth and yield of okra sown into nematode infested soil. The experimental sites were ploughed, harrowed and vegetable beds of 2.5 m by 2.5 m plot size were constructed. Each experimental site, which consisted of four blocks was laid out in a randomized complete block design, with four replicates and five treatments, including the control plot.

Plant establishment: Nematode susceptible seeds (NHAe-84-1) were obtained from the National Horticultural Research Institute (NIHORT), Ibadan, Nigeria.

Treatments application and agronomic practices: The four compost types were neem based, cassava peel based, sawdust based and Tithonia based at the rate of 1.0ton/ha. Each of the compost was prepared through Rapid Composting Technology with *Trichoderma harzianum* as decomposer, using Windrow method. Okra plot where no treatment was applied, served as control. Manual weeding, harvesting and other agronomic practices were carried out as and at when due.

Data collection: Two plants were tagged per plot for data collection, which commenced 3 weeks after planting and continued at 2 weeks interval till the end of the research at both fields. The following data were collected during field trials: plant height, number of leaf per plant, number of fruits per plant, root length, number of seeds per pod, unit weight of pod, root gall index, population of nematode in 250ml soil and population of nematode juvenile in 10g root.

Data analysis: Data obtained from both experimental fields were pooled together and analysed, using analysis of variance while differences between the means were partitioned using Duncan's multiple range test (DMRT) at 5% probability level.

RESULTS AND DISCUSSION:

The effects of different composts were assessed on the growth and yield of okra, planted in plant parasitic nematodes infested soil. The effect of different compost on the growth of Okra planted in nematode infested soil is presented on Table 1.

Compost treatment significantly increased the number of pod per plant, pod weight and number of seed per pod over the control except the saw dust compost treatment which did not differ from the control in number of pod per plant and pod weight. The effects of different composts on root gall and population of nematode juvenile in the root of okra, planted in nematode infested soil is presented on Table 3. Treatment with compost significantly reduced the root gall index and juvenile nematode population in the root of okra

Table 1: Effect of different composts on the growth of okra planted in nematode infested soil.

Treatment	Plant height (cm)	Number of leaf/ plant	Root length (cm)
Neem based compost	49.42 ±6.77b	9.25 ±1.55	12.25 ±1.25ab
Cassava peel based compost	54.25 ±8.73b	11.25 ±1.32	13.00 ±1.68ab
Sawdust based compost	40.85 ±7.35ab	8.75 ±1.65	11.62 ±1.28ab
Tithonia leaf based compost	56.53 ±5.64b	11.25± 2.25	14.75 ± 2.56b
Control	24.78 ±1.67a	8.28 ±0.26 NS	9.25 ± 0.48a

Means followed by the same alphabet are not significantly different using DMRT at 5% probability level. NS means not significant.

Table 2: Effects of different composts on the yield of okra planted on nematode infested soil.

Treatment	Number of pod/plant	Pod weight	Number of seed/ pod
Neem based compost	2.50 ±0.50b	12.96 ±6.10b	61.75 ±14.20b
Cassava peel based compost	1.50 ±0.29b	12.77 ± 2.42b	47.25 ±6.40b
Sawdust based compost	1.75 ±0.25ab	8.50 ±2.07ab	48.75 ±2.10b
Tithonia leaf based compost	2.25 ±0.48b	14.75 ± 0.43b	52.00 ± 7.26b
Control	0.00 ±0.00a	0.00 ± 0.00a	0.00 ± 0.00a

Means followed by the same alphabet are not significantly different using DMRT at 5% probability level.

Table 3: Effects of different composts on root gall and population of nematode juvenile in the root of okra planted in nematode infested soil.

Treatment	Root gall	Population of juvenile nematode
Neem based compost	1.25 ±0.14a	21.25 ±9.20a
Cassava peel based compost	1.75 ±0.32a	16.00 ±7.44a
Sawdust based compost	1.75 ±0.32a	13.25 ±1.11a
Tithonia leaf based compost	1.50 ±0.50a	9.25 ±1.44a
Control	4.58 ±0.85b	81.00 ±1.35b

Means followed by the same alphabet are not significantly different using DMRT at 5% probability.

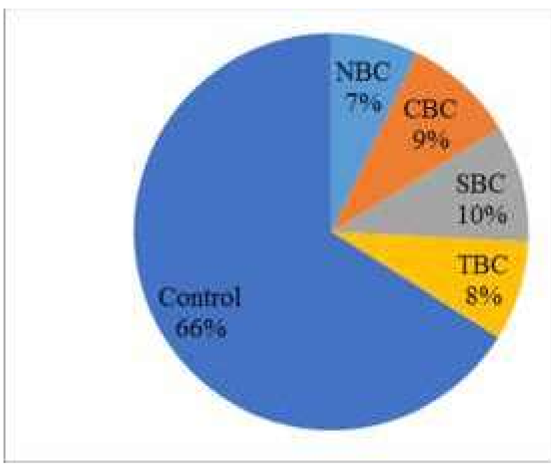

Figure 1: Effect of four different compost on *Meloidogyne* species
NBC: Neem leaf based compost, CBC: Cassava peel based compost, SBC: Sawdust based compost and TBC: Tithonia leaf based compost.

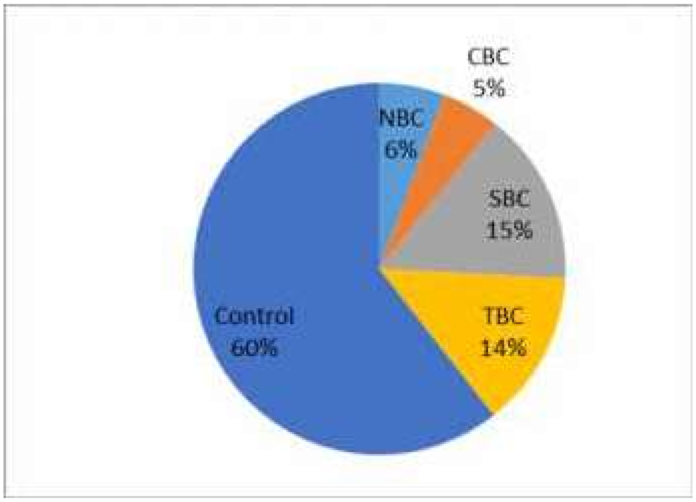

Figure 2: **Effect of four different compost on *Heterodera* species**
NBC: Neem leaf based compost, CBC: Cassava peel based compost, SBC: Sawdust based compost and TBC: Tithonia leaf based compost.

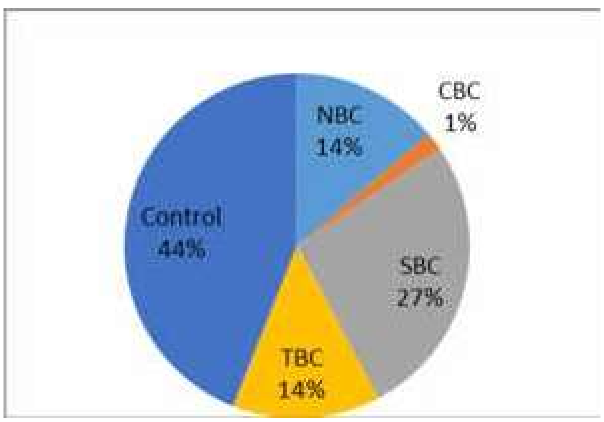

Figure 3: Effect of four different compost on *Tylenchus* species
NBC: Neem leaf based compost, CBC: Cassava peel based compost, SBC: Sawdust based compost and TBC: Tithonia leaf based compost.

The effects of different composts on the final soil nematode population of okra, planted in nematode infested soil is presented in Figures 1 -3. The population of the soil plant parasitic nematodes were significantly reduced in the compost treated soil compared with the control. Neem leaf based compost (NBC), cassava peel based compost (CBC), sawdust based compost (SBC) and Tithonia leaf based compost (TBC) significantly reduced the population of *Meloidogyne*, *Heterodera* and *Tylenchus* nematode species in the soil planted with okra when compared with the untreated control experiments.

The results obtained were in agreement with the findings of Ozores-Hampton (2002) that the use of organic amendments suppressed soil phyto-parasitic nematode populations. The use will thus reduce the adverse effects of nematicides such as pollutions, health hazards on the environment and consumer food produced from it. The result also confirms the findings of Sarwa *et al*. (2010) that the use of compost will not only supplement the chemical fertilizers, but also reduce environmental pollution. This will result in a higher yield with higher incomes to the farming community in this cultural system.

CONCLUSION

The application of *Trichoderma harzianum* incorporated into neem, cassava, sawdust and Tithonia composts have significant effect on the growth and yield of okra. It also significantly reduced the erratic nematode population changes. The results of this study has further confirmed that organic compost are nemato-toxic and they could be used in the control of *Meloidogyne, Heterodera, Tylenchus* and *Tylenchulus* infections on okra.

REFERENCES

Ariyo, O.J. (1990): Variation and heritability of fifteen characters on okra (*Abelmoschus esculentus* (L.) Moench). Trop. Agric. 67: 213-216.

Barley, K.L. and Lazarovitz, G. (2003): Suppressing soil-borne diseases with residue management and organic amendments. Soil and Tillage Research 72, 169-180.

Chang, E.H., Chung, R.S. & Tsai, Y.H. (2007): Effect of different applications rates of organic fertilizer on soil enzyme activity and microbial population. Soil science and Plant Nutrition 53, 132-140.

Greco, N. and Esmanjaud, D. (2004): management strategies for nematode control in Europe. In: Cook,R. Hunt, D.J. (Eds) Nematology monograph and perspectives. Leiden, The Netherlands: Brill press pp. 33-43.

Jagadeeswari, P.V. and K. Kumaraswamy. (2000): Long-term effects of manure fertilizer schedules on the yield and nutrient uptake by rice crop in a permanent manorial experiment. J. Ind. Soc. Soil Sci. 48: 833-836.

Martens, D. A. (2000): Management and crop residue influence soil aggregate stability. J. Environ. Qual. 29: 723–727.

Oyelade, O.J., B.I.O. Ade-Omowaye and V.F. Adeomi. (2003): Influence of variety on protein, fat contents and some physical characteristics of okra seeds. J. Food Eng. 57: 111-114.

Ozores-Hampton, M. (2002): Organic materials in horticulture: An industry perspective. Intro. Hor. Tech. 12(3): 8-9.

Sarwar, G., H. Schmeisky, M.A. Tahir, Y. Iftikhar and N. U. Sabah. (2010): Application of green compost for improvement in soil chemical properties and fertility status. The J. Animal & Plant Sciences 20(4): 258-260.

Stirling, G.R. (1991): Mode of action of organics amendments against nematode. In: Biological control of plant parasitic Nematodes. Progress, problems and prospects. C.A.B. international, pp. 170-185.

Zhang, M., S. S. Malhi, R. Panasuik and B. Henriquez. (2011): Response of turfgrass growth in a black chernozemic soil amended with municipal solid/biosolid waste compost. J. Plant Nutrition 34: 183 – 205.