

Potency of Arati-Obd+ Organic Fertilizer on Plant-Parasitic and Free-Living Nematodes in Peppermint (*Mentha Piperita* L.) Field

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Peppermint (*Mentha piperita* L.) is one of the most economical aromatic and medicinal crops useful in pharmaceutical and agro-allied industries globally. In view of the potential threat Plant-Parasitic Nematodes (PPN) pose to the crop, a study was conducted to appraise the effects of Arati-OBd⁺ organic fertilizer in the control of associated phytonematodes in a field in Abeokuta. Responses of Free-Living Nematodes (FLN) to the organic fertilizer were also recorded. The fertilizer was applied at 0 t ha⁻¹, 5 t ha⁻¹ or 10 t ha⁻¹, laid out in Randomized Complete Block Design with three replications. Five core soil samples were collected randomly from the rhizosphere at depth of 0-30 cm, once every month for the period of three months per plot. Soil samples per plot were bulked to form a composite sample from which 250 g sub-samples were obtained and assayed for nematode presence, type and numbers of each found. Results indicated that 11 genera of PPN were found in the organic peppermint tested. They included *Helicotylenchus*, *Rotylenchus*, *Rotylenchulus*, *Meloidogyne*, *Longidorus*, *Aphelenchus*, *Radopholus*, *Tylenchulus*, *Ditylenchus*, *Hoplolaimus*, *Pratylenchus* and some free-living nematodes. These nematodes varied significantly ($P \leq 0.05$) across treatments. Application of Arati-OBd⁺ at 5 t ha⁻¹ and 10 t ha⁻¹ significantly ($P \leq 0.05$) suppressed PPN compared with untreated (control) plots. *Ditylenchus*, *Tylenchulus*, *Meloidogyne*, *Radopholus* and *Aphelenchus* decreased by up to 100% (total control), *Helicotylenchus* by 73 - 50% and *Rotylenchus* by 60 - 33% in the treated plots while the FLN increased by as much as 18 - 47% in the soil following application 5 - 10 t ha⁻¹.

Introduction

Peppermint is one of the most economically important aromatic and medicinal crops in the pharmaceutical and agro-allied industries world-wide (Eccles, 1994). It is a perennial herbaceous plant with rhizome and of the family *Lamiaceae* (Begay, 2005). The leaves and shoots are commonly used as spice and medicine, which contain therapeutic properties such as antibacterial, antifungal and antiseptic (Mimica-Dukic, 2008) and also used in preparation of herbal concoction (Beemnet, 2010). Peppermint is also used as flavouring agent by food, gum, toothpaste and tea industries (Chessa, 2013). Beside this, it contains essential oil useful in pharmaceutical, nutraceutical and cosmeceutical industries (Verma, 2010) and the oil can cure headache, diarrhea and menstrual cramps (Chessa, 2013).

Phytonematodes are one of the most important groups of pathogenic organisms found around the rhizosphere, which reduce the growth and yield of medicinal and aromatic plants (Pandey *et al.*, 2010). Diversity of diseases such as nematode diseases have been reported on peppermint as a result of severe damage posed to this crop every year (Pandey, 2005). Emerging organic farmers in developing countries

must put in place sound nematode control program to make it attractive and profitable (Atungwu *et al.*, 2013).

The use of mineral fertilizer is the fastest way to meet plant nutrients (Mando, 2005), but crop yield can be affected by its excessive application and lead to soil acidification, loss of soil biological activity, nutrient imbalance and loss of soil physical properties (Adediran, 2004). Plants grown on less organic matter soil are prone to severe nematode damage compared with plants grown on high organic matter soil (Al-Rehiyani, 2001). Use of synthetic nematicides and fertilizers has been in existence but they result to environmental and health hazards. Currently, information on management of phytonematodes and their diseases in relation to medicinal and aromatic plants is limited (Pandey, 2009). The present study was therefore, designed to determine the effect of Arati-OBd⁺ organic fertilizer on plant-parasitic and free living nematodes population in peppermint field.

Materials and Methods

Five core soil samples were collected randomly on an established peppermint plot between October and December, 2014 at Organic Agriculture Skills Demonstration Plot, Federal University of Agriculture, and Abeokuta in Ogun State. Arati-OBd⁺ organic fertilizer was applied at 0 tha⁻¹, 5 tha⁻¹ or 10 tha⁻¹ and replicated three times was applied on experimental plot laid out in Randomized Completely Block Design (RCBD).

Nematode extraction from soil

Composite soil sample was gently mixed and 250 g sub-soil was taken for nematode assay using Whitehead and Hemming nematode extraction technique (Whitehead and Hemming, 1965). Double-ply nematode extractor tissue paper was sandwiched between two plastic sieves of 15 cm inside diameter, placed in a 25 cm inside diameter bowl and arranged on the laboratory bench. Two hundred and fifty millimeter (250 ml) of water was gently poured to the extraction bowl and the set up was left undisturbed for 24 hours, and thereafter poured into a 500 ml Nalgene bottle and topped up. It was left undisturbed for 5 hrs and the supernatant was siphoned out with the aid of 3 mm inside diameter siphoning tube and quantified.

Nematode assay and identification

All nematodes in the composite sample were counted and identified with the aid of stereo and compound microscope respectively using the simplified nematode pictorial key of Mai and Lyon (1975). One ml of nematode suspension was pipette to Doncaster ringed nematode-counting dish placed under stereo microscope. Nematodes were identified and counted. Unfamiliar nematodes were picked with a finely pointed broom stick to a slide and placed under compound microscope for identity confirmation.

Data collection and analysis

Soil sample collected each month were assayed for nematode presence, types and number of nematodes. Data collected on the number of nematodes were transformed to reduction percentage (Puntener, 1981).

Results

Nematode genera found in the rhizosphere of peppermint in Abeokuta, Ogun State is presented in Table 1. Eleven genera of PPN belonging to two orders were found associated with peppermint in Abeokuta, Nigeria between October and December, 2014. Ten of the eleven genera belong to the order *Tylenchida*,

while only one genus belongs to the order *Dorylaimida*. The genus belongs to different families like *Aphelenchidae*, *Tylenchulidae*, *Meloidogynidae*, *Tylenchidae*, *Pratylenchidae*, *Hoplolaimidae*, *Nacobidae*, *Heteroderidae* and *Longidoridae*.

Reduction percentage of PPN and FLN on peppermint with respect to Arati-OB^D organic fertilizer application is presented in Table 2. All PPN found on peppermint field were greatly suppressed ($P < 0.05$) by 100 – 33% in October, November and December irrespective of the application rate compared with PPN in control plot (0%) which were not reduced. The reduction rate of FLN on the field was low compared with reduction rate of PPN. Also, gradual disappearance of some PPN from peppermint field was noticed in November and December.

Table 1. **Genera, order and family of plant parasitic nematodes in the rhizosphere of peppermint in Abeokuta between October and December, 2014**

Genera	Family	Order
<i>Aphelenchus</i>	<i>Aphelenchidae</i>	<i>Tylenchida</i>
<i>Radopholus</i>	<i>Pratylenchidae</i>	<i>Tylenchida</i>
<i>Tylenchulus</i>	<i>Tylenchulidae</i>	<i>Tylenchida</i>
<i>Meloidogyne</i>	<i>Meloidogynidae</i>	<i>Tylenchida</i>
<i>Ditylenchus</i>	<i>Tylenchidae</i>	<i>Tylenchida</i>
<i>Pratylenchus</i>	<i>Pratylenchidae</i>	<i>Tylenchida</i>
<i>Helicotylenchus</i>	<i>Hoplolaimidae</i>	<i>Tylenchida</i>
<i>Rotylenchus</i>	<i>Hoplolaimidae</i>	<i>Tylenchida</i>
<i>Rotylenchulus</i>	<i>Nacobidae</i>	<i>Tylenchida</i>
<i>Hoplolaimus</i>	<i>Hoplolaimidae</i>	<i>Tylenchida</i>
<i>Longidorus</i>	<i>Longidoridae</i>	<i>Dorylaimida</i>

Table 2. **Reduction percentage of PPN and FLN population on peppermint at Abeokuta between October and December, 2014**

TRT	APH (%)	RAD (%)	TYL (%)	MEL (%)	DIT (%)	PRA (%)	HEL (%)	ROT (%)	RLUS (%)	HOP (%)	LON (%)	FLN (%)
October												
0 tha ⁻¹	0	0	0	0	0	0	0	0	0	AB	AB	0
5 tha ⁻¹	0	100	75	100	100	100	73	100	100	AB	AB	47
10 tha ⁻¹	100	0	75	100	100	100	63	0	100	AB	AB	29
November												
0 tha ⁻¹	AB	0	0	0	0	AB	0	0	0	0	0	0
5 tha ⁻¹	AB	100	0	0	100	AB	50	60	0	100	100	18
10 tha ⁻¹	AB	100	100	100	0	AB	50	60	100	0	0	1
December												
0 tha ⁻¹	AB	AB	AB	AB	0	AB	AB	0	0	AB	AB	0
5 tha ⁻¹	AB	AB	AB	AB	100	AB	AB	33	33	AB	AB	12
10 tha ⁻¹	AB	AB	AB	AB	100	AB	AB	33	33	AB	AB	12

KEY: TRT - Treatment, APH - *Aphelenchus*, RAD - *Radopholus*, THY - *Tylenchulus*, MEL - *Meloidogyne*, DIT - *Ditylenchus*, PRA - *Pratylenchus*, ROT - *Rotylenchus*, RLUS - *Rotylenchulus*, HEL - *Helicotylenchus*, HOP - *Hoplolaimus*, LON - *Longidorus*, FLN - Free Living Nematode, % - Percentage, tha⁻¹ - tons/hectare, AB - Absent.

Discussion

In this study, Arati-OBD⁺ organic fertilizer at both 5 t ha⁻¹ and 10 t ha⁻¹ application rate were found effective in suppressing the population of plant-parasitic nematodes and drastically increased their free-living counterparts in peppermint field and this corroborate findings of Renco *et al.*, (2011) who reported that several organic fertilizers have been proved to effectively suppress the population of PPN and also stimulated the population of FLN. The present study demonstrated that Arati-OBD⁺, a novel organic fertilizer been advocated for used by the emerging organic growers in Nigeria had proven to cause a great reduction in PPN population, which thereby resulted in increase of the FLN population on peppermint field.

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