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Efficacy of neem compost on root knot nematode pest of Lagos spinach, *Celosia argentea*

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The effects of neem compost on root knot nematode, *Meloidogyne incognita*, pest of Lagos spinach, *Celosia argentea*, cv. TLV 8, was studied during 2010 and 2011 planting seasons on the field. The trial was conducted at the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso, Nigeria. There were four treatments, replicated five times fitted into randomised complete block design. Neem compost was applied at 1.0, 1.5 and 2.0 tonnes/ha. Experimental plots, where no compost was applied served as the control. The result obtained shows that Lagos spinach treated with neem compost significantly ($p < 0.05$) reduced the final soil nematode population and root infections (damage), with resultant improvement on crop growth and yield. The result of the chemical analysis of the neem compost revealed the presence of flavonoids, sterols, glycosides, alkaloids and saponins.

Keywords: *Celosia argentea*; nematode; control; neem compost; Lagos spinach

1. Introduction

Lagos spinach, *Celosia argentea*, L. is a vegetable belonging to the family Amaranthaceae. It is a very common herbaceous plant in the tropical regions of the world. Vegetable is a source of food, which is low in calories and dry matter content. Nematode pests, if not duly controlled will lead to the entry and establishment of plant pathogenic fungi, bacteria or viruses (Adesiyan et al. 1979). Nematodes are important pests found in vegetables in Nigeria. Chemical nematicides are sources of environmental pollution. Globally, natural plants are at present the focus of research efforts because of their ability to produce environmentally less harmful and efficacious chemical substances (Schmutterer 1990; Olabiyi 2004).

The root knot nematode, *Meloidogyne incognita*, is sedentary endo-parasite and is among the most damaging agricultural pests, attacking a wide range of crops (Katooli et al. 2010). The infections start with root penetration of second stage juveniles, hatched

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in soil, from eggs stored in egg masses that have been laid by the female on the infected roots. Nematodes pass through an embryonic stage, four juvenile stages (J1–J4) and an adult stage. Juvenile of *Meloidogyne* hatch from eggs as vermiform second stage juveniles (J2), the first moult having occurred within the egg. Newly-hatched juveniles have a short free-living stage in the soil, in the rhizosphere of the host plant. They may reinvade the host plant of their parent or migrate through the soil to find a new host root. J2 larvae do not feed during the free living stage, but use lipids stored in the gut (Jonathan & Hedwig 1991). These nematodes burrow into the soft tissues of root tips and young root and cause the nearby root cells to divide and enlarge. Root knot galls damage the vascular tissues of root and thus interfere with the normal movement of water and nutrient through the plant.

Different plant materials, including African marigold, Basil leaf, rattle weed and Nitta plant have been used to control root-knot nematodes (Olabiyi & Ndana 2003). Also neem in composted and un-decomposed forms, wild sunflower, fresh and composted rice straw leaves, sawdust and chicken dung have been used as organic amendments in the control of nematodes (Olabiyi et al. 2008; Izuogu & Oyedunmade 2009). Vats et al. (1996) also reported reduction in number of galls and egg masses as well as increase in plant growth as a result of treating *Meloidogyne javanica* infected tomato with leaf extracts of *Azadirachta indica* and *Eucalyptus tereticornis*.

The objective of this paper is therefore to carefully examine the effect of neem compost on root knot nematode pest of Lagos spinach, *C. argentea*, cv. TLV8.

2. Materials and methods

2.1. Preparation of compost materials

A windrow method was used for the preparation of neem compost at the Teaching and Research farm, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria. Ten kilograms of neem fresh leaf material was placed into the nylon and 1 kg of poultry manure was spread across the top of the material as a biological activator. Thereafter 1 kg wood ash was placed on the material to neutralise the acidity. Five layers of this composition were prepared. The material was thereafter mixed every 4 weeks, until the material was fully formed (decomposed) at the fifth month. The decomposed material was spread and air dried. The compost was ground into powder form. This powdered compost was singly applied as soil amendments to the plots at the base of the plants in ring form and at the rates of 1.0, 1.5 and 2.0 tonnes/ha. The experimental plot where no compost was applied served as the control plot.

2.2. Experimental research

Field experiments were carried out at LAUTECH Organic Garden section of the LAUTECH Teaching and Research Farm, Ogbomoso, Nigeria. The land was prepared into vegetable beds of 4 m × 1 m sizes. Root knot nematode susceptible seeds of Lagos spinach, *C. argentea*, cv. TLV 8, obtained from National Horticultural Research Institute, Ibadan, Nigeria, were sown at three seeds per stand. Two weeks after planting, *Celosia* seedlings were thinned to two healthy plants per stand. Standard method (Hussey & Barker 1973) was used to obtain eggs of root-knot nematode, *M. incognita* from root stock culture of root knot nematode infected tomato. At three weeks after planting, each Lagos spinach plant on the field was inoculated with approximately 5000, root knot nematode eggs. The experimental field was divided into four blocks. There would be

five treatments and four replicates. The experiment was a randomised complete block design. Four weeks after planting till final harvest, data were collected on plant height, number of leaves per plant and number of branches per plant. At final harvest, data were collected on root galls on Lagos spinach following Sasser et al. (1984), on 0–5 rating scale, where 0 = no galls; 1 = 1–2% galls; 2 = 3–30% galls; 4 = 31–70% galls and 5 = 71–100% galls. Data were also collected on final root-knot nematode soil population in 200 ml soil. All data in 2010 and 2011 were subjected to analysis of variance and where necessary the means were partitioned using Duncan's Multiple Range test at 5% probability level.

2.3. Chemical analysis of neem compost

The neem leaf based compost was assessed for the presence of some chemical compounds (saponins, flavonoids, tannins, sterols, glycosides and alkaloids) in the University Central Research Laboratory, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Test for Saponin: 2 ml of crude extract of neem compost in a test tube was vigorously shaken for 2 min. Non-appearance of froth indicates the absence of saponins. *Test for Flavonoids:* 1 ml of 10% NaOH was added to 4 ml of extracts of neem compost. A yellow colour observed indicates the presence of flavonoids. *Test for tannins:* Two drops of 5% ferric chloride was added to 1 ml of crude extract of neem compost. An orange colour observed in the extract indicates the presence of tannins. *Test for sterols:* 1 ml of concentrated sulphuric acid (H_2SO_4) was added to 3 ml of neem compost solution. A reddish-brown colour solution observed indicates the presence of sterols. *Test for glycosides:* 10 ml of 50% concentrated sulphuric acid (H_2SO_4) was added to 1 ml of neem compost solution in a test tube. The mixture was heated in boiling water for 15 min. Fehling's solution (5 ml each of Fehling's solution A and B) was added and the mixture was boiled. A yellowish colour solution observed indicates the presence of glycosides. *Test for alkaloids:* 1 ml of 1% hydrochloric (HCl) acid was added to 3 ml of neem compost solution in the test tube. The mixture was boiled for 20 min and filtered. A portion of the filtrate was treated with two drops each of Mayer's and Wagner's reagent separately. It was observed that neem compost contained alkaloids.

3. Results

All the treatments performed significantly better than the control in improving the growth of Lagos spinach (Table 1). The results obtained revealed that the three applica-

Table 1. Effects of neem compost on the growth of *Celosia* cv. TLV 8.

	2010			2011		
Treatments	Mean number of leaf/plant	Mean plant height (cm)	Mean number of branches	Mean number of leaf/plant	Mean plant height (cm)	Mean number of branches
Control	90.5b	50.4c	9.2b	97.9b	52.1c	8.4b
1.0 tonne/ha	329.7a	71.6b	19.2a	332.2a	73.1b	21.5a
1.5 tonne/ha	333.5a	85.6a	19.8a	337.8a	88.1a	22.1a
2.0 tonnes/ha	347.1a	90.5a	20.5a	339.2a	89.6a	21.9a

Table 2. Effects of neem compost on the root gall and soil nematode population.

Treatments	2010		2011	
	Mean root gall index	Mean root knot soil population (200 ml)	Mean root gall index	Mean root knot soil population (200 ml)
Control	4.5b	1865b	4.7b	2669b
1.0 tonne/ha	1.5a	301a	1.3a	279a
1.5 tonne/ha	1.5a	283a	1.4a	263a
2.0 tonnes/ha	1.2a	280a	1.0a	250a

Table 3. Chemical analysis of neem compost.

Chemical constituent	Inference
Tannins	Absent
Saponins	Present
Flavonoids	Present
Alkaloids	Present
Glycosides	Present
Sterols	Present

tion rates (1.0, 1.5, and 2.0 tonnes/ha) of neem compost have significant effects on the number of leaf/plant, plant height and number of branches/plant; and were significantly better than the control plant.

Table 2 elicits the effect of neem compost on the soil nematode population and severity of nematode pest on root damage (root gall). Neem compost suppressed the increase in soil nematode population and also significantly reduced the level of damage on the root. Neem compost contained certain nematicidal properties (Table 3). Saponins, flavonoids, alkaloids, glycosides and sterols are nematoxic component of neem compost.

4. Discussion

Findings in this study showed that the neem compost has bio-nematicidal properties. However, the efficacy of the neem compost depends on the level applied. The higher levels effectively control the incidence of root-knot nematode in Lagos spinach, *C. argentea*, and thus improve growth and yield.

The results obtained corroborate earlier research finding of Siddiqqui (2004) that reported effective root-knot nematode management after the application of composted organic fertiliser on nematode infected soil grown with tomato. It had been reported that composted organic materials may suppress plant-parasitic nematode population, improve crop tolerance and increase plant growth by providing better soil structure, supply of nutrients, and build antagonistic organisms (Southey 1978). Nevertheless, compost applications for plant parasitic nematode control are extremely heterogeneous (D'Addabbo 1995). Organic matter and biofumigation soil amendments were non-chemical measures against parasitic nematode control by the Methyl Bromide Technical Options Committee (MBTOC 2002). Laboratory and field experiments have shown that compost application stimulates the biological activity of soils, increasing the populations of

antagonistic organisms of pathogens such as *Trichoderma* spp., *Pseudomonas fluorescens* and *Bacillus* spp., saprophagous and bacteriophagous nematodes, and plant-parasitic fungi (Riegel & Noe 2000; Chavarria-Carvajal et al. 2001).

Active neem constituents can be absorbed through plant roots and systemically move upward through the plant through xylem tissues (Gill & Lewis 1971; Larew 1988; Osman & Port 1990; Nisbet et al. 1993). These active constituents work best when sufficient quantities are applied to the crop root zone. Systematic effects are much less apparent from foliar sprays. Different plant species also differ widely in their ability to have systemic effects of neem. Neem constituents last much longer within the plant root rhizosphere than when sprayed on the leaves.

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