American-Eurasian Journal of Agronomy, 4 (2): 23-27, 2011
ISSN 1995-896X

Suppression of Nematode Pests of Tomato with Aqueous Leaf Extracts of Nitta, Tobacco and Pawpaw

[1]T.I. Olabiyi, [1]I.O. Adepoju,[2]S.A. Abolusoro and [3]E.E.A. Oyedunmade

[1]Department of Crop and Environmental Protection,
Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria
[2]Department of Crop Production Technology, DAC/ABU, Kabba Campus, Kogi State, Nigeria
[3]Department of Crop Protection, University of Ilorin, P.M.B. 1515, Ilorin, Nigeria

Abstract: Pot experiments with steam sterilized soil were conducted twice to examine the effect of extracts from the leaves of nitta (*Hyptis suaveolens*), tobacco (*Nicotiana tabacum*) and pawpaw (*Carica papaya*) on tomato, *Lycopersicon esculentum* cv. Ibadan local. Application of aqueous leaf extracts (50% and 100% concentrations) from the leaves of nitta, tobacco and pawpaw resulted in higher growth and yield of tomato as compared with the control (distilled water only). Both control and aqueous leaf extract treatments were replicated four times in a completely randomized design. The mean plant height, number of leaves per plant, root weight, fruit number per plant and fruit weight of the leaf extract-treated tomato was of the range 40±6 cm, 22±3, 5±2g, 15±1 and 53±4 g, respectively. The control plants were of the order 21.3 cm, 11.2, 15.4 g, 6.5 and 24.5 g, respectively. Tomato plants in the control experiment were heavily galled by *Meloidogyne* species, resulting in high root weight. Moreover, the leaf extracts significantly ($p<0.05$) suppressed the soil nematode population and root gall index.

Key words: Control · Helicotylenchus · Leaf extracts · *Meloidogyne* spp · Nematode pests · *Pratylenchus* sp. · Tomato · Xiphinema

INTRODUCTION

Tomato is susceptible to plant parasitic nematodes [1, 2]. Soil inhabiting nematode pests had been identified as a major constraint limiting the growth and yield of tomato in Nigeria [3-5].

Application of soil amendment either in the form of plant extracts, compost or manure and other biocides into the soil, in an attempt to augment soil nutrient and/or control or suppress plant diseases and insect pests under the nascent organic agriculture in Nigeria is used as a vibrant area of research interest. The agricultural sector in Nigeria is facing a new challenge as it is currently in a transition stage between conventional and organic farming system.

Scarcity, high cost, environmental safety and global restrictions on the importation of chemical nematicides have spurred scientists to search for alternative control measures against nematode pests of economic food crops [6]. The use of plant extracts for the control of nematode pests had been suggested [7]. The application of plant extracts into the soil has the potential advantage of being economical, ready available and environmentally safe [5, 8, 9].

Organic agriculture emphasizes agricultural production without the application of synthetic chemicals (fertilizers, pesticides, herbicides and antibiotics). A few plant extract had been reported to suppress nematode pests in Nigeria. Roots extracts of siam weed (*Chromolaena odorata*), neem (*Azadirachta indica*), castor oil (*Ricinus communis*) and lemon grass (*Cybopogon citratus*) [10]; root bark extract of *Bixa orellana* [11]; roots and leaves of African marigold (*Tagetes erecta*), rattle weed (*Crotalaria retusa*), nitta (*Hyptis suaveolens*) and basil, *Ocimum gratissimum* [5, 12]; the leaf, stem, root and flower of African marigold, *Tagetes erecta* [13]; neem (*Azadirachta indica*) fruits (14); neem (*Azadirachta indica*) leaf were among the few plant extracts reported to be effective against nematode pests in Nigeria [15].

This study was designed to evaluate the effects of extracts from nitta, tobacco and pawpaw leaves on nematode pests of tomato cv. Ibadan local.

Corresponding Author: Dr. T.I. Olabiyi, Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria.

MATERIALS AND METHODS

The pot experiment was carried out at the Teaching and Research Farms, Ladoke Akintola University of Technology, Ogbomoso, Nigeria. The experiment was carried out twice (2008 and 2009) and data collected was pooled together for analysis.

Soil Sterilization and Experimental Design: Top soil (1-10 cm) was mixed thoroughly, sieved (2 mm aperture) and steam sterilized (5 hours, 80-100°C). Ten [10] kilogram steam sterilized soil sample was measured into 15 litre sized perforated plastic pots and arranged on the concrete floor at the Crop-Type Collection unit of the farm. The alkalinity/acidity of the soil was tested using a pH meter and determined to be pH 6.0. The experimental design was a completely randomised design in which there were seven treatments (control inclusive), each replicated four times.

Crop Establishment: The seeds of the tomato cv. Ibadan local were collected at the National Institute for Horticultural Research and Training (NIHORT), Ibadan, Nigeria. The tomato seeds had been confirmed to be susceptible to nematode pests in an earlier experiment [2]. Four seeds were planted into each experimental pot, which were later thinned down to one healthy plant per pot.

Extraction and Inoculation of the Tomato with Nematodes: Plant parasitic nematodes were extracted from tomato using the method a standard method [16] and the extracted nematodes used for the inoculation were *Meloidogyne, Pratylenchus, Xiphinema* and *Helicotylenchus* spp. The initial population of nematode species which were used for the inoculation of the tomato plants was as recorded in Table 1. Inoculation was done at three weeks after planting (3WAP).

Preparation and Application of Plant Extracts: Extracts were prepared from the leaves of nitta, tobacco and pawpaw. Each of these leaves was collected within the University premises, air-dried on the laboratory benches at a room temperature range 25±2°C for a month and each leaf was thereafter ground into powder form using a pestle and mortar. A kilogram of each leaf, in powder form, was soaked in 1 litre of distilled water for 24 hours (1 day). The extract (stock solution or 100% concentration) was sieved (0.05 mm aperture) and the filtrate was divided into two. A portion (500 ml) was kept at 100% concentration while the other (500 ml) was diluted to 50% concentration. Four weeks after planting (4WAP), the extracts (50% and 100% concentrations) were applied at the rate of 100 ml/plant in a band form under tomato canopy. Experimental pots grown with tomato and inoculated with nematode pests and not treated with any leaf extract but only distilled water served as the control.

Data Collection and Analysis: In both trial experiments, data was collected on plant height, number of leaf, number of fruit, fruit weight, root weight, root gall index, initial and final nematode population. The data was pooled together and its means were analysed. Data collected were subjected to analysis of variance (ANOVA) and where possible means were separated using Duncan's Multiple Range Tests at 5% probability level [17].

RESULTS

Effects of Different Concentrations of the Leaf Extracts of Pawpaw, Tobacco and Nitta on the Growth and Yield of Tomato: The effects of different concentrations of leaf extracts of pawpaw, tobacco and nitta on the mean height of tomato are presented in Table 1. Tomato treated with either 50% or 100% concentrated leaf extract grew taller than the control. The mean height of the tomato treated with the different concentrations of the leaf extracts was of the range 40±6 cm. The control experimental plants had the least height of 21.3 cm. However, tomato plants treated with nitta leaf extract at 100% concentration grew taller than tomato plants in all other treatments.

The results presented in Table 1 also show that the different leaf extracts at both 50% and 100% concentrations resulted in a high number of leaves per tomato plant grown on nematode infested soil. Tomato plants that were treated with either 50% or 100% concentrated leaf extracts have higher numbers of leaves than controls without leaf extract. The leaf number of the treated tomato was 22±3 and the untreated (control) was 11.2. The control tomato plants had the least number of leaves per plant.

The results presented in Table 1 show that the leaf extracts applied at different concentration (50% and 100%) suppressed galls on the root of tomato thereby attempted to give tomato its normal root weight. Galls that were significantly reduced on the root of tomato plants that were treated with different leaf extracts caused the roots to have lower root weight than tomato roots in the control experiment. There were significant and conspicuous galls on the roots of tomato in the control experiment. Tomato plants that were not treated (control) had the highest root weight when compared with those tomato plants that were treated with either 50% or 100% concentrated leaf extracts. The root weights of treated and untreated (control) tomato plants were 5±2 g and 15.4 g, respectively.

Table 1: Effects of different concentrations of the leaf extracts of pawpaw, tobacco and nitta on the some growth and yield parameters of tomato

Plant materials	% conc.	Plant height	Number of leaf/plant	Root weight (g)	Number of fruit/plant	Fruit weight
Pawpaw leaf	50	34.0b	19.0a	7.0b	13.0a	49.0b
	100	42.4a	23.6a	5.1b	15.3a	50.0b
Tobacco leaf	50	41.1a	21.3a	5.2b	14.5a	50.0b
	100	41.9a	24.0a	5.0b	15.7a	50.0b
Nitta leaf	50	40.5a	23.2a	5.4b	15.1a	50.5b
	100	46.0a	25.0a	4.0b	16.0a	57.0a
Control	0	21.3c	11.2b	15.4a	6.5b	24.5c

Means followed by the same letter(s) along the same column are not statistically different at 5% probability level.

Table 2: The population of nematodes in the soil at planting (initial) and harvest (final) and root gall index.

		Meloidogyne spp.		*Xiphinema* sp.		*Pratylenchus* spp.		*Helicotylenchus* sp.		Root gall
Plant materials	% conc	Initial count	Final count	Initial count	Final count	Initial count	Final count	Initial count	Final count	index
Pawpaw leaf	50	785	430c	76	37a	61	27a	224	81b	2.1b
	100	796	374b	73	32a	58	30a	218	70b	1.3a
Tobacco leaf	50	788	425c	67	34a	56	32a	217	78b	1.4a
	100	801	301a	66	31a	60	29a	204	50a	1.0a
Nitta leaf	50	794	367b	70	38a	55	28a	209	56a	1.2a
	100	796	294a	76	40a	61	25a	220	52a	1.0a
Control	0	792	1894d	71	161b	59	87b	222	315c	4.5c
		NS		NS		NS		NS		

NS = Not Significant.

Means followed by the same letter(s) along the same column are not statistically different at 5% probability level

The Effects of different concentrations of the leaf extracts of pawpaw, tobacco and nitta plants on the number of fruit per tomato are presented in Table 1. The numbers of fruit per tomato were highest in tomato plants that were treated with 100% concentrated nitta leaf extract; this was closely followed by tomato treated with 100% concentrated pawpaw leaf extract. Tomato plants treated with either 50% or 100% concentrated leaf extracts gave better fruit number per plant when compared with tomato plants that were not treated (control). While the number of fruit of the treated tomato was of the range 15±1 fruits, the control had the least average of 6.5 fruits per plant.

The Effect of different concentration of leaf extracts on the fruit weight of tomato was presented in Table 1. Tomato plants that were treated with the leaf extracts (50% or 100%) had higher fruit weight than the tomato plants that were not treated with the leaf extract (control). The fruit weight of tomato plants that were treated with leaf extracts was 53±4 g while that of the untreated tomato (control) was the least at 24.5 g.

Effects of Different Concentrations of the Leaf Extracts of Pawpaw, Tobacco and Nitta on the Soil Nematode Population and Root Gall Index of Tomato: The nematode genera used for the inoculation of the tomato were *Meloidogyne, Xiphinema, Pratylenchus* and *Helicotylenchus* spp. (Table 2). The initial population of all the nematode genera (population of the nematodes at planting) were not statistically significant ($p<0.05$).

At harvest, the population (final population) of each nematode genera varied tremendously. The extracts of pawpaw, tobacco and nitta leaves at both 50% and 100% concentrations reduced the population build-up of the different nematode genera. In all cases, the population of each nematode genera significantly increased in the control experiment. Moreover, the leaf extracts of pawpaw, tobacco and nitta reduced the galls on the roots of the treated tomato plants. The galls on the untreated tomato plants (control) were significantly high, indicating that the test crop (tomato) was susceptible to root knot nematode which is known as a gall causative pathogen.

DISCUSSION

Application of different concentrations of leaf extracts of pawpaw, tobacco and nitta plants at both 50% and 100% concentrations caused a significant decline in the soil population of nematode pests and subsequently improved growth and yield of tomato. Similarly, the use of plant extracts in the control of nematode pests of crops have been documented by some investigators. Application of aqueous extracts (100% concentration) of *Lactua sativa, Amni majus, Artemisia pallens* and *Antemisia annua* resulted to 100% *Meloidogyne incognita* mortality within 24 hours of exposure had been reported [18]. Extracts of *Tagetes* species had proved to have bio-nematicidal effects on nematode pests [19].

The results of this study indicated that bio-nematicidal component in plant could also be located in the leaf of the plant. This corroborates earlier findings of some researchers who reported that the leaves and roots of *Tagetes erecta, Crotalaria retusa, Hyptis suaveolens* and *Ocimum gratissimum* contain bio-nematicidal properties [8, 12, 18]. Moreover, leaf extract of *Crotalaria grantiana* resulted in *M. incognita* juvenile paralysis *in vitro* and *C. gratiana* had been used as both green manure and an alternative to synthetic chemicals in nematode population control, especially in integrated pest management for vegetable crops in organic agriculture of tropical and temperate areas [20]. Incorporation of dry mycelium of *Penicillium chrysogenum* into the soil have enhanced plant growth and reduced root galling caused by the root knot nematode *Meloidogyne javanica* in cucumber and tomato plants [21]. *Chrysanthemum coronarium* when applied to the soil as a green manure was reported to effectively controlled root knot nematodes *Meloidogyne incognita* and *M. javanica* on tomato and resulted in improving fresh tomato weight in both greenhouse and microplots.

CONCLUSION

The result of this study show that leaf extracts of pawpaw, tobacco and nitta have the potential to suppress the soil nematode population with a resultant enhanced growth and yield of tomato. The authors aim to carry out this experiment under the field condition. Moreover, we also aim to carrying out chemical analysis on the leaf extracts and also to determine the mode of action of the leaf extract on nematode pests.

ACKNOWLEDGEMENTS

Authors are grateful to Messrs Olaiya, Amodu, Lawrence and Jewoola of the Agronomy Research Laboratory, Ladoke Akintola University of Technology, Ogbomoso, Nigeria for their technical support during the course of this study.

REFERENCES

1. Siddiqui, Z.A., 2004. Effects of plant growth promoting bacteria and composed organic fertilizers on the reproduction of *Meloidogyne incognita* and tomato growth. Bioresource Technol., 95: 223-227.
2. Olabiyi, T.I., 2005. Effects of African marigold extracts (*Tagetes erecta* L.) on root knot nematode infecting okra (*Abelmoschus esculentus* (L.) Moench). Science Focus, 10: 47-51.
3. Babatola, J.O., 1989. Effects of some organic manure on nematode in tomato cultivation. Pakistan J. Nematol., 7: 39-46.
4. Abolusoro, S.A., E.E.A. Oyedunmade and T.I. Olabiyi, 2004. Screen house and laboratory assessment of toxic effects of brimstone (*Morinda lucida*) leaf extract to the root knot nematode, Meloidogyne incognita. Ahmadu Bello University J. Vocational Studies, 2: 87-92.
5. Olabiyi, T.I., 2004. Assessment of the nematicidal properties of extracts from *Tagetes erecta, Ocimum gratissimum, Hyptis suaveolens* and *Crotalaria retusa*. Ph. D Thesis submitted to the Department of Crop Production, University of Ilorin, Nigeria, pp: 177.
6. Anonymous, 2004. Intergovernmental Forum on Chemical Safety Information Circular (IFCS). Pesticides and Alternatives, 23: 2-3.
7. Hoan, L.T. and R.G. Davide, 1979. Nematicidal properties of root extracts of seventeen plant species on Meloidogyne incognita. Philippine Agriculturist, 62: 285-295.
8. Zurren, S. and M.I. Khan, 1984. Nematicidal activity in some plant lattices. Pakistan of J. Nematol., 2: 69-77.
9. Maqbool, M.A., S. Hashmi and A. Ghaffar, 1987. Effect of latex extracts from *Euphorbia caducifola* and *Calotropis procera* on root knot nematode *Meloidogyne incognita* infesting tomato and egg plant. Pakistan J. Nematol., 5: 43-48.
10. Adegbite, A.A. and S.O. Adesiyan, 2005. Root extracts of plants to control root knot nematode on edible soybean. World J. Agricultural Sci., 1: 18-21.
11. Oladoye, S.O., T.I. Olabiyi, E.T. Ayodele and G.J. Ibikunle, 2007. Phyto-Chemical screening and nematicidal potential of root bark extract of *Bixa orellana* on nematode pests. Research on Crops, 8: 222-228.
12. Olabiyi, T.I., E.E.A. Oyedunmade and J.M. Oke, 2006. Bio-nematicidal potentials of African marigold (*Tagetes erecta* L.), rattle weed (*Crotalaria retusa* L.), nitta (*Hyptis suaveolens Poit.*) and basil (*Ocimum gratissimum* L.). J. Agricultural Research and Development, 5: 27-35.
13. Oyedunmade, E.E.A., 2000. Laboratory and field toxicities of the African marigold (*Tagetes erecta*) to root knot nematodes. African Scientist, 1: 177-182.
14. Olabiyi, T.I. and M.O. Olabode, 2001. The effects of neem (*Azadirachta indica*) fruits on nematodes in cowpea cultivation. African Scientist, 2: 73-76.

15. Olabiyi, T.I. and R.Y. Gwazah, 2001. Efficacy of neem leaf powder in the control of root knot nematode (*Meloidogyne incognita*) on soyabean. African Scientist, 2: 77-80.
16. Whitehead, A.G. and J.R. Hemming, 1965. A comparison of some quantitative methods of extracting small vermiform nematodes from soil. Annals of Applied Biol., 55: 25-38.
17. Duncan, D.B., 1955. Multiple range and multiple *F* tests. Biometrics, 11: 1-42.
18. Pandey, R., 1990. Studies on the phytonematoxic properties in the extract of some medicinal and aromatic plants. International Nematology Network Newsletter, 7: 19-20.
19. Zavaleta-Mojia, E., A.E. Castro and V. Zamudis, 1993. Effecto del cultivo e incorporacion de *Tagtes erecta* L sobre lapoblacion e infecio de *Meloidogyne incognita* (Kofoid and White) Chitwood in chilli (*Capsicum annuum* L.). Nematropica, 23: 49-56.
20. Jourand, P., S. Rapior, M. Fargette and T. Mateille, 2004. Nematostatic effects of a leaf extract from *Crotalaria virgulata* subsp. *grantiana* on *Meloidogyne incognita* and its use to protect tomato roots. Nematology, 6: 79-84.
21. Gotlieb, D., Y. Oka, B.H. Ben-Daniel and Y. Cohen, 2003. Dry mycelium of *Penicilium chysogenum* protects cucumber and tomato plants against the root knot nematode Meloidogyne javanica. Phytoparasitica, 31: 217-225.
22. Bar-Eyal, M., E. Sharon and Y. Spiegel 2006. Nematicidal activity of *Chrysanthemum coronarium*. European J. Plant Pathol., 114: 427-433.