Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.4, No.24, 2014

Management of Root-Knot Nematodes (Meloidogyne Spp) on Tomato using Antagonistic Plants

Bello, T.Tesleem.[1*] B. Fawole[2] Abiodun Claudius-Cole[2]
1.Department of Agricultural Education, Federal College of Education Abeokuta, Nigeria
2.Department of Crop Protection and Environmental Biology, Faculty of Agriculture and Forestry, University of Ibadan, Ibadan, Nigeria
* E-mail of the corresponding author: tesleembello@yahoo.com

Abstract
African marigold (Tagetes erecta) and Crotalaria juncea were used as intercrops to control root knot nematodes on a susceptible tomato cultivar, Ibadan local in a pot experiment at the roof top of Crop Protection and Environmental Biology Dept, University of Ibadan, Ibadan, Oyo State, Nigeria. Four weeks old tomato plants intercropped with African marigold (Tagetes erecta) and Crotalaria juncea were inoculated with 5000eggs of root knot nematodes. Results indicated that absence of marigold or Crotalaria plants in the inoculated treatments led to increase in the number of second stage juvenile of root knot nematodes. The antagonistic plants produced significant reduction ($P<0.05$) in the root gall indices, reproductive factor and final nematode population in susceptible tomato plants roots. However, no significant differences were observed across the treatments in terms of mean number of leaves and plant heights. The results obtained have important implications for the design of alternative nematode management strategies using antagonistic plants.
Keywords: antagonistic plants, root-knot nematodes, Gall index, Reproductive factor.

1. Introduction

Root knot nematodes infect a wide range of important crop plants and are particularly damaging to vegetable crops in tropical and subtropical countries (Sikora and Fernandez 2005). There are more than 90 described species in the genus *Meloidogyne* but the four most commonly occurring species are *Meloidogyne incognita*, *M. arenaria, M. javanica* and *M. hapla* (Karssen 2000; Hunt *et al.,* 2005). The short life cycle of 6 to 8 weeks enables root knot nematode populations to survive well in the presence of a suitable host and their populations build up to a maximum usually as crops reach maturity (Shurtleff and Averre 2000).

The root knot nematode *Meloidogyne incognita* is a major constraint to vegetable production throughout the world (Lindsey and Clayshulte, 1982; Thomas, 1994; Adesiyan *et al.,* 1990). Root knot nematodes (RKN) are one of the major pathogens of tomatoes worldwide and limit fruit production (Sikora and Fernandez 2005, Tisserat 2006). Nematode control therefore, becomes essential in order to reduce crop losses and to ensure self-sufficiency in the requirement for food and industrial raw materials.

Currently, pre-plant fumigation of soil with methyl bromide or other fumigant nematicides is the primary method used to control root-knot nematodes in vegetables in Africa and worldwide. However, apart from its very high cost, there is growing public uncertainty about the routine use of pesticides, including nematicides, in global agriculture. Concern about pesticides use has stimulated interest in the development of alternative pest management strategies. In recent times, researchers have paid more attention to the study of natural pesticides in nematode control (Adegbite and Adesiyan 2005). Results available from these studies show great promise. Several plants have been identified with nematicidal or nematostatic properties either in their seeds, fruits, roots, leaves, barks or in their root exudates and have been used in rotational practices to control root-knot nematodes (Claudius-Cole *et al*., 2001). Evidence has shown that host plants can be protected against nematode infection through intercropping practices (Egunjobi 1992), especially when plants susceptible to nematodes are cropped with plants that possess nematicidal properties (Haroon and Smart, 1993). Roots of African and French Marigold and Asparagus have been found to produce exudates that are toxic to soil nematode. (Yadav, 1970). Also, Wilson and Caveness (1980) observed *Crotalaria juncea* to be a non-host plant to M. incognita. The soil populations of root-knot nematode juveniles were found to be significantly reduced within six months under the host plants most damaged by *Meloidogyne spp*.

This investigation is an attempt to identify and compare the suppressive effects of 2 nematode antagonistic plants namely, *Crotalaria juncea* and *Tagetes erecta* (African marigold) on the root-knot nematode infected susceptible variety of tomato.

2. Materials And Methods

The root-knot nematode utilized for the experiment was obtained from galled roots of Celosia plants collected from NIHORT Ibadan, Nigeria. Extraction of eggs from the galled roots was done using 0.5% NaOCl (Hussey and Baker 1973). Seeds of Ibadan local tomato which has been identified to be highly susceptible to root-knot nematodes, were planted directly into 5litter plastic pots containing sterilised soil. After emergence, the tomato plants were thinned to one stand per pot. Marigold and Crotalaria seeds were also planted directly in the sterilized soils and thinned to one or two per pot in line with the treatments.

Each pot containing 4 weeks old tomato plants were inoculated with 5000 eggs of root knot nematode obtained from galled roots of Celosia plants using 1ml micropipette into two holes dug around the roots. The experiment was replicated seven times arranged in a completely randomized design, kept in the screen house and watered every second day. The experiment ran for 8 weeks and parameters like number of leaves, plant height were recorded weekly. At exactly 8 weeks after inoculation, the tomato plants were uprooted roots rinsed and fresh root weights, fresh shoot weights and number of fruits per plants was recorded. Afterwards roots were rated for severity of galling using a scale of 0-5, as described by Taylor and Sasser (1978).

Where 0 = no gall;
1 = 1-20% of the root system galled;
2 = 21-40% of the root system galled;
3 = 41-60% of the root system galled;
4 = 61-80% of the root system galled; and
5 = 81-100% of the root system galled.

Eggs were extracted from the tomato plant roots using 0.5% NaOCl (Hussey and Barker 1973). Eggs were counted under a stereo microscope. The final nematode population was estimated by adding the extracted second-stage juveniles by Pie-pan method (Whitehead and Hemming, 1965) from 100 ml soil to the number of eggs extracted from 5g of roots with the sodium hypochlorite method (Hussey and Barker, 1973). Host efficiency was determined by the calculation of the Reproductive Factor (RF) and using it in combination with the Galling index (GI) (Nwauzor and Fawole, 1992; Almeida and Santos, 2002). RF = Pf/Pi where Pf is the final nematode count and Pi the initial inoculum level.

2.1 Statistical procedure

Data were analysed using ANOVA with GLM procedure of SAS System 9.1(SAS2002) and count data were transformed using $\log_{10}$ (X+1) before analysis (Gomez and Gomez 1984) . Means were partitioned using Duncan's Multiple Range Test at a probability level of 5%. The means of data collected in the two trials were not significantly different ($p < 0.05$). Therefore, the data were combined for analysis and their means presented in both pot and field experiments.

3. Results

A significant decrease ($p<0.05$) in the root gall indices was recorded across the treatments as compared to the control. The lowest root gall index (0.6) was observed in the treatment with 2 crotalaria plants (Table 1). The egg population in the tomato roots across the treatments decreased significantly ($p<0.05$) as compared to the control with the treatment with 1 Crotalaria plant as intercrop recording the lowest number of nematodes eggs (148) in the roots of tomato (Table 1).

Means on the same column with the same alphabets are not significantly different ($P<0.05$).

The treatment involving 2 Crotalaria plants as intercrop recorded the least reproductive factor (0.1) which was significantly different ($P<0.05$) from the other treatments and the Control (Table 2).

A similar trend was observed in the mean final nematode population in the pot with the treatment with 2 *Crotalaria juncea* plants recording the least the mean final nematode population (569.5) which was significantly different ($p<0.05$) from the rest of the treatments and the control (Table 2).

The result of the growth and fruit yields of tomato plants intercropped with antagonistic plants (*Crotalaria juncea* and *Tagetes erecta*) produced no significant different across the treatments and the control. However, the Control recorded the highest mean number of leaves (15.2), (Table 3). The treatment with 1 Tagetes plant recorded the highest mean plant height of (35.6) while the treatment with 1 crotalaria plant recorded the highest mean number of fruits 213.4) (Table 3).

4. Conclusion

The antagonistic plants used as intercrop were found to have significant effects ($p<0.05$) on the galling index, nematode (juvenile) population in the soil and number of eggs in the tomato roots. Suppressive effects of the intercrops (Crotalaria and Tagetes) on root knot nematodes were shown in all the treatments as compared to the control. The highest level of nematode suppression in tomato plant as measured by galling index, number of juveniles in the soil and reproductive factor was recorded in the treatment with 2 Crotalaria plants. These agrees with the finding of Wilson and Caveness (1980) who observed *Crotalaria juncea* to be a non host to *Meloidogyne incognita* also, Luc *et al.,* (1990) reported that Crotalaria plants produce exudates that is effective in the control of root knot nematodes in pineapple. The lowest reproductive factor (Pf) was observed in the treatment with Crotalaria plants as intercrop. This agrees with Esparago *et al*., (1999) who reported that *Crotalaria juncea* reduced the population of 3 species of root knot nematode in vegetables.

Evidences have shown that host plant can be protected against remarkable infection through intercropping practices using non-host antagonistic plants where plant residues of Marigold (*Tagetes erecta*) have been reported to protect tomato cultiva *Pusa puby* against *M.incognita* (Akhtar and Malik, 2000, Anaya 2006).

Further trials geared towards using *Crotalaria juncea* and *Targetes erecta* as short term, fallow plants would give a more conclusive result in their use in nematode management. This is important because intercrops most times have been found to have high competitive effects on crops for essential growth factors which may in turn affect the yield of crops.

References

Adegbite, A.A. and S.O. Adesiyan. 2005. Root extracts of plants to control root-knot nematodes on edible soybean. *World Journal of Agricultural Sciences*. 1(1) : 18-21.

Adesiyan, S.O., F.E. Caveness., M.O. Adeniji and B. Fawole. 1990. *Nematode pests of Tropical Crops*. Heinemann Edu. Books (Nig) Ltd. Ibadan. 114 pp.

Akhtar, M and A. Malik. 2000. Role of organic soil amendments and soil organisms in the biological control of plant-parasitic nematodes: A review. *Bioresource Technology*, 77 (1): 35-47.

Almeida, A.M.S.F and M.S.N.deA. Santos. 2002. Resistance and host reponse of selected plants to *Meloidogyne megadora. Journal of Nematology*. 32 (2): 140-147.

Anaya, A. L. 2006. Allelopathic organisms and molecules: Promising bioregulators forthe control of plant diseases, weeds and other pests. Pp 31-78. In Inderjit and K.G.Mukerrji (eds.) *Allelochemicals: Biological control of plant pathogens and diseases*. Springer. The Netherlands.

Claudius-Cole, A.O., B. Fawole and Asiedu. 2001. The role of cover crops in the management of *Meloidogyne incognita* and other plant-parasitic nematodes. *African Crop Science Proceedings*, 5: 265-269.

Egunjobi, O. A. 1992. The place of cultural control strategies in the management of nematode problems of food crops in Africa. Pp 155-173. In Fawole, B., O. A.Egunjobi., S.O. Adesiyan., J. O. Babatola and A. A. Idowu (eds.). *The Biology and Control of Nematode Pests of Food Crops in Africa*. African Society of Nematologists. HisWill infoResources Managment Limited. Ibadan.

Esparrago, G., Barreiro, J.M., Ruales, C. and Bieche, B.J. (1999) Comparison of the reproduction of Meloidogyne populations on roots of Crotalaria spectablilis and processing tomato varieties with the Migene. Acta Horticulturae 487, 267–270

Haroon S. And G Smart (1993) " Development of *Meloidogyne incognita* inhibited by *Digitaria decumbena* cv pangola" Nematol:, 15: 101-105http:// www.plantpath.ksu.edu/pages/extension

Hunt, G. I., M. Luc and R. H. Manzanilla-Lopez. 2005. Identification, morphologys and biology of plant-parasitic nematodes. Pp 11-52. In Luc, M., R. A. Sikora and J. Bridge (eds.). *Plant-Parasitic Nematodes in Subtropical and Tropical Agriculture*. CAB International.

Hussey, R. S. and K. R. Barker. 1973. A comparison of methods of collecting inocula of *Meloidogyne* spp. *Plant Disease Reporter*, 57: 1025-1028.

Karssen, G. 2000. The plant parasitic nematode genus *Meloidogyne goeldi*, 1892(Tylenchida) in Europe. Brill Academic publishers, Leiden, The Netherlands, 160pp.

Lindsey D. L., and M. S. Clayshuttle. 1982. Influence of initial population densities of Meloidogyne incognita on three chile cultivars. Journal of nematology 14:353-358.

Luc, M., R. A. Sikora and J. Bridge (1990). *Plant-Parasitic Nematodes in Subtropical and Tropical Agriculture*. 2nd Edition. CAB International.

Nwauzor, E. C and B. Fawole. 1992. The development and life cycle of *Meloidogyne incognita* race 2 on *Dioscorea rotundata* var Okwocha.Pp 127-133.

Shurleff, M.C. and C.W. Averre, III, 2000. Diagnosing plant disease caused by plant parasitic nematodes. The American Phytopathol Society, pp: 187.

Sikora, R. A and E. Fernandez. 2005. Nematode parasites of vegetables. Pp 319-392. In Luc, M., R. A. Sikora and J. Bridge (eds). *Plant-Parasitic Nematodes in Subtropical and Tropical Agriculture*. 2nd Edition. CAB International.

Taylor, A. L and J. N. Sasser. 1978. *Biology, Identification and Control of Root-knot Nematodes Meloidogyne spp*. North Carolina UniversityUSAID. 111pp.

Thomas, S. H., L. W. Murray and M. Cardenas. 1995. Relationship of preplant population densities of *Meloidogyne incognita* to damage in three chile pepper cultivars. *Plant Disease*, 79: 557-559

Tisserat, N. 2006. Root-knot nematodes of tomato. *Fact sheets tomato.* Extension plant pathology. Kansas State University,Manhattan

Whitehead, A. C and J. R. Hemming. 1965. A comparison of some quantitative methods of extracting small vermiform nematodes from soil. *Annals of Applied Biology*, 55: 25-28.

Wilson, G.F and F.E Caveness (1980). Effects of rotation crops on the survival of root-knot, root lesion and

spiral nematodes. Nematropica 10: 56-61
Yadav, B. S. (1970) Test for the nematological properties of some weeds plants on *M*. Incognita. Proc. Indian sc. Congress Association 57:551

Table 1: Mean galling indices, Juvenile population per/100ml of soil and nematode population/g of root in susceptible Ibadan Local tomato intercropped with Crotalaria and Tagetes plants.

Treatments	**Gall index**	**Juvenile in 100ml of soil**	**Nematode population/g of root**
Inoculated tomato + 1crotalaria plt	1.1^{bc}	9.3^{c}	148^{b}
Inoculated tomato + 2crotalaria plt	0.6^{c}	9.3^{c}	104.5^{c}
Inoculated tomato + 1 tagetes plt	1.6^{b}	17.8^{b}	151.3^{b}
Inoculated tomato + 2tagetes plt	1.8^{b}	14.5^{b}	163.7^{b}
Inoculated tomato plant no intercrop	4.2^{a}	18.9^{a}	1846.5^{a}

Analysis of nematode data undertaken on $\log_{10}$ (X+1) transformed with back-transformed means presented.
Means on the same column with the same alphabets are not significantly different.

Table 2 mean number of eggs in root, final nematode poplation and reproductive factor in susceptible Ibadan Local tomato intercropped with Crotalaria and Tagetes plants.

Treatments	***Eggs in root***	*Final nematode population*	*Reproductive factor(RF)*
Inoculated tomato + 1crotalaria plt	475^{c}	623^{bc}	0.12^{c}
Inoculated tomato + 2crotalaria plt	465^{c}	569.5^{c}	0.10^{c}
Inoculated tomato + 1 tagetes plt	890^{b}	1041.3^{b}	0.20^{b}
Inoculated tomato + 2tagetes plt	725^{b}	888.7^{b}	0.20^{b}

Analysis of nematode data undertaken on $\log_{10}$ (X+1) transformed with back-transformed means presented.
Means on the same column with the same alphabets are not significantly different.

Table 3: Mean growth and fruit yield of susceptible Ibadan Local tomato intercropped with Crotalaria and Tagetes plants.

Treatments	*Number of leaves*	*Plant height*	*Number of fruits*
Inoculated tomato + 1crotalaria plt	14.6^{a}	34.7^{a}	213.4^{a}
Inoculated tomato + 2crotalaria plt	12.3^{a}	32.8^{a}	161.6^{ab}
Inoculated tomato + 1 tagetes plt	14.2^{a}	35.6^{a}	188.5^{a}
Inoculated tomato + 2tagetes plt	13.3^{a}	35.4^{a}	181.4^{a}

Analysis of nematode data undertaken on $\log_{10}$ (X+1) transformed with back-transformed means presented.
Means on the same column with the same alphabets are not significantly different.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar