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Evaluation of Some Botanicals on Root – Knot Nematode (*Meloidogyne javanica*) in Tomato *(Lycopersicon esculentum*, Mill) in Yola Adamawa State, Nigeria

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ABSTRACT: Laboratory and screen house experiments were carried out to evaluate the effect of two botanicals- Oil palm fibre and cocoa bean testa in the control of root knot nematode (*M. javanica*) on tomato. Approximately 100 eggs and juveniles were dispensed into petridishes containing both the crude and diluted extracts of the botanicals except the control which contained only distilled water. .In the screen house 10, 20 and 30 g (equilvalent to 5.7, 11.4 and 17.1 t/ha respectively) of powdered plant material was applied on top of soil in form of mulch to each pot except the control which received no treatment. Carbofuran a chemical nematicide was used as a check and applied at the rate of 1 g/cm^3 of soil. The results in both experiments indicated that cocoa bean testa crude extract gave the best egg hatch inhibition (only 8 % of eggs hatched after 96 hrs), recorded highest juvenile mortality of 100 %, and recorded the highest growth parameters and least nematodes population. It is recommended that Cocoa bean testa extracts and powder be tried in the field before recommending to tomato farmers for the control of *M. javanica.*

Key words: Oil palm fibre, cocoa bean testa, eggs, juveniles, *M. javanica*

INTRODUCTION

Tomato *(Lycopersicon esculentum*, Mill) is the second most cultivated vegetable crop in the world, after potato, with an annual production of nearly 100 million tons of fresh tomatoes in 3.7 million ha worldwide, China, USA and Turkey are the leading producers (FAO, 2004). It is a short duration crop, high yielding, economically attractive and its area of cultivation is increasing daily (Sharkara *et al*., 2005).The fruit contain antioxidants, vitamins and minerals, and can be processed into juices, ketchup, puree, eaten raw in salads or cook into stew (Beutner *et al*., 2001).

Root knot nematodes (*Meloidogyne* spp) are one of the major root pests of tomato worldwide and limit its production (Sikora and Fernandez, 2005). Crops infected by nematodes especially vegetables such as tomato record yield losses of up to 80 % on heavily infested soils (Kaskavalci, 2007). In Nigeria a yield loss of between 28-68 % was reported in tomato fields (Adesiyan *et al*., 1990).

Chemical nematicide is one of the most fastest and effective nematode control methods, but they are detrimental to both humans and the environment and are relatively unaffordable to the average small scale farmer (Washira *et al*., 2009). There is therefore the need to develop alternative methods of control that are cheap, environmentally friendly and not harmful to humans. The use of botanicals is one of the alternative methods suggested by nematologist for nematode control. Botanicals such as *Azadirachta, Eucalyptus, Chrommelina, Sida acuta* and *Targetis* have been found to be effective in the control of nematodes in cowpea, tomato and egg plant fields (Umar *et al*., 2010).These botanicals not only control nematodes but also improve the soil productivity and crop yield by several folds. The objective of the study was to evaluate the effectiveness of cocoa bean testa and oil palm fruit fibre on the control of *M. javanica* in laboratory and screen house. The botanicals are cheap, available and environmentally friendly form the basis of the research.

MATERIALS AND METHODS

Experimental site

The experiment was carried out in the laboratory and screen house of the Department of Crop Protection, Modibbo Adama University of Technology, Yola. Yola lies between latitude 8^{o}N and 11^{o}N, longitude 11.5^{o}E and 13.5^{o}E at an altitude of 185.9 m above sea level (Bashir, 2000).

Preparation of extracts
The plant materials for the experiment were Cocoa bean testa and oil palm fruit fibre. Cocoa bean testa was ground into powder using pestle and motar. Oil palm fruit fibre was burnt with fire to obtain the ash. The extract was obtain using the methods described by Adegbite and Adesiyan (2005) as follows:- 50 g of each plant material was weigh separately and soaked in 1000 ml flask containing 500 ml of distilled water for 24 hrs. This was then filtered using Whatman No. 2 filter paper to obtain the crude extract. Serial dilution was then carried with 5, 10 and 15 ml distilled water.

Phytochemical analysis of plant materials
Phytochemical analysis of the plant materials was carried out in the laboratory using the methods described by Sofowora (1993); Trease and Evans, 1989).

Extraction of eggs
Eggs were extracted using the methods described by Hussey and Barker (1973) as follows:-Egg masses collected from roots of tomato cv Roma VF were shaken with 0.5 % sodium hypochlorite in a 250 ml stopper flask for 2 min. Eggs were washed by rinsing with tap water over a 75 µm sieves and collected over a 26 µm sieve. The eggs were washed into a beaker forming egg suspension.

Extraction of juveniles of *M. javanica*
Root knot nematode (*M. javanica)* was identified using the head and stylet morphology described in Eisenback *et al*. (1981). It was then maintained on tomato cv Roma VF and second stage juveniles were extracted from galled roots using the methods described by Whitehead and Hemming (1965).

Effect of extract on egg hatch of *M. javanica*
100 eggs suspensions contain in a 10 ml syringe were dispensed into petri dishes. 5, 10 and 15 ml of the crude extract and diluted form were separately added into petri dishes except the control which contain distilled water and eggs only. There were 9 treatments replicated three times (T1 – oil palm crude extract, T2- oil palm crude extract + 5 ml of distilled water, T3- oil palm extract + 10 ml of distilled water, T4- oil palm crude extract + 15 ml distilled water, T5- cocoa bean testa crude extract,T6- cocoa bean testa crude extract + 5 ml distilled water, T7- cocoa bean testa crude extract + 10 ml distilled water, T8- cocoa bean testa crude extract + 15 ml distilled water, Con- Control). Petri dishes were arranged in a complete randomized design in the laboratory. Percentage egg hatch was observed over a period of 96 hrs.

Effect of extract on juvenile mortality of *M. javanica*
100 juvenile suspensions of *M. javanica* contain in a 10 ml syringe were dispensed into petri dishes. 5, 10 and 15 ml of the crude extract and diluted form were separately added into petri dishes except the control which contain distilled water and juveniles only. There were 9 treatments replicated three times (T1 – oil palm crude extract, T2- oil palm crude extract + 5 ml of distilled water, T3- oil palm extract + 10 ml of distilled water, T4- oil palm crude extract + 15 ml distilled water, T5- cocoa bean testa crude extract,T6- cocoa bean testa crude extract + 5 ml distilled water, T7- cocoa bean testa crude extract + 10 ml distilled water, T8- cocoa bean testa crude extract + 15 ml distilled water, Con- Control). Petri dishes were arranged in a complete randomized design in the laboratory. Percentage juvenile mortality was observed over a period of 96 hrs.

Screen house experiment
4 kg sterilized sandy loam soil was filled into 20 cm diameter perforated plastic buckets with depth 30 cm. Four week- old tomato seedlings cv Roma VF raised in sterilized soil in the nursery was transplanted into each pot. 1000 juveniles suspensions of *M. javanica* contain in a syringe were inoculated into each pot by exposing the roots and emptying the syringe. 10, 20 and 30 g (equilvalent to 5.7, 11.4 and 17.1 t/ha respectively) of powdered plant material was applied on top of soil in form of mulch to each pot except the control which received no treatment. Carbofuran a chemical nematicide was used as a check and applied at the rate of 1 g/cm^3 of soil. Super hydro–solution organic fertilizer containing macro and micro elements was applied thrice at the rate of 1 ml/ litre of water every forth night using 5 litre sprayer. There were 8 treatments replicated thrice. Pots were arranged in a complete randomized design in the screen house. Data were collected on growth parameters and yield. Galls were rated using the rating scheme described by Sasser *et al*. (1984). Nematode were extracted and counted using the methods described in Barker (1985). All data collected were subjected to analysis of variance and Duncan's New Multiple Range Test was used to separate means at 5 % level of probability.

RESULTS AND DISCUSSION

Fig. 1 shows the effect of different concentrations of oil palm fibre and cocoa bean testa powder extracts on *M. javanica* egg hatch inhibition in the laboratory. The result indicated that crude extract of cocoa bean testa (T5) gave the best inhibition (only 12.1 % of the egg hatched), followed by T6 (16.8.%) and T7 (24.3%) respectively. The result indicated that cocoa bean testa extract was more effective than oil palm extracts. Also the higher the dilution of the extracts the lower their inhibitions against egg hatch. This shows that as dilutions increases the toxicity decreases and hence decreased in percentage egg hatched. The control recorded 100 % egg hatch because it contained only distilled water. The inhibitory effect of the extract could be as result of their phytochemical content (Table 1) which has ovicidal property. Adegbite (2003) reported that extracts that contained alkaloids and flavonoids have ovicicidal property against *Meloidogyne* eggs.

Table 1: Phytochemical analysis of the botanicals.

Botanical	Tannin	Saponin	Alkaloid	Cardiac glycosides	Flavonoids	Anthraquinones
CBT	+	+	-	+	+	+
OPF	+	+	-	+	-	+

CBT- Cocoa bean testa, OPF – Oil palm fibre
\+ presence of phytochemical
\- Absence of phytochemical

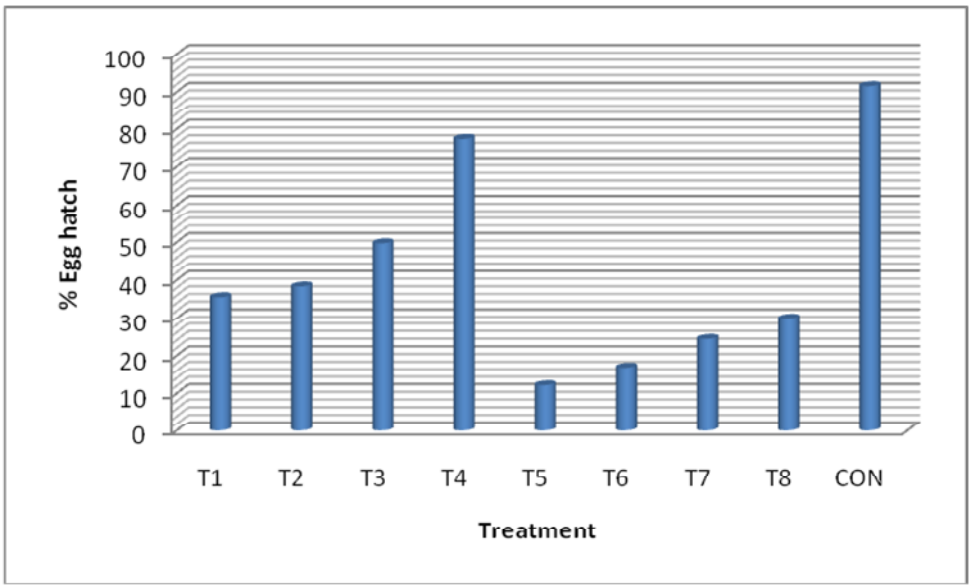

Fig. 1. Effect of extracts on egg hatchability of *M. javanica* in the laboratory.

Fig. 2 shows effect of various concentrations of the powder extracts of oil palm fibre and cocoa bean testa over a period of 96 hrs. All the extracts whether crude or diluted caused significant larval mortality compared to control. The crude extract of cocoa bean testa (T5) gave the best result (100 %), followed by its dilution T6 (88.7) and oil palm fibre crude extract (T1) 85.1 % respectively. The result of the study indicated that the higher the dilution the lower the larval mortality and vice versa. The control recorded the lowest mortality (1.8 %) because it was only distilled water. Nematicidal property of these extracts could be as result of their high phytochemical (saponins, flavonoids and glycocides) content or oxygenated compounds which have been characterized by their lipophylic properties that enable them dissolve the cytoplasmic membrane of nematode cells and their functional groups interfering with enzyme protein structures of nematodes (Knobloch *et al*., 1989; Trifone and Atanasov, 2009). The result obtained showed Cocoa bean testa contained these phytochemicals while oil palm fibre lacks alkaloids and flavonoids as shown in Table1.

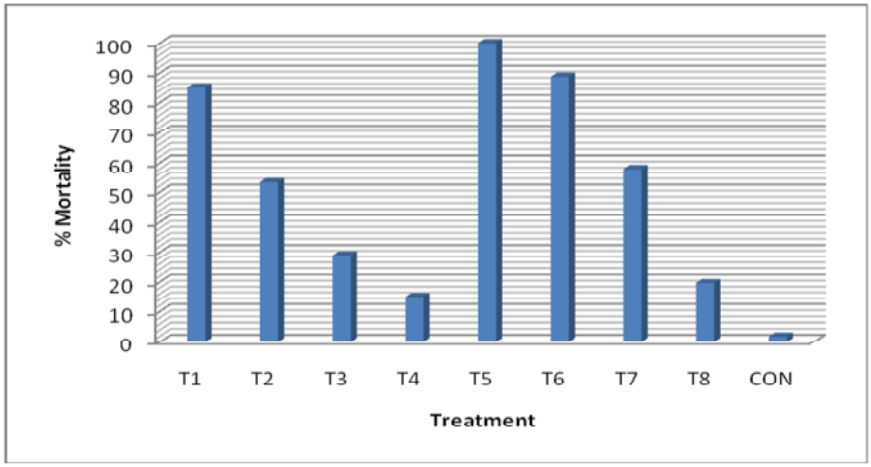

Fig. 2. Effect of extracts on juvenile mortality of *M. javanica* in the laboratory.

Table 2. Effect of oil palm fruit powder on the control of *M. javanica* in tomato plants cv Roma VF in the screen house 2012.

	Parameter									
TRT (t/ha)	PH (cm)	NL	NF	FW (g)	FSW (g)	DRW (g)	FRW (g)	DRW (g)	NG	NP
5.7	29.3b	7.3c	3.7b	12.7c	19.6b	5.6b	13.5b	1.8b	2b	660b
11.4	34.3a	8.5b	3.9b	19.3b	20.5b	5.8b	11.2c	1.6c	2b	650b
17.1	35.7a	10.7a	7.0a	24.3a	24.0a	6.9a	9.6d	1.3d	1c	50c
CF	30.3b	8.0b	3.8b	24.1a	25.1a	7.3a	4.3e	1.2d	1c	30d
CN	25.1c	4.0d	1.0c	10.6d	14.2c	3.5c	20.6a	8.6a	6a	1700a
SE	0.13	0.09	0.09	0.13	0.13	0.06	0.12	0.02	0.01	0.30

Table 3. Effect of Cocoa bean testa powder on the control of *M. javanica* in tomato plants cv Roma VF in the screen house 2012.

	Parameter									
TRT (t/ha)	PH (cm)	NL	NF	FW (g)	FSW (g)	DRW (g)	FRW (g)	DRW (g)	NG	NP
5.7	30.3d	9.6c	4.6c	13.7c	23.2c	7.1c	11.0b	1.7b	2b	500b
11.4	35.4c	10.3b	6.7b	21.3b	25.6b	8.8b	8.6c	1.4c	2b	450b
17.1	39.6a	15.6a	8.9a	25.7a	31.7a	9.5a	7.3c	1.3d	1c	40c
CF	37.4b	9.0c	3.8d	24.8a	26.1b	7.8c	7.0c	1.2c	1c	30d
CN	20.1e	3.0d	1.1e	8.6d	13.2d	3.0d	23.6a	9.4a	6a	1850a
SE	0.14	0.09	0.09	0.12	0.12	0.06	0.14	0.02	0.01	0.40

The application of the powder of plant materials as mulch in screen house pots gave significantly different results among the various rates applied. The results indicated that plants treated with 17.1 t/ha of cocoa bean testa powder gave the best result in all growth parameters (plant height, number of leaves, number of fruits and fruit weight) measured for both years (Tables 2 and 3) and higher dry matter accumulation, fewer galls and low population of nematodes recorded compared to oil palm fibre treated plants. The cocoa bean teata powder applied as mulch might have been lethal to nematodes larvae. The powder probably acted directly on the second stage juveniles in the soil, thus reducing the number of motile juveniles available to penetrate the roots of tomato plants in the screen house. This result was similar to those obtained by Agbenin, *et al*. (2005) on tomato when they used some botanicals to control *M. incognita*. The control recorded the lowest growth rates, high galling due to nematode activity at root zone resulting in giant cell formation, high population of nematodes because the nematodes larvae were able to penetrate roots freely and reproduce without any inhibition. The low growth parameter performance by the control plants could be as result of the combined effect of nematodes and availability of nutrients (Netcher and Sikora, 1990).

CONCLUSION AND RECOMMENDATION

The results of the study showed that cocoa bean testa crude extract and powdered mulch in the screen house was able to inhibit egg hatch, caused larval mortality and reduced the population of nematodes in potted tomato plants. It is recommended that field trials be carried out to determine its efficacy before recommending to tomato farmers.

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