REACTION OF TOMATO CV. ROMA VF (*SOLANUM LYCOPERSICUM*) TO *MELOIDOGYNE JAVANICA* TREUB INFESTATION IN AN ULTISOL TREATED WITH AQUEOUS LEAF EXTRACTS OF BITTER LEAF (*VERNONIA AMYGDALINA* L.) AND MANGO (*MANGIFERA INDICA* L.)

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Abstract: The reaction of tomato cv. Roma vf (*Solanum lycopersicum*) to *Meloidogyne javanica* Treub infestation in an ultisol treated with aqueous leaf extracts of bitter leaf (*Vernonia amygdalina* L.) and mango (*Mangifera indica* L.) was investigated in the Federal College of Agriculture Ishiagu, Ebonyi State, SE Nigeria. Two pot experiments were performed in 2008 and 2009. The various leaf extracts were used at three concentrations of 150 g/l, 300 g/l, and 450 g/l. The soil of the site was characterised as ultisol. Soil without the extracts served as the control. The experiment was set up in a Completely randomized design with four replications. Data obtained were averaged for the two experiments and subjected to the statistical analysis of variance using Genstat Edition 3 Release 7.2. Obtained data concerned plant height (cm), number of leaves at 50% anthesis, number of fruit and fruit weight (g) at harvest, number of galled roots and gall index at harvest. Results showed that the two leaf extracts had highly significant ($p < 0.01$) effects on all the data. The extracts showed a high nemato-toxic effect on the nematode by reducing the number of galled roots and gall index as well as increasing the fruit weight at the application of water extracts of bitter leaf and mango leaf at the concentration of 450 g/l. This dose gave the highest fruit weight and could be recommended to farmers.

Key words: nemato-toxic, Roma vf, reduction in galled roots and gall index

INTRODUCTION

Commercial tomatoes belong to the family Solanaceae which is an important source of vegetables, and desert crops. The tomato belongs to the species most frequently referred to the genus *Solanum lycopersicum.* This species is native to the Andes region of South America. Tomato as one of the vegetable crops and as fruit is very important in human nutrition.

In Nigeria, tomato production amounts to 600 000 tonnes per year (Ojeniyi *et al.* 2007). Tomato grows well in many types of soils ranging from sandy to the heavy clayey soils (Uguru 1996). Mbagwu (1992) reported that more than 70% of the total land area in south-eastern Nigeria is covered by ultisols. Ultisols are soils with low nutrients which are highly weathered and leached (Nottidge *et al*. 2009).

Jaraba *et al*. (2007) reported that sand to sandy-loam soils are conducive to *Meloidogyne* species. The production of tomato is limited by the attack of pests and diseases. This results in acute shortage of the fresh fruits in certain periods of the year. Yield losses are partly attributed to the susceptibility of tomato cultivars to serious pests and diseases (Udo 2004).

Roma vf tomato is one of the susceptible cultivars with high commercial value. It is gradually becoming prominent over other varieties in the Nigerian markets because of its palatable taste. Unfortunately, its yield has been impaired by root knot nematode infestation in most Nigerian soils.

Reducing these unprofitable situations in the farms through the use of natural plant extracts is one of the major challenges facing tomato farmers in Nigeria. This method will lower the cost of production of this important vegetable to a significant extent.

Ogwulumba *et al.* (2008) used the extract of bitter leaf to control fungal pathogens of groundnut. The use of aqueous extracts of leaves of bitter leaf (*Vernonia amygdalina* L.) and mango (*Mangifera indica* L.) in controlling *Meloidogyne javanica* infestation on tomato has received little or no attention in Nigeria, let alone globally.

The aim of this research was therefore to evaluate the efficacy of the extracts of the leaves of bitter leaf and mango in controlling *M. javanica* infection on tomato cv. Roma vf.

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MATERIALS AND METHODS

Pot experiments were carried out in the Research and Teaching Farm of the Federal College of Agriculture Ishiagu. Seeds of roma vf variety were obtained from Rossen Seeds BV, Holland.

Top soil of 0–30 cm depth, was collected from the student project site Federal College of Agriculture Ishiagu. The soil was sterilized in the laboratory using an electric soil sterilizer, at 50°C for two hours to ensure that no micro-organism was left alive.

Nursery

The roma vf seedlings were raised in a wooden tray measuring 100 cm by 50 cm by 30 cm. Sterilized top soil, which was watered every other day depending on the intensity of the sun, was used.

Preparation of plant extracts

Fresh leaves of both plants were separately washed with clean tap water and rinsed in sterile distilled water. The leaves were then macerated separately in an electric blender. The macerated leaves were separated into 150 g, 300 g and 450 g samples respectively, and soaked in one litre of sterile water. Such mixtures were left for 12 hours (overnight). After that, the mixtures were filtered through a cheesecloth. Filtrates of the leaves of tested plants were obtained in 150 g/l, 300 g/l and 450 g/l concentrations.

Inoculum source

Eggs of *M. javanica* were extracted from infected Indian spinach (*Spinache oleraceae)* roots previously maintained in inoculum buckets using the methods of Hussey and Barker (1973). The roots were thoroughly washed with distilled water, cut into pieces and put into a 1 000 ml measuring cylinder. A solution that was 200 ml of 0.5% sodium hyprochlorite (house-hold bleach) was poured into the measuring cylinder, tightly capped, and shaken vigorously for three minutes to dissolve the gelatinous matrix. The mixture was poured through a 200 mesh sieve, set inside a 500 mesh sieve. The sieves were shaken as the liquid passed through. The 200 mesh sieve was removed and the eggs caught in the 500 mesh sieve were washed thoroughly three times with distilled water. Distilled water was added to the liquid in the flask until the level reached 500 ml. Using a graduated syringe, 1 ml of the inoculum was introduced into a counting dish. Following the grid on the counting dish, the total number of eggs in 1 ml was estimated. This was repeated three times, and the average of three counts was 500 eggs/ml.

Potting

Polythene bags of 29 by 30 cm were used for the transplanting of young tomato seedlings. Five kg of sterilized soil were put into each polythene bag. The seedlings were transplanted four weeks after germination. Each of the tomato stands contained in the plots was inoculated with 5 000 root-knot nematode (*M. javanica)* eggs. Inoculation took place two weeks after transplanting with the use of a syringe and by pulling away the soil around the roots 2 cm deep and 3 cm from the root. The eggs were inoculated into the hole and slightly covered with soil. Each bag contained one seedling.

The stands were treated with 50 ml of various concentrations of the plant extracts 72 hours after inoculation. The untreated soil served as the control.

Experimental design

Completely randomized design (CRD), with four replications was used for this experiment. Each replication contained ten bags.

Collected data concerned plant height at 50% flowering, number of leaves at 50% flowering, number of fruits per plant at harvest, weight (g) of fresh fruit at harvest, number of galled roots per plant and gall index per plant. Gall index was determined according to the Taylor and Sasser (1978) scale as follows:

0 = no galls, 1 = 1–2 galls, 2 = 3–10 galls, 3 = 11–30 galls, 4 = 31–100 galls, 5 = > 100 galls.

Data analysis

All collected data were subjected to the statistical analysis of variance (ANOVA), using GENSTAT Edition 3 Release 7.2 and the significant means were separated using F-LSD at 5% level of probability according to Obi (2002).

RESULTS

The result of the physio-chemical analysis of the soil used in this research are recorded in table 1. Soils in the Federal College of Agriculture Ishiagu had been described as ultisols which are highly weathered and leached (Nottidge *et al.* 2009).

Table 1. Physio-chemical properites of soil

Phisical and chemical properities	Values
Sand	60.40%
Silt	22.80%
Clay	14.80%
Texture	sand-loam
pH (H_20)	4.32
P (mg/g)	16.80
% N	0.07
% organic carbon	0.897
% organic matter	1.550
Ca (cmol/kg)	3.20
Mg (cmol/kg)	2.00
K (cmol/kg)	0.23
Na (cmol/kg)	0.131
EA (cmol/kg)	2.24
ECEC (cmol/kg)	7.801
% BS	71.29

EA – Exchangeable Acidity; ECEC – Exhaustive Cation Exchange Capacity; BS – Base Saturation

Table 2 reveals the effect of the aqueous leaf extracts on the plant height (cm) and number of leaves at 50% anthesis. Highly significant ($p < 0.01$) effect of the plant ex-

tract on the plant height was observed. Bitter leaf (BL) at 450 g/l caused the highest plant height of 50.33 cm which differed significantly ($p < 0.05$) from other treatments except BL300. The lowest plant height of 28.83 cm was observed in the control.

Table 2. Effect of tested plant extracts on plant height (cm) and number of leaves at 50% anthesis

Botanicals [g/l]	Plant height [cm]	Number of leaves
Control	28.83	20.70
BL150	40.00	38.30
BL300	47.10	98.00
BL450	50.33	105.00
MG150	33.90	56.00
MG300	36.87	67.00
MG450	42.10	105.00
F-LSD = 0.05	7.18	39.84
CV [%]	10.30	32.50

BL – bitter leaf; MG – mango leaf

Tested plant extracts affected significantly ($p < 0.05$) the number of leaves produced by the tomato plant (Table 2). The highest number of leaves (105) were obtained for bitter leaf extracts at the concentration of 300 g/l and mango leaf extract at the same concentration. These differed significantly ($p < 0.05$) from other treatments except BL450 and MG450. The lowest leaf number of 20.70 was obtained in the control.

The results presented in table 3 indicate that the plant extracts had a highly significant ($p < 0.01$) effect on the number of produced fruits. The highest number of fruits which amounted to 11.00 was obtained in the BL300 concentration, which differed significantly ($p < 0.05$) from other treatments except BL450. The lowest number of fruits (3.99) was obtained in the control.

Highly significant ($p < 0.01$) influence on the weight of fruits produced by the plant was also observed. The highest fruit weight amounted to 26.50 g, which differed significantly ($p < 0.05$) from other treatments, was obtained in MG450 combination. The lowest fruit weight (10.83 g) was obtained in the control (Table 3).

Table 3. Effect of tested plant extracts on number of fruits and fruit weight (g) at harvest

Botanicals [g/l]	Number of fruits	Fruit weight [g]
Control	3.99	10.83
BL150	8.01	20.30
BL300	10.33	20.50
BL450	11.00	22.00
MG150	5.10	14.33
MG300	5.10	16.00
MG450	7.30	26.50
F-LSD = 0.05	0.76	4.23
CV [%]	6.00	13.00

BL – bitter leaf; MG – mango leaf

Table 4 shows that the tested extracts also significantly ($p < 0.01$) affected the number of galled roots. The highest number of galled roots (249) was obtained on the control tomato plants while fewer galled roots (16.60) were obtained in the BL150 combination. No galls were observed in all the other treatments.

The gall index followed the same trend by showing the significantly ($p < 0.01$) highest quantity (4.67) in the control and lower quantity (1.67) in BL150. This culminated in the high degree of coefficient of variability of 34.10% ,between the treatments and the gall index (Table 4).

Table 4. Effect of tested plant extracts on number of galled roots and gall index at harvest

Botanicals [g/l]	Number of galled roots	Gall index
Control	249.00	4.67
BL150	16.60	1.67
BL300	0.00	0.00
BL450	0.00	0.00
MG150	0.00	0.00
MG300	0.00	0.00
MG450	0.00	0.00
F-LSD = 0.05	0.67	0.54
CV [%]	1.00	34.10

BL – bitter leaf; MG – mango leaf

DISSCUSION

Growth is the irreversible increase in size of a living organism. Plant height is one of such responses to environmental factors. The treated plants were higher than the untreated. The extracts exerted serious damaging effects on the nematode activities thereby allowing plants to grow better in the treated than in the untreated combinations. The bitter taste of the extracts may contribute to their adverse effects on the nematode. Thus, a favourable environment for the plants to thrive in, was created in the treated soils. Ihejirika *et al*. (2006) reported that the creation of favourable conditions for absorption of available nutrients also provides ideal crop interaction. Efficient use of available soil nutrient allows for optimum growth and development of the plant. Bitter leaf treatment showed a higher percentage of increase in plant height which may also be attributed to the degree of bitter taste. The formation of leaves increased with increased concentrations of the leaf extracts.

The number of fruits produced by tomato plants was better in the treated combinations than in the untreated. The control had the lowest number of fruits. This is in agreement with the results of the work of Mbah *et al*. (2005) who found the yield of tomato plants treated with plant leaf extracts higher than those of untreated (control) plants. The treatments depressed nematode activities thereby allowing the plants to absorb nutrients for proper development. Sasser (1989) reported that low yield and poor quality of crops result from nematode damage to crops. Applications of leaf extracts increased fruit weight compared to the control. Fruit weight is important in agricultural production as it is one of the major determinant parameters of market prices. Increase in weight of fruits among treated plants compared to the untreated, also supported the works of Mbah *et al*. (2005).

The higher number of galled roots and gall index expressed by the control (untreated) plants showed that to-

mato cv. roma vf is highly susceptible to *M. javanica* infection. The treatments reduced significantly the infectivity of the nematode on tested plants. This indicates that the leaf extracts have nematicidal effects on this nematode. There were drastic reductions in the infection levels of *M. javanica* according to the increase in the concentrations of the extracts. Onyenobi and Aghale (2003) reported the efficacy of various plant extracts in the control of root knot nematode on crops.

CONCLUSION

The use of these extracts in controlling the infection of *M. javanica* on tomato cv. roma vf proved to be efficacious. Bitter leaf at the concentration of 450 g/l reduced significantly the symptoms of the nematode thereby producing higher fruit weight. Mango leaf aqueous extract at a 450 g/l concentration also caused the highest fruit weight in the studied cultivar. Therefore, these can be recommended as alternative nematicides at these levels which will aid in the reduction of the cost of production regarding the purchase and application of synthetic nematicides. Farmers are advised to embrace the use of these cheap, readily available nematicides.

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POLISH SUMMARY

REAKCJA POMIDORA (*SOLANUM LYCOPERSICUM*) – ODMIANY ROMA VF NA OPANOWANIE PRZEZ PATOGENICZNY NICIEŃ *MELOIDOGYNE JAVANICA* TREUB W GLEBIE POTRAKTOWANEJ WODNYM ROZTWOREM EKSTRAKTU Z LIŚCI ROŚLIN *VERNONIA AMYGDALINA* L. ORAZ MANGOWCA (*MAGNIFERA INDICA* L.)

Przedstawiono wyniki badań nad reakcją roślin pomidora (*Solanum lycopersicum*) – odmiany Roma vf, na opanowanie przez patogeniczny nicień *Meloidygene javanica* Treub, w glebie potraktowanej wodnym roztworem ekstraktu pochodzącym z liści roślin: *Vernonia amigdalina* L. oraz mangowca (*Magnifera indica* L.). Badania prowadzono na Uniwersytecie Rolniczym Ishiagu w stanie Ebonyi w południowo-wschodniej Nigerii. W latach 2008–2009 wykonano dwa doświadczenia wazonowe. Ekstrakty z liści zastosowano w trzech koncentracjach: 150 g/l, 300 g/l oraz 450 g/l. Glebę wykorzystaną do doświadczeń sklasyfikowano jako „ultisol". Kontrolę stanowiły wazony nie traktowane ekstraktami z liści. Doświadczenia założono metodą bloków losowanych w 4 powtórzeniach. Uzyskane dane z dwóch doświadczeń uśredniono i poddano analizie wariancji Genstat Edition 3 Release 7.2. Analizowano wysokość roślin (cm), liczbę liści przy 50% kwitnieniu roślin, liczbę owoców, masę owoców (g) w okresie zbioru, liczbę korzeni z galasami oraz ilościowy wskaźnik galasów w okresie zbiorów. Wyniki badań wykazały, że obydwa ekstrakty z liści testowanych roślin miały istotny ($p < 0,001$) wpływ na wszystkie analizowane czynniki doświadczenia. Obydwa ekstrakty charakteryzowały się silnym nicieniobójczym działaniem. Zarówno liczba korzeni z galasami, jak też ilościowy wskaźnik galasów uległy znacznemu zmniejszeniu. Najwyższy plon owoców uzyskano po zastosowaniu badanych ekstraktów z obydwóch roślin w koncentracji 450 g/l. Z tego względu dawkę tą można zalecić do stosowania w praktyce przez rolników.