



COMPARATIVE EFFICACY OF FOUR PLANT LEAF EXTRACTS AGAINST ROOTKNOT NEMATODE (*Meloidogyne javanica*) IN JALINGO, NIGERIA

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ABSTRACT

An experiment was carried out to compare the effects of four plant leaf extracts (*Newbouldia laevis*, *Triumfetta rhomboidea*, *Piliostigma thonningii* and *Ageratum conyzoides*) against rootknot nematode (*Meloidogyne javanica*) in 2017 and 2018 at Jalingo Nigeria. Eggplant cv Bello variety seedlings were transplanted into a nematode infested field and water extracts of these plant leaves were applied at transplanting and eight weeks thereafter. Data was collected and subjected to analysis of variance (ANOVA) and means were separated using SEM. The result showed that there was no significant difference among the extract treatments for almost all the parameters but highly significant difference between extracts and control for all treatments. For gall index, in 2017 and 2018, Control recorded 4.27 and 4.47 whereas *Ageratum conyzoides* followed with 2.72 and 2.66, *Piliostigma thonningii* (2.56 and 2.65), *Triumfetta rhomboidea* (2.44 and 2.51) and *Newbouldia laevis* was least with 2.22 and 2.28 respectively. For final nematode population, control plot (CT) had significantly ($P=0.05$) higher number with a mean of 890.6 nematodes followed by *A. conyzoides* (215.4), *T. rhomboids* (204.6), *P. thonningii* (200.6) and least was *N. laevis* with 188.9 nematodes. Control plants had significantly heavier mean root weight (307.7 g) than *A. conyzoides* (222.0 g), *P. thonningii* (170.8 g), *N. laevis* (169.5 g) and *T. rhomboidea* (166.7 g). The research indicates that the four plant leaf extracts are at par in their ability to prevent/reduce damage by *M. javanica* on eggplant and therefore can be used as environmentally friendly tool for controlling the nematode.

Keywords: Extracts, Eggplant, Rootknot, Nematocidal, *M. javanica*

INTRODUCTION

Plant extracts have been studied extensively for their efficacy against nematodes, providing environmentally friendly alternatives to synthetic nematicides. Ginger extracts contain bioactive compounds such as gingerol and shogaol, which exhibit nematocidal activity. El-Borai *et al.* (2014) demonstrated the efficacy of ginger rhizome extract against root-knot nematodes, resulting in significant reductions in nematode population densities and root galling. Adegbite *et al.* (2020) demonstrated significant reductions in nematode population densities and root galling following ginger rhizome extract application against root-knot nematodes (*Meloidogyne incognita*) on okra plants. Wu *et al.* (2020) evaluated the efficacy of garlic bulb extract against the pine wood nematode (*Bursaphelenchus xylophilus*) and demonstrated that garlic extract significantly reduced nematode mortality and inhibited nematode reproduction, suggesting its potential for pine wood nematode management. Sharma *et al.* (2021) found that neem seed kernel extract significantly reduced root-knot nematode (*Meloidogyne incognita*) population densities in soil and suppressed root galling, resulting in improved growth tomato plant. Baidoo *et al.* (2022) investigated the efficacy of marigold leaf extracts against root-knot nematodes (*Meloidogyne spp.*) on tomato plants and reported that marigold extract significantly reduced nematode populations in soil and suppressed root galling, leading to enhanced plant growth.



Studies have also compared the efficacy of different plant extracts in controlling nematodes. Kumar *et al.* (2018) compared the nematicidal activity of neem, garlic, and marigold extracts against root-knot nematodes (*Meloidogyne spp.*) on tomato plants. They found that neem extract significantly reduced nematode populations compared to garlic and marigold extracts. Voss *et al.* (2022) compared the efficacy of garlic bulb extract with synthetic nematicides against root-knot nematodes (*Meloidogyne spp.*) on cucumber plants under greenhouse conditions and reported comparable efficacy between garlic extract and synthetic nematicides in reducing nematode population densities and improving plant growth. Mishra *et al.* (2023) compared the efficacy of neem leaf and seed extracts against root-knot nematodes (*Meloidogyne incognita*) on tomato plants. The study found that both neem leaf and seed extracts significantly reduced nematode population densities in soil and suppressed root galling, with neem seed extract showing slightly higher efficacy. Omondi *et al.* (2023) found that marigold flower extract effectively reduced root-knot nematodes (*Meloidogyne spp.*) populations and root galling on common bean plants, demonstrating comparable efficacy to chemical nematicides. Kumar *et al.* (2023) compared the efficacy of ginger rhizome extract with other botanical extracts against root-knot nematodes (*Meloidogyne spp.*) on tomato plants and reported that ginger extract showed comparable efficacy to other botanical extracts in reducing nematode populations and suppressing root galling. The nematocidal activity of extracts of *N. laevis*, *P. thonningii*, *A. conyzoides* and *T. rhomboidea* against *M. javanica* on Eggplant have been established (Mamman *et al.*, 2020; Mamman *et al.*, 2021; Umar *et al.* 2023, Mamman, 2023). This study was carried out to compare the efficacy of these four plant extracts for control of root-knot nematode *M. javanica* on Eggplant in Jalingo.

MATERIALS AND METHOD

The Study Area

The experiment was conducted at the Teaching and Research Farm of College of Agriculture, Jalingo, Nigeria during 2017 and 2018 rainy seasons.

Experimental Materials, Source and Preparation

Leaves of *N. laevis*, *P. thonningii*, *A. conyzoides* and *T. rhomboidea* were removed sourced within and around Taraba State University, Jalingo. The leaves were washed, air-dried ground to powder using mortar and stored in plastic containers. Water-soluble extracts of these plant powders were prepared following procedures described by Umar (2009): 50 g of each plant powder prepared above was poured in to a 5 litre plastic bucket containing 500 ml distilled water. This set up was left to stand for 48 hours and filtered through filter paper.

Experimental Design

The site of the experiment was ploughed, levelled and demarcated into 15 plots; each plot measured 2 m x 2 m (4 m²). The site had three replications with each replication having five plots. The plots were arranged in a randomized complete block design (RCBD) in both 2017 and 2018. Seedlings of Eggplant cv *Yalon Bello* were raised in plastic pots (20 cm diameter) for three weeks in the month of June before they were transplanted to the field in July of 2017 and 2018. Eggplant seedlings were transplanted to the field one plant per stand and nine plant per plot, and spaced at 60 cm x 60 cm. The holes into which seedlings were transplanted were first drenched with 10 ml extract of *N. laevis*, *P. thonningii*, *A. conyzoides* and *T. rhomboidea* after that 10 ml extracts was applied weekly for eight weeks. All agronomic practices were carried out as required.



Data Collection and Analysis

Data from Plant height, number of leaves, number of branches, shoot weight, root length, root weight, number of fruits, fruit weight, fruit girth, yield, galling index, nematode population and reproduction factor were collected from three tagged plants per plot.

Soil was sampled at a depth of 0 – 15 cm for nematode population using an auger. All data collected were subjected to analysis of variance (ANOVA) using SAS and means were separated using SEM (Standard Error of the Mean) at $P=0.05$ level of significance.

RESULTS AND DISCUSSION

Results of the experiment are presented in Tables 1 to 3. For gall index, result shows that for both 2017 and 2018, Control recorded significantly ($P=0.05$) greater mean gall index than all other treatments indicating that the rate of galling was much higher in the control than the other treatments at 4.27 and 4.47 respectively. Among the four plant extracts, *Newbouldia laevis* recorded the least mean gall index of 2.22 and 2.28 followed by *Triumfetta rhomboidea* (2.44 and 2.51), *Piliostigma thonningii* (2.56 and 2.65) and highest was *Ageratum conyzoides* with 2.72 and 2.66 respectively (Table 1).

For final nematode population, control treatment (CT) had significantly ($P=0.05$) higher number of 898.8 (2017) and 882.4 (2018) with a mean of 890.6 nematodes than all other treatments for both years. There was no significant ($P=0.05$) difference in final nematode population among the four plant extracts though *A. conyzoides* recorded the highest population with 215.4 followed by *T. rhomboids* (204.6), *P. thonningii* (200.6) and least was *N. laevis* with 188.9 nematodes ($P=0.05$).

M. javanica seemed to reproduce significantly ($P=0.05$) better in untreated control with Rf of 2.35 (2017) and 2.32 (2018) than all other treatments. *N. laevis* treated plants recorded the lowest mean Rf for 2017 and 2018 of 0.49 followed by *P. thonningii* (0.53), *T. rhomboidea* (0.54) and *A. conyzoides* with 0.57 (Table 1). This indicates that *M. javanica* reproduced more poorly in *N. laevis* than all other plant extracts showing its level of toxicity to the nematode.

Roots of control plants were significantly ($P=0.05$) heavier (307.7 g) than other treatments indicating that the absence of any plant extract in the soil gave *M. javanica* free reign in penetrating roots and causing damage. Roots of plants treated with extracts were significantly ($P=0.05$) lighter than control with *T. rhomboidea* having the least mean root weight (166.7 g) followed by *N. laevis* (169.5 g), *P. thonningii* (170.8 g) and *A. conyzoides* (222.0 g). There was no significant ($P=0.05$) difference in mean root weight between the treatments but the difference was significant ($P=0.05$) between the three plant extracts and *A. conyzoides* showing that these plant extracts were more active in preventing the activity of *M. javanica* on the eggplants than *A. conyzoides* (Table 1).



Table 1: Effect of Plant Extracts on Nematode Parameters of Eggplant Infested with *Meloidogyne javanica* in 2017 and 2018

Parameter	Gall Index											
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean
NL	2.22	2.28	2.25	195.2	182.5	188.9	0.51	0.48	0.49	169.4	169.6	169.5
TR	2.44	2.51	2.48	210.2	198.9	204.6	0.55	0.52	0.54	166.6	166.7	166.7
PT	2.56	2.65	2.60	206.8	194.4	200.6	0.54	0.51	0.53	170.9	170.7	170.8
AC	2.72	2.66	2.69	221.5	209.2	215.4	0.58	0.55	0.57	222.1	221.9	222.0
CT	4.27	4.47	4.38	898.8	882.4	890.6	2.35	2.32	2.34	307.2	308.2	307.7
Mean	2.84	2.91	2.88	346.5	333.5	340.0	0.91	0.88	0.89	207.2	207.4	207.34
SEM (±)	0.36	0.39	0.38	138.1	137.2	137.7	0.36	0.36	0.36	27.0	27.2	27.1

PE [Plant extracts (NL-*Newbouldia laevis*, TR-*Triumfetta rhomboidea*, PT-*Piliostigma thonningii*, AC-*Ageratum conyzoides*, CT- Control)]
 SEM-Standard Error of the Mean



The result as presented in Table 2 revealed that, eggplants treated with the extracts recorded significantly ($P=0.05$) longer roots than untreated control in both 2017 and 2018. NL-treated eggplants recorded the longest mean root length of 65.1 cm followed by AC-treated plants (62.3 cm) though not significantly ($P=0.05$) different. However, the difference in mean root length between NL and the other two extracts (PT -59.0 cm and TR-55.5 cm) were significant whereas the difference between NL and CT (36.5 cm) was highly significant ($P=0.05$). The significant ($P=0.05$) difference between the extracts and control showed that extracts may have reduced the harmful activities of *M. javanica* on eggplant thereby allowing the roots to grow and perform their function with much less disturbance from the nematode. Among the extracts, NL seemed to have significantly longer mean root length than others giving an indication that its antinematicidal activity was higher in terms of root length. Extract-treated eggplants produced significantly ($P=0.05$) higher mean number of fruits than control (Table 2). There was no significant ($P=0.05$) difference in mean number of fruits between the extract treatments with PT having the highest of 22.4 fruits followed by NL (22.3), AC (20.9) and TR was lowest with 20.4. CT or control was least with 10.8 fruits per plant. PT (22.4) and NL (22.3) produced the highest mean number of fruits which goes to demonstrate that they had better effect in curtailing *M. javanica*'s damage on eggplant leading to the higher mean number of fruits recorded.



Table 2: Effect of Plant Extracts on Some Growth and Yield Parameters of Eggplant Infected with *M. javanica* in 2017 and 2018

Parameter	Root length (cm)			Shoot weight (g)			Fruit weight (g)					
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean
NL	64.9	65.4	65.1	1318.5	1319.4	1318.9	22.1	22.5	22.3	90.7	92.3	91.5
TR	55.1	55.8	55.5	1194.7	1195.5	1195.1	20.0	20.7	20.4	89.7	90.3	89.9
PT	58.7	59.3	59.0	1083.3	1093.0	1088.2	22.1	22.6	22.4	90.5	90.9	90.7
AC	62.2	62.5	62.3	1304.5	1305.6	1305.2	20.6	21.3	20.9	89.2	89.9	89.6
CT	36.5	36.6	36.5	143.7	143.1	143.4	10.6	10.9	10.8	37.9	38.7	38.3
Mean	55.5	55.9	55.68	1008.94	1011.32	1010.16	19.1	19.6	19.36	79.6	80.42	80.0
SEM (\pm)	5.03	5.06	5.05	220.4	220.8	220.6	2.16	2.19	2.18	10.4	10.4	10.4

PE [Plant extracts (NL-*Newbouldia laevis*, TR-*Triumfetta rhomboidea*, PT-*Piliostigma thonningii*, AC-*Ageratum conyzoides*, CT- Control)]

SEM-Standard Error of the Mean



Table 3: Effect of Plant Extracts on Growth Parameters of Eggplant Infected with *Meloidogyne javanica* in 2017 and 2018

Parameter	Yield (tons/Ha)			Plant height (cm)			Number of Leaves			Number of branches		
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean
NL	41.2	42.7	41.9	111.2	111.7	111.5	120.9	121.3	121.2	16.6	17.2	16.9
TR	37.0	38.6	37.8	111.4	111.6	111.5	119.3	119.8	119.6	16.8	17.3	17.0
PT	42.2	43.7	42.9	107.5	107.8	107.7	118.5	119.8	119.1	16.1	16.6	16.3
AC	37.9	39.6	38.7	103.8	104.1	103.9	115.0	115.5	115.3	15.8	16.1	15.9
CT	8.60	9.16	8.89	48.8	48.9	48.9	54.8	55.6	55.2	8.10	8.72	8.39
Mean	33.38	34.752	34.038	96.54	96.82	96.7	105.7	106.4	106.08	14.68	15.184	14.898
SEM (\pm)	6.27	6.46	6.36	12.0	12.0	12.0	12.7	12.7	12.7	1.65	1.62	1.64

PE [Plant extracts (NL-*Newbouldia laevis*, TR-*Triumfetta rhomboidea*, PT-*Piliostigma thonningii*, AC-*Ageratum conyzoides*, CT- Control)]
 SEM-Standard Error of the Mean



For yield, there was a highly significant ($P=0.05$) difference between eggplants treated with plant extract and the control but no significant ($P=0.05$) difference in yield between the extract treatments. PT recorded the highest mean yield of 42.9 t/ha followed by NL (41.9 t/ha), AC (38.7 t/ha), TR (37.8 t/ha) and least was CT with 8.89 t/ha (Table 3). Eggplants treated with the four plant extracts were statistically similar in height as there was no significant ($P=0.05$) difference between them but the difference between them and control was highly significant ($P=0.05$). NL and TR produced eggplants with the same mean height of 111.5 cm followed by PT (107.7 cm), AC (103.9 cm) and shortest was CT with 48.9 cm (Table 3). NL, TR, PT and AC recorded significantly ($P=0.05$) higher mean number of leaves than control CT but between them, there was no significant ($P=0.05$) difference in mean number of leaves. NL recorded the highest mean number of leaves with 121.2 followed by TR (119.6), PT (119.1), AC (115.3) and least was CT with 55.2 (Table 3). The four extract treatments produced significantly ($P=0.05$) higher mean number of branches than control but with no significant ($P=0.05$) difference between the extracts. For these four parameters, there is no significant difference between the plant extracts showing that their effects on *M. javanica* on eggplant are similar.

Controlling nematodes using plant extracts is an area of interest due to its potential for environmentally friendly pest management. Kumar *et al.* (2018) compared the nematocidal activity of neem, garlic, and marigold extracts against root-knot nematodes (*Meloidogyne spp.*) on tomato plants and found that neem extract significantly reduced nematode populations compared to garlic and marigold extracts. Also, Mishra *et al.* (2023) compared the efficacy of neem leaf and seed extracts against root-knot nematodes (*Meloidogyne incognita*) on tomato plants who found that both neem leaf and seed extracts significantly reduced nematode population densities in soil and suppressed root gallings, with neem seed extract showing slightly higher efficacy. Voss *et al.* (2022) compared the efficacy of garlic bulb extract with synthetic nematicides against root-knot nematodes (*Meloidogyne spp.*) on cucumber plants under greenhouse conditions and reported comparable efficacy between garlic extract and synthetic nematicides in reducing nematode population densities and improving plant growth.

The findings of this research shows the effect of the four plant extracts on *M. javanica* on eggplant generally are similar. The not significant difference between the extracts for most of the parameters shows that their activity against *M. javanica* does not differ much and any of the extracts can be used for the nematode's control and similar result will be obtained. Between the four extracts and control, the highly significant difference shows that applying the extracts is a far better option than not doing. The result of this study supports the work of Mamman *et al.* (2020), Mamman *et al.* (2021), Umar *et al.* (2023) and Mamman (2023) by showing that the plant extracts are active against *M. javanica* but went farther to compare their activity against *M. javanica* with each other and the data obtained shows no significant difference.

CONCLUSION AND RECOMMENDATION

Eggplant cv *Yalon Bello* is clearly susceptible to attack by *M. javanica* and the crude extracts of the four plant leaves (*Newbouldia laevis*, *Triumfetta rhomboidea*, *Piliostigma thonningii* and *Ageratum conyzoides*) possess the capacity to reduce the damaging effect of the nematode on the eggplant. Statistical analysis from this research shows that when the effects of these plant leaves on *M. javanica* were compared, it was found that there was no significant difference. It was therefore concluded that their effects were similar and none had an edge over the other in controlling *M. javanica*. It is therefore recommended that crude



extracts of any of these plant leaves can be used in Eggplant cv *Yalon Bello* fields infested with the nematode.

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