Nematicidal potential of *Faidherbia albida* fruit against *Meloidogyne javanica* on cowpea

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Abstract

The effect of *Faidherbia albida* fruit powder and extract on root-knot nematode *Meloidogyne javanica* in the laboratory and screen house was investigated. Nematodes egg suspension at 100 eggs/5ml syringe introduced into each Petri dish containing both crude and diluted extracts of fruit powder (5, 10, 15 and 20 ml) except the control, which received only distilled water. Petri dishes were treated to the same concentrations of the extract in Petri dishes containing 1000 second stage juveniles of *M. javanica*. Egg hatch inhibition and larval mortality was observed over a period of 72 hrs. Sterilized loamy soil (4 kg) contained in 36 perforated plastic pots (30 cm dia. and 40 cm depth) were separately mixed with 0, 30, 40, 50 and 60 g (equivalent to 0, 10 15, 20 and 25 tons/ha) of the fruit powder. Carbofuran was applied at 0.060 g/pot. Control pots received no amendment. Two early maturing cowpea varieties EX-Gurin and EX-Yobe were planted separately into the pots containing the amendment. Pots were inoculated with 1000 J_2/pot. The results of the study showed that the crude extract gave better egg inhibition and 85% juvenile mortality. In the screen house pots treated with 25 t/ha gave better growth parameter, yield and better nematode control than the other treatments. It is suggested that field trial be conducted to determine the level of control before recommending to cowpea farmers.

F*aidherbia albida* is one of the fastest growing tree of Africa and the Middle East. It is deciduous and can grow up to the height of 30 m tall. It produces pale grey leaves which are twice compound having a conspicuous gland at the base of each pair of pinnate (leaflets). It has straight, whitish thorns which are in pairs and grow up to 40 mm long. It produces scented, pale cream colour flowers and form elongated spike up to 35-160 x 200 mm and bears orange to brown fruits (Coates, 2002).

Cowpea (*Vignia unguiculata* (L.) Walp.) is an important food legume and an essential component of cropping systems in dry regions of the tropics and subtropics. In Nigeria, the most cultivated and eaten legume is cowpea and grown on large area in the northern states of Nigeria (Ononuju & Nzenwa, 2011). The major problem of cowpea are pests and diseases which not only cause low yield but also discourage most farmers from cultivating the crop (Emechebe, 1985). *Meloidogyne* species is one of the major root pest of cowpea in all the producing areas of Nigeria (Iheukwumere *et al*., 1995). Symptoms of nematodes attacked on cowpea includes stunted growth, chlorosis and crop failure (Umar, 2012). Losses caused by nematodes on cowpea are estimated to range between 10-69% (Olowe, 2009). Nematodes control is best achieved through the use of chemical nematicides, but they have been found to expensive, phytotoxic to plants, hazardous to human health and environment as well as unaffordable to peasant farmers in Nigeria. The indiscrimate use of synthetic nematicides has also resulted in development of resistance. This has led nematologists to develop cheaper, non toxic and environmental friendly botanicals which have been found effective in the control of nematodes in screen house and field experiments (Umar, 2012; Ogwulumba *et al*., 2011; Yasmin *et al*., 2003). The objective of this study was to find out the effect of powder and extracts of *Faidherbia albida* fruits on *M. javanica* in the laboratory and screen house experiments.

Materials and Methods

Experimental site: The experiments were conducted in the laboratory and screen house of the Department of Crop Protection, Modibbo Adama University Yola, Adamawa State, Nigeria, between January and April 2012 and 2013.

Preparation of powder: *Faidherbia albida* fruits were collected from trees around the University farm. The fruits after collection were shade dried on polythene sheets for two weeks. The fruits after drying were grinded into powder in the laboratory using an electric grinding machine. The obtained powder was stored in polythene bags in the laboratory.

Phytochemical analysis: Phytochemical analysis of the fruit powder was carried out in the laboratory for alkaloid, tannin, phenol, saponin and flavonoid content using the methods described by Trease & Evans (1989), Silva *et al*., (2003) and Sofowora (1993).

Preparation of extracts: Water soluble extracts of the fruit powder was prepared as fruit powder 50 g placed in 5 litre plastic bucket containing 500 ml distilled water. The set up was then allowed to stand for 48 hrs before it was centrifuged at 500 rpm for ½ h and filtered through Whatman No. 2 filter paper. The filtrate obtained was designated as crude extract (S) and serial dilution was carried out with 5, 10 and 15 ml distilled water given S_1, S_2 and S_3, respectively.

Extraction of *M. javanica* juveniles and eggs: *Meloidogyne javanica* was identified using the head and stylet morphology described in Eisenback *et al*., (1981) and maintained on local tomato cultivar EX-Dasin. The second stage juveniles were extracted from roots of tomato using the tray method (Whitehead & Hemming, 1965). Egg-masses from roots of tomato were used for extraction of eggs. Eggs were extracted by agitating washed roots of tomato in 0.05 % sodium hypochlorite solution in a conical flask for 2-3 mins (Hussey & Baker, 1973). Eggs were collected and rinsed with tap water on nested 150 followed by 25 µm pore sieves (Dong *et al*., 2007).

Egg hatchability test: The method described used by Ononuju & Nzenwa (2011) was used for the test as follows: Nematodes egg suspension at 100 eggs per 5 ml introduced into each Petri dish through a syringe containing both crude and diluted extracts of fruit powder (5, 10, 15 and 20 ml) and control received only distilled water. There were five treatments and replicated three times, arranged in a completely randomized design (CRD) in the laboratory. Egg hatch was observed over a period of 72 hrs. Mean egg percent was calculated and plotted as a graph.

Juvenile mortality test: Nematodes juvenile suspension at 1000 juveniles per 10 ml was introduced into each Petri dish through a syringe containing both crude and diluted extracts of fruit powder (5, 10, 15 and 20 ml distilled water) and control received only distilled water. There were five treatments and replicated three times, arranged in a completely randomized design (CRD) in the laboratory. Juvenile mortality was observed. Mean juvenile mortality percent was calculated over a period of 72 hrs.

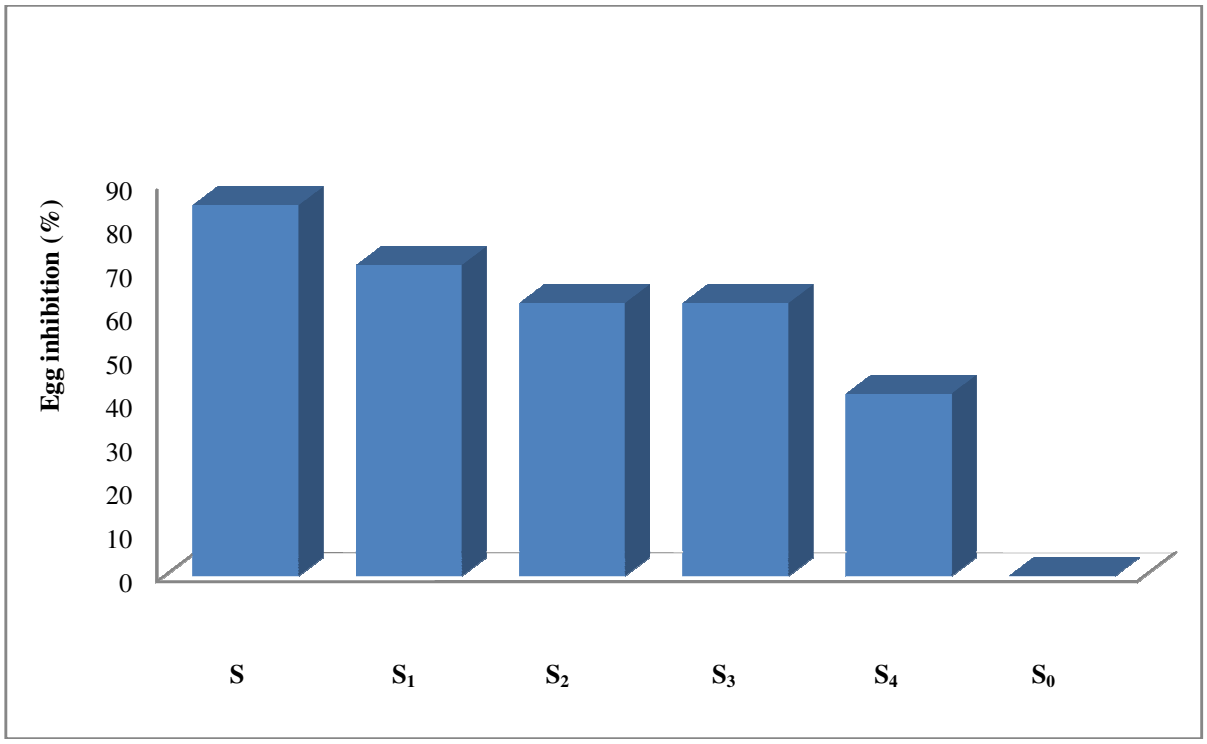
Pot experiment: Sterilized loamy soil (4 kg) contained in 36 perforated plastic pots (30 cm dia. and 40 cm depth) were separately mixed with 0, 30, 40, 50 and 60 g (equivalent to 0,10 15, 20 and 25 t/ha) of the fruit powder. Carbofuran was applied at 0.060 g/pot. Control pot received no amendment. Two early maturing cowpea varieties EX-Gurin and EX-Yobe were planted separately into 36 pots containing the amendment at the rate of 2 seeds/pot and later thinned down to one plant/pot. Each variety had 18 pots. There were 6 treatments and three replications. Pots were arranged in completely randomized design in the screen house. *M. javanica* juveniles at 1000/pot were applied with a syringe to the base of each cowpea plant a week after germination. Agronomic activities such as watering, hand pulling of weeds and fertilizer application were

done. Data was collected on both above and below ground parts of plants. Galls were rated using the rating scheme described by Sasser *et al*., (1984) and final nematode population obtained by extracting 500 cm^3 of soil from each treatment using Whitehead and Hemming method (1965). All data collected were subjected to analysis of variance and means separated using Duncan's New Multiple Range Test at 5%.

Results and Discussion

Pytochemical composition: Phytochemical analysis of the fruit extract indicated that fruit contained low amount of alkaloid, moderate content of tannin and glycosides and high content of saponins while, phenols and flavonoids were not detected.

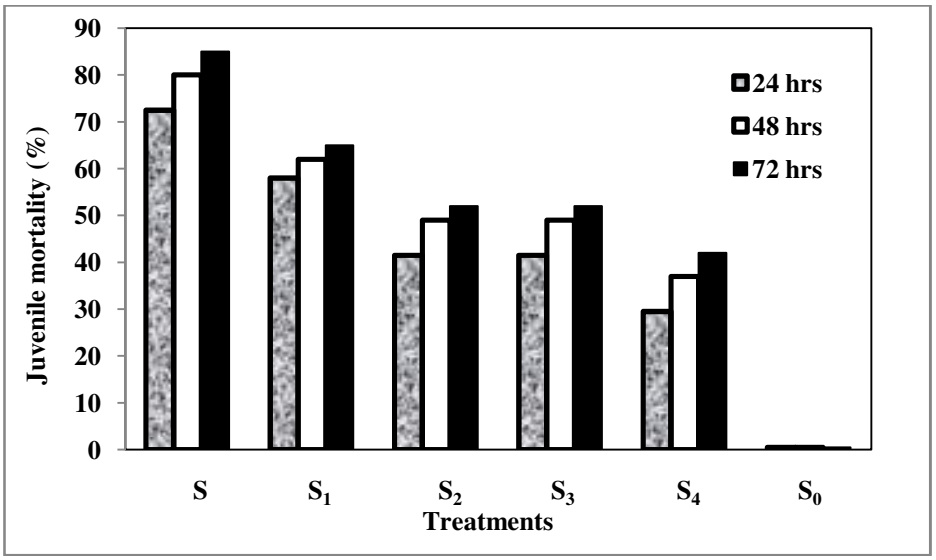
Egg hatching: Effect of the different concentrations of the fruit extracts of *F. albida* on egg of *M. javanica* in the laboratory (Fig. 1) indicated that 85% egg hatching (inhibition) was obtained by crude extract application followed by 5 ml dilution (71%) and 0% inhibition was recorded in the control after 12 hrs. The result shows that the longer the exposure time the better the rate of inhibition. Also, it was evident from the study that level of toxicity of the extract decreases with increased in dilution. The control recorded 0% inhibition because it has no effect on preventing nematodes eggs from hatching. The effect of the extract as a result of the phytochemical content of the fruit which tend to inhibit egg hatching. It has been reported that extracts of plants that contained saponins and tannins tend to inhibit nematodes egg hatch because of their ovicidal property (Adegbite & Adesiyan, 2005; Umar, 2013).



S = Crude extract; S_1 = Crude extract diluted with 5 ml distilled water; S_2= Crude extract diluted with 10 ml distilled water; S_3 = Crude extract diluted with 15 ml distilled water; S_4 = Crude extract diluted with 20 ml distilled water; S_0 = Control.

Fig. 1. Effect of extracts of fruit powder of *F. albida* on egg hatch inhibition of *M. javanica*

Juvenile mortality: Effect of the various concentrations of the fruit extracts on larval mortality of *M. javanica* has been found. The result of the study shows that crude extract recorded the highest juvenile mortality (85%), followed by 5 ml dilution (65%) and the least in the control after 72 hrs (Fig. 2). The result also showed that the lower the concentration and exposure time the lower the mortality of nematodes. The result showed that toxicity effect of fruit powder of *F. albida* extract was concentration dependent. Earlier studies by Gamal *et al*., (2008) showed that leaf extract of *F. albida* fruit was found effective on second stage juveniles of *M. incognita*. The mechanisms of the plant extracts action may include denaturing and degrading of proteins and other compounds and results in the death of nematodes. The control being distilled water showed no effect on mortality of nematodes.



S = Crude extract; S_1 = Crude extract diluted with 5 ml distilled water; S_2 = Crude extract diluted with 10 ml distilled water; S_3 = Crude extract diluted with 15 ml distilled water; S_4 = Crude extract diluted with 20 ml distilled water; S_0 = Control.

Fig. 2. Effect of extracts of fruit powder of *F. albida* on juvenile mortality of *M. javanica*.

Pot experiment: The results of the potted experiments are presented in Tables 1, 2 and Fig. 3. The results of these studies indicated that 25 t/ha provided best growth parameters of cowpea plants in both years (plant height, number of leaves, pod weight, fresh and dry shoot weights). The results also showed that the other treatments were not as effective as compared with the 25 t/ha treatment more effective than the control. The treated pots recorded fewer galls and lower nematodes population than the control in both years. The significant reduction of nematode population in the treated pots could be due to phytochemicals present in the powder which may possess larvicidal properties. Carbofuran a chemical nematicides recorded fewer galls and lowest nematode population than all the treatments. Incorporation of plant materials into soil have been reported to improve soil conditions, plant growth, yield and control nematodes (Akhtar, 1993). It was reported by Adekunle & Akinlua (2007) that incorporation of plant materials in potted soil delay development and consequently reduced population of nematodes. The results obtained in this study were similar to those obtained by Umar (2012), Ononuju & Nzenwa (2011) when they incorporated botanicals into the soil to control nematodes. The poor performance of cowpea plants in control pots for all growth parameters measured could be as a result of heavy infestation of roots by nematodes. The control plants were

heavily galled due to infection and this could have disrupted the normal transportation of water and nutrients from the roots to the other parts of the plants which translated to poor growth and yield.

Table 1. Effect of *F. albida* on growth parameters of cowpea for the control of *Meloidogyne javanica*.

TRT t/ha	2012				2013			
	PH (cm)	NL	FSW (g)	DSW (g)	PH (cm)	NL	FSW (g)	DSW (g)
Cowpea cv. Yar Gurin								
10	15.70b	16.33b	17.16d	4.10b	17.76c	17.33	19.46c	7.13b
15	16.80b	15.66c	17.93d	4.56b	19.00b	16.00	22.46b	6.93c
20	18.93a	16.33c	18.70c	4.96b	19.83b	19.33	22.53b	8.20a
25	19.16a	20.33a	21.86b	4.50b	21.00a	21.33	24.56a	8.53a
0	19.73a	18.33b	22.90a	5.80a	22.16a	23.66	23.93a	8.36a
C	9.86c	14.33d	15.33e	3.20c	13.50a	9.00	11.36d	5.66d
Cowpea cv. Yar Yobe								
10	15.16e	18.33e	17.90d	7.30b	16.50e	19.33e	18.43e	8.26c
15	17.00d	21.00d	18.10d	7.40b	17.66d	21.33d	21.13d	8.33c
20	18.00c	23.66c	20.60c	7.56b	19.00c	24.80c	24.30c	8.56c
25	20.66b	28.33b	23.70b	9.06b	20.16b	29.66b	26.13b	10.03b
0	11.16f	13.00f	12.00e	4.73c	9.66f	11.66f	11.20f	3.90d
C	22.50a	32.00a	26.43a	10.23a	23.33a	34.00a	29.70a	11.26a

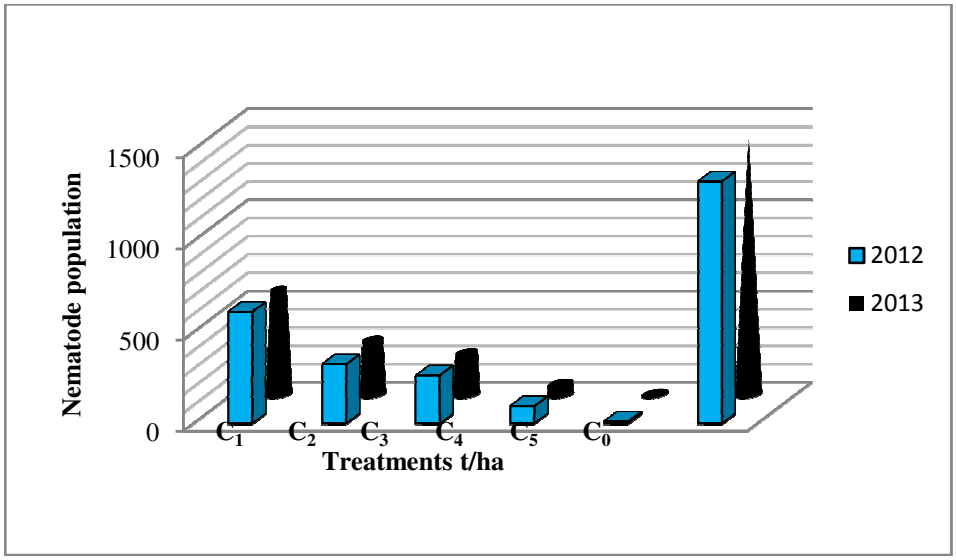
Means followed by the same letters in the same column are not significantly different at p = 0.05.
TRT = Treatment, PH = Plant height, NL = Number of leaves, FSW = Fresh shoot weight, DSW = Dry shoot weight, C = Carbofuran.

Table 2. Effect of *F. albida* on growth parameters and galling of cowpea for the control of *Meloidogyne javanica.*

TRT t/ha	2012					2013				
	FRW (g)	DRW (g)	FPW (g)	DPW (g)	GI	FRW (g)	DRW (g)	FPW (g)	DPW (g)	GI
Cowpea cv. Yar Gurin										
10	10.73b	2.36a	15.00c	9.23b	2b	10.90b	2.33b	15.13d	9.26d	2b
15	9.10c	1.23b	19.03b	11.46a	2b	10.16b	2.20b	20.03c	10.30c	2b
20	8.00d	1.33b	19.26b	11.53a	1c	8.46c	1.80c	21.53b	11.03b	1c
25	6.96c	1.10b	20.10a	11.66a	1c	6.20d	1.10c	21.83b	11.93b	1c
C	6.06c	1.10b	20.83a	11.93a	1c	5.03d	1.00c	23.20a	12.46a	1c
0	22.10a	2.00a	6.50d	4.03c	4a	24.10a	5.20a	7.33e	5.16e	4a
Cowpea cv. Yar Yobe										
10	11.63b	3.66b	17.33d	10.03d	2b	9.83b	2.36b	22.60d	11.03d	2b
15	10.40b	3.06b	18.20d	11.23c	2b	8.70b	2.40b	23.10d	12.00c	2b
20	9.16b	3.06b	20.70c	12.10c	1c	7.93c	2.73b	25.86c	14.30c	1c
25	8.36c	2.73c	25.63b	16.00b	1c	7.76c	2.60b	30.83b	18.53b	1c
C	7.96c	2.10c	28.76a	18.03a	1c	6.26c	1.43c	34.93a	20.66a	1c
0	20.86a	9.93a	11.36e	3.13e	4a	21.3a	9.36a	11.80e	2.46e	4a

Means followed by the same letters in the same column are not significantly different at p = 0.05.

TRT = Treatment, PH = Plant height, NL = Number of leaves, FSW = Fresh shoot weight, DSW = Dry shoot weight, C = Carbofuran



C_1=10 t/ha, C_2=15t/ha, C_3= 20 t/ha, C_4= 25t/ha, C_5= Carbofuran, C_0= Control

Fig. 3. Effect of fruit powder of *F. albida* on final *M. javanica* population on cowpea in the screen house.

Conclusion

The result of study showed that both the extracts and powder of *F. albida* fruit was effective against root-knot nematode *M. javanica*. However, the crude extracts and 25 t/ha gave the best results. It is recommended that field trial be conducted to determine the population of nematodes that would cause economic losses before suggesting to cowpea farmers.

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