Research Article

Response of *Meloidogyne incognita* infected *Abelmoschus esculentus* Plants to Fractions of *Anacardium occidentale*

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Abstract | Root knot nematodes belonging to the Genus *Meloidogyne* are regarded as very serious pests of many vegetables. Okra production in Nigeria and many parts of the world is threatened by the menace of RKNs and causing significant yield losses in production. Many growers result to the use of synthetic nematicides to combat this risk. However, due to the increasing awareness about the detrimental effects of chemicals on human health and the environment, its continuous use is discouraged worldwide. The search for other eco-friendly alternatives has led to the use of different plant extracts with known pesticidal properties. This current research was conducted to determine the nematicidal status of *Anacardium occidental* fractions. Analysis of ethanol extract of *A. occidentale* using gas chromatography spectrometry revealed the presence of several phyto constituents such as phenol, triterpenoids, flavonoids and other bio-active compounds. The array of fatty acid esters revealed in the GCMS result of the fractions especially fraction 52-71/Z2 is responsible for the exhibited toxicity to *M. incognita* with observed reduction in nematode population in roots and soil of the Okro plants. This resulted in increased fruit weight and the number of fruits per plant.

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Introduction

Plant parasitic nematodes (PPNs) have been indicated to be responsible for a great number of economic losses to crops (UNEP, 2000). The root-knot nematodes *Meloidogyne* spp. are particularly damaging to a number of crops and vegetables (Sasser and Freckman, 1987; Bello *et al.*, 2021; Fabiyi, 2022a, b, c, d). Symptoms of infection include characteristic root galling, yellowing of plant leaves and stunting. An estimated yield loss of about $100 billion worldwide has been attributed to *Meloidogyne* spp. alone (Oka *et al.*, 2000). The wide host range of this species has made control a little difficult (Fabiyi and Olatunji, 2018; Fabiyi, 2020; Bello *et al.*, 2020). Okra plant (*Abelmuschus esculentus* L. Moench) is a very important

vegetable of the tropical and subtropical areas of the world (Hussain *et al*., 2011; Fabiyi, 2021). In Nigeria, okra is grown for its young leaves and green pods. The vegetable contains proteins, foliate, vitamin C, calcium, potassium and carbohydrate in large quantities. The crop has been implicated with having several nutritional and health benefits. Consumption of okra has been linked with reduced risk of cancer and heart diseases. It is used to keep the intestinal tract healthy with a laxative effect (Broek *et al*., 2007; Duvauchelle, 2011). It is also considered useful against genito-urinary disorders, spermatorrhoea, haemorrhoids and chronic dysentery (Nadkarni, 2009). Root-knot nematodes are one of the major constraints to okra production in Nigeria (Fabiyi, 2021). The crop is susceptible to *Meloidogyne incognita* infestation, suppressing plant growth and reducing fruit yield (Khan and Khan, 1994; Hussain *et al*., 2012). The control of plant parasitic nematodes on okra has been achieved mostly by chemical methods. The fundamental health and environmental risk associated with the use of synthetic chemicals has necessitated research into alternatives to synthetic chemicals, with the aim of minimizing their negative effects (Fabiyi and Olatunji, 2021; Fabiyi *et al*., 2022; 2024; Fabiyi *et al*., 2023). Despite the volumes of available research about the antimicrobial nature of *A. occidentale* leaves, no current research has been conducted to evaluate fractions from *Anarcardium occidentale* for their possible nematicidal potential. Agedah *et al*. (2010) reported antimicrobial activity of ethanolic extract of *A. occidentale* leaves which was attributed to anacardic acid and other compounds such as tatrols and tannins. It has also been shown by Rajesh *et al*. (2009) to possess wide spectrum antifungal activity as well as bactericidal and bacteriostatic activities. This current research was therefore conducted to determine the phytochemical constituents of *Anacardium occidentale* and its nematicidal potential for managing RKN pests of okra.

Materials and Methods

Collection of materials

Matured barks of *Anacardium occidentale* plants were collected from a home garden at Tanke Ajanaku area in Ilorin, Kwara State, Nigeria. The plant samples were identified and documented in the Herbarium of the Department of Plant Biology, University of Ilorin, Nigeria.

Extraction and isolation of fractions

Crude extracts of *Anacardium occidentale* were obtained by pulverizing the barks and subsequent drying under ambient conditions. Six hundred grams of the dried bark materials were weighed and used for extraction by soaking in ethanol for 7 days. The product after soaking in ethanol was filtered off and concentrated using a rotary evaporator.

Phytochemical screening

Phytochemical analysis of crude extract to detect the presence of steroids, flavonoids, terpenoids, saponins etc. was conducted using standard laboratory procedures as described by (Williams and Douglas, 2005).

Thin layer chromatography

The extracts were spotted on appropriately cut commercial thin layer chromatographic plates (Merck, Germany), and developed in a chromatographic tank. Dichloromethane was utilized as solvent while thin layer chromatographs were viewed using UV lamp at 366 nm wavelength.

Column chromatography

Column chromatography involving dichloromethane and n-hexane was the eluent used for the fractionation of crude *A. occidentale* extracts. Fractionation began with 100 ml of n-hexane and gradually increased in polarity with dichloromethane addition at the ratio 4:1 to 1:4, respectively. Fractions were collected in a 50 ml flask and identical fractions were detected depending on their TLC profiles and pooled accordingly. Identified impure fractions were purified with preparative thin layer chromatography (PTLC) which was coated with a binder of calcium sulphate mixed with slurry silica gel. Activation was set for 15 mins at 103°C to dry in the oven.

Spectroscopy

Instrument used for spectroscopy includes Fourier Transform-Infrared (FT-IR) spectrophotometer, (Shimadzu, Japan), and Agilent 7890A GC/MS, Quadrupole Mass Spectra Detector, Auto sampler GC-MS. Equipment was set at ACQ_mode, relative detector mode, interfaced temperature of 250°C, start to end time of 3 min to 56 min, event time 0.5 secs and scan speed of 1428. Upon reaching the GC equilibrated temperature of 250°C, isolates were diluted using acetone and placed in micro sample vials on the auto sampler from where it was transferred

directly into the GC system for sample injection. Further reactions such as volatilization, ionization, separation and fragmentation were achieved within the GC system. Peak enrichment technique was used for identification of volatile compounds which also served as reference and confirmation of peak identification by the GC-MS.

Nematicidal assay

Nematicidal screening (*In vitro*): Pure culture of *M. incognita* eggs used for this screening was obtained from pre-identified samples of Bello *et al.* (2020), cultured at the International Institute of Tropical Agriculture, IITA, Ibadan Nigeria. The culture was multiplied further on a susceptible tomato variety (Tropimech) following the protocol of Hussey and Barker (1973) where the roots were rinsed under flowing tap water to free the attached soil and debris before they were cut into 1-2 cm and poured into a 1-litre glass jar containing 0.05% sodium hypochlorite. The jar was agitated for 4 minutes to dissolve the gelatinous matrix and have the eggs released into the solution. The released eggs were poured through a stack of sieves where the 25 µm which retained the eggs was rinsed with water. The eggs were then collected into a beaker. The number of eggs and juveniles per volume was estimated by taking aliquots of one mL three times and counting under the stereo microscope (x40) using Doncaster's (1962) counting dishes. 5 mL aliquots of 50 eggs and juveniles were transferred separately into Petri dishes (70 mm diameter). A total of 72 Petri dishes were used for the experiment. There were six (6) treatments, three (3) replicates and four (4) rates of application. Each fraction at 10 mg was dissolved in 50 mL (40 mL distilled water and 10 mL non-ionic surfactant) from which serial dilutions were made into 25, 50 and 75% concentrations. Nematicidal activities of the crude extract was based on the mean percentage eggs hatched and juvenile mortality (Abbasi *et al.*, 2008; Fabiyi *et al.*, 2020, 2021a).

Screenhouse experiment

A screenhouse experiment was initiated at the Faculty of Agriculture, University of Ilorin, Nigeria. Seventy-two (5.5 liters), 25 cm diameter pots were filled with pasteurized sandy loam soil. The pots were raised on bricks to avoid re infection in the course of the experiment. Treatments were arranged in randomized complete block design (RCBD). The initial 4 seeds sown per pot was manually thinned to one per pot upon seedling emergence a week after sowing. The okra plants were inoculated with 1500 second stage juveniles (J2) of *M. incognita* a week after emergence. *A. occidentale* solution used for treating the Okra plants was prepared by dissolving 20 mg of each fraction in 60 mL (50 mL distilled water and 10 mL non-ionic surfactant) from which serial dilutions were made into 25, 50 and 75% concentrations. Each pot received 700 mL of tap water every other day. Exactly a week after nematode inoculation, extracts of *A. occidentale* fraction was applied in a ring like form 2cm away from the base of each Okro plant (Fabiyi, 2021b). Data was taken on nematode population in 10 gram root and galled roots were rated using the rating scale described by Das and Sukul (1986) which is as follows: 5=91-100% of root galled; 4=90-66% of root galled; 3=65-36% of root galled; 2=35-11% of root galled; 1=10-1% of root galled; 0=0% gall completely absent on root. Also, 200 cc of soil was collected per treatment and nematode J2s was extracted using a modification of Coyne (2007) technique. Yield data collected were number of okra fruits per plant and fresh fruit weights. The collected data were analyzed using analysis of variance and means separated with the Tukey's HSD at $P< 0.05$.

Results and Discussion

Phytochemical screening of the crude extracts

The ethanolic extract of *Anacardium occidentale* bark showed various phytochemicals including phenols, flavonoids, triterpenoids and saponins. Alkaloids were however, not detected in any of the samples screened.

Spectroscopic result

IR Spectra of CC/52-71/PTLCG: The CC/52-71/PTLCG produced IR spectra showing the peaks with both the finger print region and the functional group region. From the IR data, the O-H stretching vibration showed at 3460cm^{-1} which can be attributed to an alcohol, and aliphatic C-H stretching was observed at 2926 and 2850 cm^{-1}. The C=C absorption peak of an alkene appeared at 1633 cm^{-1} while the C-O stretching frequency which corresponds to that of an alcohol showed at 1122 cm^{-1}. The C-H bend peak occurred at 1469 cm^{-1} while the O-H bend showed at 1274 cm^{-1} and 1265 cm^{-1}.

IR Spectra of CC/27-34/PTLCZ2: The CC/27-34/PTLCZ2 gave IR spectra depicting peaks with both finger print region and the functional group region.

Peaks detected include those of an alcohol (O-H) band at 3431cm^{-1}, aliphatic (C-H) compound stretching band at 2924cm^{-1}, ester (C=O) band at 1743 cm^{-1} and a conjugated alkene (C=C) stretching at 1637cm^{-1}. The peak observed at 1125 cm^{-1} represents the C-O stretching absorption frequency. The O-H bend band was detected at 1265 cm^{-1} while the C-H bend band was detected at 1458cm^{-1}. The IR spectral data are in consonance with those of the anacardic acid ester reported by Kubo *et al.* (2011). The aromatic C-H stretching can be said to have been subsumed by the aliphatic C-H stretching, making it inconspicuous.

IR Spectra of CC/11-19/PTLCZ3: Detected peaks include: alcohol (O-H) at 3452 cm^{-1}, aliphatic group (C-H) at two peaks: 2854 cm^{-1} and 2929 cm^{-1} respectively. Absorption peak (C-O) for alcohol was observed at 1141cm^{-1} and 1195 cm^{-1} respectively while O-H bend band was detected at 1261 cm^{-1} and 1274 cm^{-1}.

IR Spectra of CC/51-53/PTLCZ2: The CC/51-53/PTLCZ2 IR gave alcoholic O-H stretching at a peak of 3412cm^{-1}. Although the aliphatic C-H stretching was detected at two peaks of 2850 and 2922 cm^{-1}, absorption peak (C-O) of alcohol showed at 1078 cm^{-1} with the (O-H) and (C-H) bends occurring at 1265 cm^{-1} and 1413 cm^{-1}, respectively.

IR Spectra of CC/1-10/PTLCZ2: The CC/1-10/PTLCZ2 presented IR spectra showing O-H stretching vibration at 3454cm^{-1} which can be attributed to an alcohol, aliphatic C-H stretching at 2926, 2850 cm^{-1}. The C=C absorption peak of an alkene appeared at 1633cm^{-1} while the C-O stretching frequency which corresponds to that of an alcohol showed at 1186 cm^{-1}. The C-H bend peak occurred at 1469 cm^{-1} while the O-H bend at 1265 cm^{-1}.

GC-MS analysis

Results obtained from the GC-MS spectrum of CC/52-71/PTLCZ2 revealed three main peaks which corresponded to 3 compounds in the group of esters and fatty acids. These three peaks constitute up to 87.65% of the total GC data generated. Matching with NIST library data revealed n-hexadeconoic acid having 34.22%, RT= 45.447; cyclohexane carboxylic acid decyl ester at 51.19% and RT= 53.434 (Table 1). Results of the MS spectra showed that the isolate

Table 1: *GC-MS Analysis Results of CC/52-71/PTLCZ2, CC/11-19/PTLCZ1, CC/27-34/PTLCZ1 and CC/51-53/PTLCZ2*

S.	Name of proposed compound	Ret. time	% Composition	Mass spectra data
	GC-MS analysis of CC/52-71/PTLCZ2			
1	n-hexadecanoic acid	45.847	34.22	57, 60,69, 73,83,97, 115, 129,171, 185, 213, 256
2	17-octadecynoic acid	50.110	14.59	55, 50,73, 83, 91, 95, 109, 207
3	Cyclohexanecarboxylic acid, decyl ester	53.434	51.19	57, 73,84, 98, 116, 129, 147,185,207, 239, 281
	GC-MS analysis of CC/11-19/PTLCZ1			
4	2-trifluoroacetoxydodecane	43.032	22.76	55, 60, 69, 73, 77, 84, 98, 111, 116, 129, 207
5	Oleic acid	48.199	18.21	55, 69,73, 77, 81, 91, 95, 109,116, 123, 129, 135, 147, 165, 185, 207, 221, 239, 281
6	1-cyclohexylnonene	48.365	7.03	55, 69, 73, 83, 97, 105, 129, 179, 191, 207, 267, 281, 341
7	Octadecanoic acid, 2,3-dihydroxypropyl ester	49.052	45.04	55, 69, 84, 98, 116, 129, 154, 171,185, 193, 207, 267, 281, 297
8	3-[(trimethylsilyl)oxy]-17-[o-(phenylmethyl) oxime]-(3α,5α)-androstane-11,17-dione	53.560	7.0	55, 69, 73, 81, 97, 111, 129, 147, 179, 193, 207, 221, 267, 281, 327, 341
	GC-MS analysis of CC/27-34/PTLCZ1			
9	5-ethyl-2-heptanol	48.411	44.41	55, 57, 67, 71, 73, 84, 98,112, 116, 129
10	Cyclohexanecarboxylic acid, decyl ester	48.428	16.63	55, 69, 83, 98, 116,129, 281
11	2-nonanol	48.531	38.96	57, 69, 73, 81, 84, 98,116,129
	GC-MS analysis of CC/51-53/PTLCZ2			
12	3-heptadecenal	53.446	100	55, 67, 73, 81, 98, 112, 116, 129, 135, 207

CC/52-71/PTLCZ2 column chromatography fractions 52 to 71, purified with PTLC and the zone 2 was isolated. CC/11-19/PTLCZ1 column chromatography fractions 11-19 purified with PTLC and the zone 1 was isolated. CC/27-34/PTLCZ1 column chromatography fractions 27-34 purified with PTLC and the zone 1 was isolated. CC/51- 53 /PTLCZ2 column chromatography fractions 51-53 purified with PTLC and the zone 2 was isolated.

consists of a mixture of several compounds by producing a total of 5 peaks which corresponded to 5 different compounds as displayed in Table 1. Compounds detected are oleic acid (18.21%, RT= 48.199), 2-trifluoroacetoxydodecane (22.76%, RT= 43.032), 2, 3-dihydroxypropyl ester (45.06%, RT= 49.052), 1-cyclohexylnonene (7.03%, RT= 48.365), 3-[(trimethylsilyl) oxy] -17-[o- (phenylmethyl) oxime]- (3α, 5α)- androstane-11, 17-dione. 2, 3-dihydroxypropyl ester was the predominant ester group which represents 67.82% of the total.

The GC-MS of CC/11-19/PTLCZ1 depicts 3 peaks, indicating three compounds which are esters and alcohols. This infers that the isolate is a mixture. The compounds present are 5-ethyl-2-heptanol (44.41%, RT= 48.411), cyclohexane-carboxylic acid, decyl ester (16.63%, RT = 48.428) and 2-nonanol (38.96%, RT= 48.531). The major compositions are 5-ethyl-2-heptanol and 2-nonanol which make up 83.47% of the total. 2-nonanol a straight chain aliphatic alcohol is one of the most abundant components of the isolate. From the GC-MS spectral data for CC/51-53/PTLCZ2, only one peak was observed which implies it is a pure isolate. The peak corresponds to the compound 3-heptadecenal.

Laboratory and screenhouse results

The effect of the fractions on percentage mortality is shown in Table 2. Among the fractions under investigation, the analysis of variance revealed that there was no significant difference between 52-71$_{Z2}$ and 51-53/$_{Z2}$, however oxamyl had the highest percentage mortality throughout the period of observation. The least percentage mortality was observed in fraction 1-10/z_2 at 24 hours of exposure. The effect of rate of application is depicted in Table 2; the zero level of application did not record any mortality throughout the observation period conversely to other rates of application. The highest rate of application was however the most effective. Table 3 shows the performance of the fraction on egg hatch of *M. incognita*. Few egg hatchings were recorded among fractions 27-34/z_1, 51-53/z_2 and 52-71/z_2 from the fourth day of exposure to the end of observation on day twelve, however a significantly higher percentage was observed in fraction 1-10/z_2 on day twelve of the experiment (Table 3) The percentage egg hatch was equally observed to be reduced after the treatment with the fractions, the untreated control recorded the highest percentage egg hatch (Table 3). Nematode population in root and soil was highest in fraction 1-10/z_2 with a corresponding higher gall index (Table 4). Fewer nematodes were recovered in the roots and soil of plants treated with other fractions. Fruit weight and number of fruits per plant was significantly higher in oxamyl and fractions 52-71/$_{z2}$, 51-53/$_{z2}$ and 27-34/$_{z1}$, while 1-10/$_{z2}$ had fewer numbers of fruits and lighter fruit weight (Table 4).

Table 2: *Percentage mortality of M. incognita juveniles exposed to fractions from A. occidentale.*

Treatments	Day 1	Day 3	Day 5	Day 7	Day 9	Day 11
$OXML_1$	17.37^{a}	31.28^{ab}	46.09^{b}	53.37^{b}	68.32^{b}	76.51^{b}
$OXML_2$	19.05^{a}	38.29^{a}	61.45^{a}	79.06^{a}	85.13^{a}	98.18^{a}
$52\text{-}71Z^2_1$	10.19^{cd}	14.13^{c}	17.15^{d}	21.23^{d}	28.04^{d}	33.08^{d}
$52\text{-}71Z^2_2$	14.29^{b}	18.18^{b}	33.29^{c}	44.1^{c}	51.19^{c}	58.05^{c}
$51\text{-}53Z^2_1$	11.05^{c}	16.21^{bc}	17.59^{d}	24.01^{d}	30.16^{d}	32.47^{d}
$51\text{-}53Z^2_2$	14^{b}	22.39^{b}	41.2^{b}	50.16^{b}	59.17^{bc}	64.15^{b}
$27\text{-}34Z^2_1$	6.04^{e}	11.05^{d}	13.26^{e}	14.07^{ef}	16.39^{ef}	20.02^{ef}
$27.34Z^2_2$	8.21^{d}	15.02^{c}	19^{d}	23.19^{d}	28.03^{d}	31.28d
$11\text{-}19Z^3_1$	6.17^{e}	7.08^{e}	11.07^{ef}	13.02^{f}	14.36^{f}	17.11^{f}
$11\text{-}19Z^3_2$	6.44^{e}	12.03^{d}	15.22^{d}	16.19^{e}	19.28^{e}	24.11^{e}
$1\text{-}10Z^2_1$	3.1^{f}	6.08^{f}	8.04^{g}	9.03^{g}	13.16^{f}	15.31^{f}
$1\text{-}10Z^2_2$	5.04^{ef}	9.12^{e}	10.01^{f}	12.36^{f}	17.22^{e}	19.01^{f}
Control	0g	0g	0h	0.02^{h}	0.08^{g}	0.2g

Means in the same column with same alphabets are not significantly different at P < 0.05.

Table 3: *Percentage hatch of M. incognita eggs exposed to fractions from A. occidentale.*

Treatments	Day1	Day 3	Day 5	Day 7	Day 9	Day 11
$OXML_1$	0^{b}	0^{f}	0^{i}	0.21^{i}	2.17^{f}	3.54^{f}
$OXML_2$	0^{b}	0^{f}	0^{i}	0^{j}	0^{h}	0.09^{h}
$52\text{-}71Z^2_1$	0^{b}	0^{f}	1.18^{g}	2.22^{g}	5.37^{e}	10.3^{d}
$52\text{-}71Z^2_2$	0^{b}	0^{f}	0.76^{gh}	1.09^{gh}	2.11^{f}	4.14^{f}
$51\text{-}53Z^2_1$	0^{b}	0^{f}	1.4^{g}	3.29^{f}	6.83^{e}	11.05^{d}
$51\text{-}53Z^2_2$	0^{b}	0^{f}	0.32^{h}	0.87^{h}	1.7^{g}	2.17^{g}
$27\text{-}34Z^2_1$	0^{b}	4.32^{d}	6.18^{e}	8.06^{e}	10.18^{d}	11.98^{d}
$27.34Z^2_2$	0^{b}	1.1^{e}	1.98^{f}	3.11^{f}	5.21^{e}	6.31^{e}
$11\text{-}19Z^3_1$	0^{b}	10.87^{c}	12.04^{c}	13.29^{cd}	16.25^{c}	18.07^{c}
$11\text{-}19Z^3_2$	0^{b}	8.11^{c}	9.34^{d}	11.22^{d}	12.09^{cd}	13.32^{cd}
$1\text{-}10Z^2_1$	0^{b}	16.19^{b}	19.11^{b}	20.33^{b}	23.05^{b}	29.19^{b}
$1\text{-}10Z^2_2$	0^{b}	12.32^{c}	14^{c}	16.06^{c}	17.19^{c}	20.27^{c}
Control	13.12^{a}	29.1^{a}	35.36^{a}	49.41^{a}	62.22^{a}	65.58^{a}

Means in the same column with same alphabets are not significantly different at P < 0.05.

Table 4: *Nematode reproduction parameters and yield of M. incognita infected okra plants treated with fractions from A. occidentale.*

Treatments	Yield (g)	Nematode pop in soil	Nematode pop in root	Root gall index	Fruit number/plant
$OXML_1$	*839.10^{b} ±101.2	9.36^{h} ± 1.17	2.07^{g} ± 0.8	1.00^{e} ± 0.02	18.08^{ab} ± 2.03
$OXML_2$	1826.21^{a} ± 332.1	2.58^{h} ± 0.9	0.16^{h} ± 0.03	1.04^{e} ± 0.12	22.05^{a} ± 4.45
$52\text{-}71Z^2_1$	638.10^{c} ± 143.7	51.23^{f} ± 12.08	17.11^{f} ± 3.31	2.00^{c} ± 0.18	9.08^{c} ± 1.10
$52\text{-}71Z^2_2$	704.32b^{c} ± 100.7	31.10^{g} ± 9.92	10.09^{f} ± 2.81	1.53^{d} ± 0.31	12.67^{b} ± 2.07
$51\text{-}53Z^2_1$	674.75^{c} ± 89.2	49.07^{f} ± 11.3	28.03^{e} ± 9.22	2.42^{c} ± 0.44	8.54^{c} ± 1.73
$51\text{-}53Z^2_2$	876.11^{b} ± 202.9	27.06^{g} ± 4.07	9.17^{f} ± 3.4	1.30^{d} ± 0.03	11.32^{b} ± 2.06
$27\text{-}34Z^2_1$	448.18^{de} ± 71.5	151.29^{de} ± 28.05	60.05^{d} ± 14.48	3.01^{bc} ± 0.28	6.02^{d} ± 1.67
$27.34Z^2_2$	502.31^{d} ± 88.3	103.22^{e} ± 21.21	41.36^{de} ± 11.36	3.00^{bc} ±0.41	7.32^{cd} ± 1.2
$11\text{-}19Z^3_1$	318.29^{e} ± 60.6	205.09^{d} ± 78.52	85.19^{cd}± 18.92	3.60^{b} ± 0.08	5.13^{e} ± 0.87
$11\text{-}19Z^3_2$	389.05^{e} ± 61.7	178.28^{de} ± 18.04	71.00^{cd} ± 15.37	3.51^{b} ± 0.29	6.22^{d} ± 1.06
$1\text{-}10Z^2_1$	202.16^{f} ± 55.9	426.05^{b} ± 93.69	221.00^{b} ± 40.51	4.84^{a} ± 0.98	3.18^{f} ± 0.22
$1\text{-}10Z^2_2$	294.11^{f} ± 41.6	318.27^{c} ±101.59	104.18^{c} ± 33.57	4.62^{a} ± 0.71	3.76^{f} ± 0.05
Control	85.27^{g} ±12.9	3028.04^{a} ± 688.31	1407.02^{a} ± 252.49	5.00^{a} ± 0.77	0.58^{g} ± 0.33

**Means ± SE in the same column with same alphabets are not significantly different at P < 0.05.*

Fractions from *A. occidentale* bark extract has been demonstrated to be nematostatic in this research. Several factors may be responsible for this observation. *A. occidentale* fractions contain phenolic compounds, organic acids, terpenes, coumarins, anarcadic acids, cardinol, quercetin, kaempferol glycosides, aldehyde and a host of phytochemicals. The presence of these complex mixtures of secondary metabolites in *A. occidentale* is substantiated with the result of the preliminary phytochemical screening of the fractions which stated the presence of phenols, flavonoids, triterpenoids and saponins. This was further supported by the IR and GCMS results. The functional groups of alcohol, phenols, ketones, esters, aldehydes, acids and carbonyls were identified in the infra-red results. Generally, the GCMS revealed the presence of fatty acid esters, hydrocarbons, aldehydes, aliphatic alcohol and carboxylic acids. The presence of anarcadic acids, cardinol, quercetin and kaempferol glycosides have been reported in *A. occidentale* (Oliver-Bever, 1986; Rehm and Espig, 1991), which corroborates the findings in this research. The nematicidal effects of aliphatic alcohols like nonacosane-10-ol and 23a-homostigmast-5-en-3*ß*-ol were reported by Naz *et al.* (2013). 5-ethyl-2-heptanol and 2-nonanol which are aliphatic alcohols are one of the major constituents of fraction $27\text{-}34/_{z1}$ this however explains the observed biological activity of this particular fraction. Fabiyi *et al.* (2012) established the toxicity of fatty acid methyl and ethyl esters to *M. incognita*. The array of fatty acid esters revealed in the GCMS results of the fractions most especially fraction $52\text{-}71/_{z2}$ substantiated the toxicity of the substances to *M. incognita* vis a vis the observed reduction in nematode population in roots and soil of plants treated with the highest concentration of the fractions. This result is supported by the reports of Fabiyi (2022) who affirmed the effectiveness of fatty acid esters on *M. incognita*. The resultant effect of the foregoing is the observed increase in fruit weight and number of fruits per plant.

Conclusions and Recommendations

Based on the findings of this research, fractions from *A. occidentale* proved effective in the management of *M. incognita* in the screenhouse study. Therefore, nematode control with the use of fractions from *A. occidentale* bark could be an eco-friendlier alternative to nematicides and other incompatible bio control agents. Further studies on the field with these fractions and their full characterization with spectroscopic techniques are suggested.

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Novelty Statement

First report on fractions from Anarcardium occidentale and their possible nematicidal potential

Author's Contribution

Olaolu Fadeyi: Bench work, took data, spectral interpretation, manuscript draft.
Oluwatoyin Fabiyi: Conceptualization, design of experiment, bench work, took data, manuscript draft
Tesleem Bello: Data analysis, manuscript draft, manuscript editing.
Gabriel Olatunji: Supply of materials, supervision, manuscript proof reading.

Conflict of interest
The authors have declared no conflict of interest.

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