In vitro Nematocidal Potential of *Ricinus communis* and *Mangifera indica* Leaf Extracts Against Root-Knot Nematodes (*Meloidogyne spp*.)

Barnabas Mantim Timson[1], Deborah Ezekiel Dawen[1], David Eno Abel[2], and Ode Brains Okechalu[1*]

[1]Department of Plant Science and Biotechnology, University of Jos, Plateau State, Nigeria.
[2]Department of Crop Science, Federal University of Agriculture Zuru, Kebbi State, Nigeria.
Corresponding Authors Email: okechalub@unijos.edu.ng, https://orcid.org/0009-0002-9786-2629[1]; https://orcid.org/0009-0008-7694-5672[2]; https://orcid.org/0009-0006-8482-0330[3]; https://orcid.org/0009-0002-8437-217X[4]

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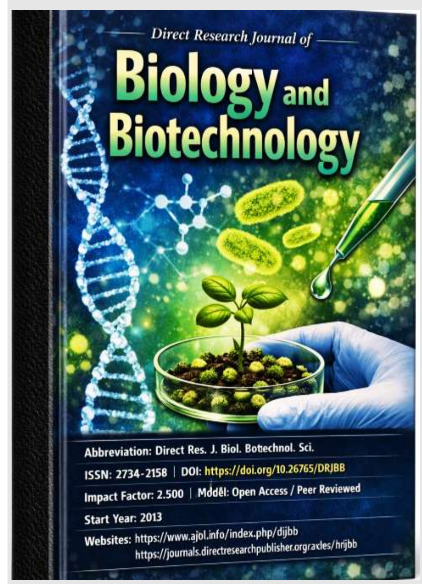
ABSTRACT

Root-knot nematodes (Meloidogyne spp.) are among the most destructive plant-parasitic nematodes causing substantial yield losses in agricultural production worldwide. The extensive use of synthetic nematicides for their control has raised concerns regarding environmental pollution, human health risks, and the development of resistance, thereby necessitating the search for eco-friendly alternatives. This study evaluated the in vitro nematocidal activities of aqueous leaf extracts of Ricinus communis L. and Mangifera indica L. against second-stage juveniles (J2) of Meloidogyne spp. Nematodes were extracted from infected roots and rhizosphere soils of Musa spp. using the modified Baermann funnel technique. Aqueous leaf extracts were prepared by maceration and screened for phytochemical constituents. The extracts were tested at concentrations of 40, 60, 80, and 100 mg mL⁻¹, while distilled water served as the control. Nematode mortality was assessed at 24-hour intervals over a 120-hour exposure period. Data were subjected to two-way analysis of variance and treatment means separated using the Least Significant Difference (LSD) test at the 5% probability level. Phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, saponins, phenols, terpenoids, and steroids in both plant extracts, suggesting their potential nematocidal properties. The extracts exhibited concentration- and time-dependent nematocidal activities, with mortality increasing significantly ($P < 0.05$) as concentration and exposure duration increased. Ricinus communis consistently demonstrated greater nematocidal activity than M. indica at all concentrations and exposure periods. The highest mortality rates were recorded at 100 mg mL⁻¹ after 120 h of exposure, resulting in 83.44% and 65.94% mortality for R. communis and M. indica, respectively. The findings indicate that both plant extracts possess promising nematocidal properties, with R. communis showing superior efficacy, and may serve as environmentally sustainable alternatives to synthetic nematicides for the management of root-knot nematodes.

Keywords: *Botanical nematicides, Meloidogyne spp., Ricinus communis, Mangifera indica, phytochemicals, sustainable pest management.*



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INTRODUCTION

Plant-parasitic nematodes (PPNs), particularly root-knot nematodes (*Meloidogyne spp*.), remain among the most destructive soil-borne pathogens threatening agricultural productivity globally. Recent evidence indicates that PPNs are responsible for approximately US$358 billion in annual global crop losses, with severe implications for both yield quantity and crop quality, particularly in tropical and subtropical agroecosystems where nematode pressure is greatest. Root-knot nematodes (RKNs), especially *Meloidogyne incognita, M. javanica, M. arenaria, and M. hapla*, account for a substantial proportion of these losses due to their wide host range exceeding 2,000 plant species and their ability to induce root galling, impaired nutrient uptake, stunted growth, and reduced productivity. Yield reductions caused by RKN infestation commonly range from 20–80 % depending on crop susceptibility, infestation intensity, and environmental conditions, thereby posing a major challenge to food security and sustainable crop production systems worldwide (Camelia *et al*., 2024).

The increasing burden of root-knot nematodes has increased concerns with respect to food insecurity, especially in developing nations where staple crops are highly vulnerable to nematode infestation and access to effective pest management technologies remains limited. The economic consequences extend beyond direct yield reduction to include deterioration in crop quality, increased production costs, reduced market value, and losses in farmer income. Consequently, sustainable and environmentally acceptable approaches for nematode management have become an urgent global priority (Abd-Elgawad, 2023). Historically, synthetic nematicides such as methyl bromide and aldicarb constituted the primary management strategy against plant-parasitic nematodes. However, growing environmental concerns, toxicity to non-target organisms, persistence in soil, and human health risks have resulted in the withdrawal or restriction of many conventional nematicides. This has accelerated research into safer and sustainable alternatives capable of reducing reliance on synthetic chemicals while maintaining effective nematode suppression (Contreras-Soto *et al*., 2025). Recent advances (2024–2026) in botanical nematicides have demonstrated substantial promise for the management of root-knot nematodes. Plant-derived extracts, essential oils, secondary metabolites, and phytochemicals are increasingly recognized as eco-friendly bioactive agents with nematocidal properties. Studies have shown that compounds such as alkaloids, flavonoids, tannins, terpenoids, saponins, and phenolics can interfere with nematode mobility, egg hatchability, feeding behavior, reproduction, and survival. These phytochemical-based mechanisms provide a biologically safer alternative to synthetic nematicides supporting ecological sustainability (Contreras-Soto *et al*., 2025). Furthermore, sustainable pest management strategies now emphasize integrated approaches involving botanical extracts, organic amendments, composts, vermicompost, microbial antagonists, and biological control agents. Biological alternatives including beneficial fungi such as Trichoderma spp., hematophagous fungi, and antagonistic bacteria have demonstrated significant suppressive effects against Meloidogyne species through mechanisms involving parasitism, competition, induced systemic resistance, and toxin production. These biological interventions are increasingly promoted within integrated pest management (IPM) frameworks because they provide long-term suppression with fewer environmental risks (Rahman *et al*., 2024). Despite increasing interest in botanical nematicides, important knowledge gaps remain concerning the comparative efficacy of different plant species and their phytochemical profiles against root-knot nematodes. *Ricinus communis* and *Mangifera indica* were selected for this study because both species are widely available, locally accessible, economically affordable, and have been reported to contain bioactive phytochemicals with pesticidal potential, including flavonoids, alkaloids, terpenoids, tannins, and saponins known for anti-nematodes' activities. However, existing literature has largely focused on individual plant extracts or generalized botanical screening, while comparative evaluations between *Ricinus communis* and *Mangifera indica* against *Meloidogyne spp*. remain limited, particularly under controlled *in vitro* conditions. Available studies also provide inadequate information regarding differences in efficacy, concentration-dependent responses, and phytochemical contributions to nematicides' activity (Juan *et al*., 2026). Therefore, the present study addresses an important research gap by comparatively evaluating the *in vitro* nematocidal activities of *Mangifera indica* and *Ricinus communis* leaf extracts against *Meloidogyne spp*., while also assessing their phytochemical composition as potential environmentally friendly alternatives to synthetic nematicides. Findings from this study are expected to contribute new scientific evidence regarding plant-based nematicides suitable for sustainable agricultural production and integrated nematode management. Therefore, this study evaluated the *in vitro* nematocidal activities of *Mangifera indica* and *Ricinus communis* leaf extracts against *Meloidogyne spp*. as potential environmentally friendly alternatives to synthetic nematicides."

MATERIALS AND METHODS

Experimental Site/ Study Area

The study was carried out at the Botany Lab II of the Department of Plant Science and Biotechnology, University of Jos (Main Campus), Bauchi Road, Jos North, Plateau State, Nigeria. Jos North Local Government Area, lies within the Guinea Savannah ecological zone, between latitude 9°52′N and longitude 8°54′E, at an elevation of

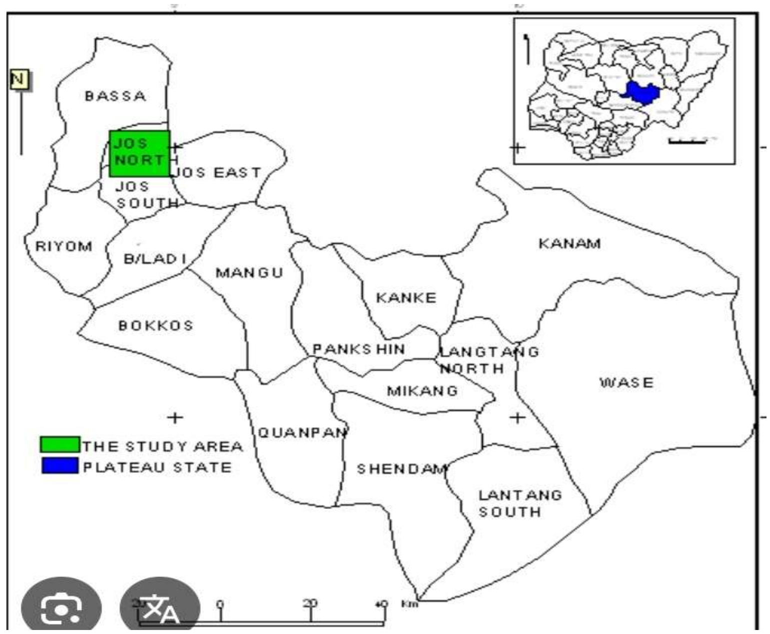

Figure 1: Map of Plateau State Showing the Study Area in green, Survey and Town Planning, Jos Plateau State

about 1,200 m above sea level (Figure 1). The climate is characterized by a relatively cool temperature compared to other parts of the state and Nigeria at large, with annual mean temperatures ranging from 18–25 °C. Annual rainfall averages 1,200–1,400 mm, concentrated between May and October, while the dry season extends from November to April. Location for study is as shown on Map of Plateau State (Figure 1). Relative humidity fluctuates seasonally between 50–80% (Plateau State Ministry of Environment, 2020).

Collection, Identification and Preparation of Test Materials

Mangifera indica and *Ricinus communis* leaves were sourced from University of Jos Bauchi Road Main Campus, while castor oil plant leaves were collected at the Botanical Garden of the Department of Plant Science and Biotechnology, Permanent Site, University of Jos Senior Staff Quarters, and were brought to the laboratory for analyses. The *Mangifera indica* L. (Mango) and *R. communis* L. leaves, obtained were collected fresh and young, brought to the laboratory, washed under running tap-water and dried at room temperature to a constant dry weight, then pulverized, using a sterile pestle and mortar. The samples were extracted using maceration method by soaking in sterile water, and intermittent agitation for three days before filtering and evaporation to obtain dry extracts as described by Dawen *et al*. (2024). A population of *Meloidogyne spp*. were isolated from infected roots and rhizospheres of Musa spp. at the University of Jos Senior Staff Quarters. Nematodes population were extracted using the Modified Baermann's Funnel method of nematode extraction as described by Okechalu *et al*. (2020).

Identification of Meloidogyne

Second-stage juveniles (J2) were examined for stylet length, tail length and hyaline tail terminus. Adults, when present were examined for head shape, and stylet morphology. All these were compared with and confirmed by established taxonomic keys.

Mortality Assessment

Nematodes were examined under binocular light microscope. Individuals were considered dead if immobile after gentle probing with a fine needle. Mortality Percentage (%) was calculated using the formula:

$$\text{Mortality Percentage} = \frac{\textit{Number of Dead Nematodes}}{\textit{Total Number of Nematodes}}\ X\ 100$$

Mortality Percentage Image

Phytochemical Screening of the Test Plants

The phytochemical analyses for qualitative detection of

Table 1: Phytochemical Constituents of *R. communis* L. and *M. indica* L. Leaf Extracts

Phytochemicals	*R. communis* L.	*M. indica* L.
Carbohydrates	+	+
Saponins	+	+
Tannins	+	+
Phenols	+	+
Flavonoids	+	+
Alkaloids	+	+
Terpenoids	+	+
Steroids	+	+
Cardiac Glycosides	+	-
Ricins	+	-
Mangiferins	-	+

Key: + = Present, - = Absent

flavonoids, tannins, alkaloids, saponins, carbohydrates, cardiac glycosides, steroids, terpenoids, were performed on both plant extracts, as described by AOAC (2007) and Dawen *et al*. (2024) at the Pharmacognosy Lab, University of Jos Main Campus, Bauchi Road.

Estimation of Nematodes Population

Nematode populations were estimated by simply counting the number of active juveniles in 1 ml of homogenized suspension of root-knot nematodes, under a binocular light microscope at X4 magnification. One millilitre (1 ml) of homogenized suspension contained an average of 40 nematode juveniles.

Experimental Design

A Completely Randomized Design (CRD) was adopted for this study, with extracts from two (2) plants *(M. indica and R. communis)*, four (4) concentrations and a Control, repeated four (4) times, for each concentration of the freshly prepared plant extracts used, the average number of Dead/Live nematodes per concentration were determined and recorded.

Data Analyses

Apart from phytochemical analyses, all data collected were analyzed using double factor Analysis of Variance (ANOVA) at 5% Level of Probability and the means were separated using the Least Significant Difference (LSD).

RESULTS

Qualitative phytochemical screening revealed the presence of several bioactive secondary metabolites in the aqueous leaf extracts of both *Ricinus communis and Mangifera indica*. The phytochemicals detected in both plant extracts included carbohydrates, saponins, tannins, phenolic compounds, flavonoids, alkaloids, terpenoids, and steroids (Table 1). However, variations were observed in their phytochemical composition. Cardiac glycosides and *ricins* were detected exclusively in *R. communis*, whereas *mangiferin* was identified only in M. indica extract. These compositional differences may partly explain the variation in nematocidal efficacy observed between the two plant species. The presence of diverse phytochemicals in both extracts suggests their potential as sources of biologically active compounds capable of suppressing plant-parasitic nematodes. In particular, alkaloids, phenolics, flavonoids, tannins, and terpenoids have been widely associated with pesticidal, antimicrobial, and nematocidal activities due to their ability to disrupt physiological and biochemical functions in target organisms.

Effects of *Ricinus communis* and *Mangifera indica* Leaf Extracts on Juvenile Mortality of *Meloidogyne spp*.

The aqueous leaf extracts of *R. communis* and M. indica demonstrated considerable nematocidal activity against second-stage juveniles (J2) of *Meloidogyne spp*. across all concentrations and exposure periods investigated (Tables 2–4). Mortality of nematode juveniles increased progressively with increasing extract concentration and duration of exposure, indicating a concentration- and time-dependent nematocidal response. For *R. communis*, the highest juvenile mortality was recorded at the maximum concentration of 100 mg/ml following 120 h of exposure, resulting in a mean mortality of 66.00 juveniles (83.44%). Mortality progressively declined with decreasing concentrations, such that the lowest mortality was observed at 40 mg/ml after 24 h exposure (11.56%). Similarly, *M. indica* exhibited concentration-dependent nematocidal effects, with the highest mortality (65.94%) recorded at 100 mg/ml after 120 h of exposure, whereas the lowest mortality occurred at 40 mg/ml after 24 h exposure (8.13%). Comparatively, *R. communis*

Table 2: Estimated Mean Number of Nematode Juveniles (Dead/Alive) Exposed to Varying Concentrations of *R. communis* L. Leaf Extracts at Different Time Intervals.

Concentrations (mg/ml)	24 Hours		48 Hours		72 Hours		96 Hours		120 Hours	
	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive
100.00	28.00	52.00	31.50	48.50	35.00	45.00	47.75	32.25	66.00	14.00
80.00	23.75	56.25	27.25	52.75	31.75	48.25	40.75	39.25`	57.75	22.25
60.00	16.75	63.25	19.50	60.50	28.25	51.75	33.00	47.00	51.50	28.50
40.00	9.25	70.75	15.25	64.75	24.50	55.50	30.25	49.75	43.00	37.00
Control	0.00	80.00	0.25	79.75	0.75	79.25	3.75	76.25	7.00	73.00

Table 3: Estimated Mean Number of Nematode Juveniles (Dead/Alive) Exposed to Varying Concentrations of *M. indica* L. Leaf Extracts at Different Time Intervals.

Concentration (mg/ml)	24 Hours		48 Hours		72 Hours		96 Hours		120 Hours	
	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive
100.00	19.25	60.75	24.00	56.00	32.50	47.50	40.75	39.25	52.75	27.25
80.00	15.25	64.75	22.00	58.00	26.25	53.75	35.00	45.00`	41.75	38.25
60.00	10.00	70.00	17.25	62.75	22.00	58.00	29.50	50.50	34.25	45.75
40.00	6.50	73.50	11.00	69.00	19.50	60.50	22.00	58.00	29.00	51.00
Control	0.00	80.00	0.25	72.75	0.75	79.25	3.00	77.00	5.50	74.50

consistently exhibited superior nematocidal efficacy relative to M. indica across all concentrations and exposure periods. At the highest concentration (100 mg/ml), *R. communis* caused 83.44% juvenile mortality after 120 h, compared with 65.94% observed for M. indica. Statistical analysis revealed significant differences (P < .05) in nematocidal activity between both plant extracts, with *R. communis* exhibiting significantly greater suppression of Meloidogyne juveniles than M. indica. Tables 2 and 3 showed the results of aqueous extracts of M. indica L. and *R. communis* L. leaves both of which possessed nematocidal effects on the second stage juveniles (J2) of *Meloidogyne spp*. (root-knot nematodes). They exhibited varying degrees of suppression against the second stage juveniles (J2) of root-knot nematodes. The results also showed that the nematocidal activities of the extracts increased with increase in concentrations of each test plant extracts and increased time of exposure. Additionally, the deaths of nematode juveniles were highest at the highest concentration of 100 mg/ml for each plant extracts, followed by 80 mg/ml, 60 mg/ml and 40 mg/ml, respectively. Mortality was recorded for the Control too however, it was below the number observed for groups treated with the different leaf extracts (Tables 2) The results also showed that the highest nematocidal effects (66.00 dead) was recorded at the highest exposure time (120 hrs.), followed by 96 h., 72 h., 48 h. and least at 24 hrs., respectively, for both plant extracts. The result further showed that the number of dead nematode juveniles recorded in the Control test increased with time of exposure (Tables 3). The untreated control exhibited minimal juvenile mortality throughout the experiment, although mortality slightly increased with prolonged exposure time. Mortality in the control remained substantially lower than in extract-treated groups, confirming that observed nematode mortality was attributable primarily to phytochemical activity rather than environmental stress or natural mortality. No statistically significant difference in juvenile mortality was observed in the control at 24, 48, and 72 h; however, mortality significantly increased between 96 and 120 h. The percentage mortality of nematode juveniles exposed to both test plant extracts increased with time of exposure and concentration. For *R. communis*, the highest percentage mortality of 83.44% was recorded after 120 h at 100 mg/ml, while for M. indica, it was 65.94%, recorded at 100 mg/ml after 120 h (Table 4). These results also showed that extracts of *R. communis* exhibited highest nematocidal effect for all concentrations and time of exposure, compared to that of M. indica. The highest concentration, being 100 mg/ml was the most effective for both test plant extracts and has the highest nematodes mortality at 120 h. time of exposure. Statistical analyses showed that there was a significant difference in the nematocidal effects of both test plants at 0.05 level of probability. *R. communis* extracts accounted for significantly higher ($P<0.05$) nematode mortality than M. indica L. extracts at all concentrations and exposure time. Statistical analyses also showed that the nematocidal activities of the two test plant extracts were significantly higher ($P<0.05$) than that of the Control (Table 4). There was no significant difference in mortality of juveniles for time interval of 24, 48 and 72 h in the Control, but a significant difference between 96 and 120 h.

Table 4: Mean Percentage (%) Mortality of Nematode Juveniles Exposed to Varying Concentrations of *Ricinus communis* L. and *Mangifera indica* L. Leaf Extracts at Different Time Intervals.

Test Plant	Concentration (mg/ml)	24 Hours	48 Hours	72 Hours	96 Hours	120 Hours	LSD
R. communis	100.00	35.00	39.38	43.75	59.69	83.44	
R. communis	80.00	29.69	34.06	39.69	50.94	73.44	
R. communis	60.00	20.94	24.38	35.31	41.25	65.00	
R. communis	40.00	11.56	19.06	30.31	37.81	53.75	
R. communis	Control	0.00	0.31	0.94	4.69	8.75	
M. indica	100.00	24.06	30.00	40.63	50.94	65.94	0.76
M. indica	80.00	19.06	27.50	32.81	43.75	52.19	
M. indica	60.00	12.50	21.56	27.50	36.88	42.81	
M. indica	40.00	8.13	13.75	24.38	27.50	36.25	
M. indica	Control	0.00	0.31	0.94	3.75	6.88	
LSD			1.71				

Values are means of five replicates. Pairs of means that differ by more than their LSD value are significantly different at 5 % Level of Probability.

DISCUSSION

The present study demonstrated that aqueous leaf extracts of Ricinus communis and *Mangifera indica* possess substantial nematocidal activity against second-stage juveniles of *Meloidogyne spp*., thereby supporting the growing body of evidence advocating plant-derived bioactive compounds as environmentally sustainable alternatives to synthetic nematicides. The significant mortality recorded in nematode juveniles exposed to both plant extracts highlights the potential of botanical resources in integrated nematode management programs.

The phytochemical screening conducted in this study revealed the presence of important secondary metabolites, including flavonoids, alkaloids, tannins, phenols, saponins, terpenoids, and steroids in both plant extracts. These bioactive constituents are known to contribute significantly to plant defense mechanisms and possess toxicological effects against a wide range of agricultural pests, including plant-parasitic nematodes. Secondary metabolites function through diverse biochemical pathways, including inhibition of feeding behavior, disruption of cell membrane integrity, interference with metabolic enzymes, inhibition of egg hatchability, suppression of reproduction, and induction of paralysis in nematodes (Meresa *et al*., 2024). The comparatively higher nematocidal activity recorded for *R. communis* may be attributed to its unique phytochemical composition, particularly the presence of cardiac glycosides and *ricins*, which were absent in M. indica. Ricin-related compounds and associated phytochemicals in *R. communis* have been reported to exhibit strong pesticidal and antimicrobial properties, potentially contributing to enhanced juvenile mortality of *Meloidogyne spp*. In contrast, although M. indica contained *mangiferin* a potent phenolic compound with antimicrobial and antioxidant properties its nematocidal activity appeared comparatively moderate under the present experimental conditions. These findings suggest that differences in phytochemical composition may significantly influence efficacy against root-knot nematodes. The concentration-dependent increase in nematode mortality observed in this study indicates that increasing phytochemical concentration enhanced toxicity against Meloidogyne juveniles. The highest concentration (100 mg/ml) consistently produced the greatest juvenile mortality for both extracts, whereas lower concentrations resulted in comparatively reduced effectiveness.

This observation suggests that bioactive compounds became increasingly available at higher extract concentrations, thereby intensifying physiological disruption and mortality among nematodes. Similar concentration-dependent responses have been documented in recent studies evaluating plant-derived nematicides against root-knot nematodes, where increased extract concentration significantly enhanced suppression of juvenile mobility, egg hatchability, and survival (Dababat *et al*., 2025). Likewise, prolonged exposure duration significantly increased nematode mortality, suggesting that phytochemical toxicity may accumulate with increased contact time. The highest juvenile mortality recorded after 120 h exposure for both plant extracts demonstrates the importance of sustained interaction between nematodes and bioactive compounds in maximizing nematocidal efficacy. Similar observations have been reported for other botanical extracts, where longer exposure periods enhanced toxicological effects against Meloidogyne species through prolonged biochemical interference and physiological disruption (Rahman *et al*., 2024). The significantly higher mortality observed in extract-treated groups compared with untreated controls confirms that the inhibitory effects recorded were primarily induced by the active compounds present in the extracts rather than natural mortality. Although a slight increase in mortality occurred within the control treatment over time, this was considerably lower than observed in treated samples and may plausibly be associated with starvation stress or natural senescence under laboratory conditions. The superior efficacy of *R. communis* over M. indica observed in this study corroborates previous reports demonstrating the pesticidal and nematocidal potential of castor-derived compounds against plant-parasitic nematodes. Similarly, studies on mango-derived phytochemicals have reported moderate but significant suppressive effects on nematode activity, particularly due to phenolic constituents such as *mangiferin* and flavonoids.

However, comparative evaluations between these two plant species remain limited in the literature, thereby highlighting the contribution of the present study in generating new comparative evidence regarding their relative efficacy under *in vitro* conditions. The findings of this study have important implications for sustainable agriculture and integrated pest management. Synthetic nematicides, although effective, have increasingly become restricted because of environmental contamination, persistence in soil ecosystems, toxicity to non-target organisms, and risks to human health. Consequently, plant-based nematicides are receiving increasing scientific attention as biodegradable, affordable, locally accessible, and environmentally compatible alternatives.

The demonstrated effectiveness of *R. communis* and M. indica leaf extracts against *Meloidogyne spp*. suggests their promising applicability as botanical nematicides for reducing root-knot nematode populations in agricultural systems. Nevertheless, while the present findings demonstrate strong *in vitro* nematocidal activity, field validation remains essential before broad-scale recommendations can be made. Environmental variables such as soil composition, microbial interactions, degradation rates, climatic conditions, and plant–soil dynamics may influence efficacy under natural conditions. Future studies should therefore focus on in vivo evaluation, formulation optimization, dosage standardization, and toxicological assessment to enhance practical applicability in sustainable nematode management.

Conclusion

The present study demonstrated that aqueous leaf extracts of Ricinus communis and *Mangifera indica* possess appreciable nematocidal activities against second-stage juveniles (J2) of *Meloidogyne spp*., thereby indicating their potential as environmentally sustainable alternatives for root-knot nematode management. Qualitative phytochemical screening revealed the presence of several biologically active secondary metabolites, including alkaloids, flavonoids, tannins, phenols, terpenoids, saponins, and steroids, which are widely recognized for their pesticidal and anti-nematodes properties. These phytochemicals likely contributed to the suppression and mortality of nematode juveniles observed during the study. The findings further revealed that nematocidal efficacy was significantly influenced by extract concentration and exposure duration, with mortality increasing progressively as concentration and contact time increased. Among the evaluated botanicals, *Ricinus communis* consistently exhibited significantly greater nematocidal activity than *Mangifera indica* across all concentrations and exposure periods. The highest juvenile mortality was recorded at 100 mg/ml after 120 hours of exposure, indicating that maximum suppression of *Meloidogyne spp*. may be achieved under prolonged exposure and increased extract concentration. The superior efficacy of *Ricinus communis* suggests that its phytochemical composition, particularly the presence of ricin-associated compounds and cardiac glycosides, may confer stronger nematocidal potential relative to *Mangifera indica*. Nonetheless, both plant species demonstrated considerable inhibitory effects compared with the untreated control, emphasizing their promise as botanical resources for sustainable nematode management. Given increasing concerns surrounding the environmental persistence, ecological toxicity, and human health risks associated with synthetic nematicides, the findings of this study contribute important evidence supporting the exploration of plant-based biopesticides as safer, biodegradable, and economically accessible alternatives. The present study therefore advances current knowledge by comparatively evaluating the nematocidal potential of *Ricinus communis* and *Mangifera indica* under *in vitro* conditions and provides a scientific basis for their possible integration into sustainable pest management systems. However, while the *in vitro* findings are promising, caution should be exercised in extrapolating these results directly to field conditions, where environmental and biological interactions may influence efficacy. Further validation under greenhouse and field conditions remains necessary to determine practical applicability, dosage optimization, and long-term effectiveness.

RECOMMENDATION

Bio-pesticides from *R. communis L. and M. indica L.* for soil amendment should be encouraged and continuously harnessed, because they are effective and environmentally benign, due to their biodegradability and cheap sources that can be applied without any specialty against chemical nematicides, since the latter have been reportedly seen to have long-term effects of environmental pollution, due to non-degradation. They can as well alter the soil Image and even become toxic, if not properly handled and as such, often required skilled persons. Amongst the test plants used in this study, *R. communis L.* is recommended ahead of M. indica L., because it had higher nematocidal activities in vitro. It is also recommended that further studies be carried out in vivo to evaluate the nematocidal potential of higher concentrations of the two (2) test plants.

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