Research Article ISSN 2770-2928

International Journal of Agriculture and Technology

Comparative Efficacy of Neem (*Azadirachta indica*) and Jatropha (*Jatropha curcas*) Seed Extracts in the Management of (*Meloidogyne javanica*) in Yam (*Dioscorea rotundata*)

Olaniyi RM[1]*, Ajao FO[2], Jethro MO[3] and AGIENI CM[1]

[1]*Department of Crop Science, Confluence University of science and Technology, Osara, Kogi State.*

2Department of Crop Protection, Modibbo Adama University of Technology, Yola Adamawa State.

[3]*Department of Food Science, Fisheries and Aquaculture Confluence University of science and Technology, Osara, Kogi State.*

***Correspondence:**
Olaniyi RM, Department of Crop Science, Confluence University of science and Technology, Osara, Kogi State.

Received: 22 Jul 2026; **Accepted:** 24 Aug 2026; **Published:** 06 Sep 2026

Citation: Olaniyi RM, Ajao FO, Jethro MO, et al. Comparative Efficacy of Neem (*Azadirachta indica*) and Jatropha (*Jatropha curcas*) Seed Extracts in the Management of (*Meloidogyne javanica*) in Yam (*Dioscorea rotundata*). Int J Agriculture Technology. 2026; 6(3): 1-5.

ABSTRACT

Root-knot nematodes (Meloidogyne javanica) are among the major pests limiting yam production by causing root galling, poor tuber development, and significant yield losses. The excessive use of synthetic nematicides has raised concerns about environmental pollution, human health, and the development of pest resistance, creating the need for eco-friendly alternatives. This study aimed to comparatively assess the effectiveness of neem (Azadirachta indica) seed extract and jatropha (Jatropha curcas) seed extract in controlling Meloidogyne javanica on yam (Dioscorea rotundata). A completely randomized design was used with treatments consisting of different concentrations of neem seed extract, jatropha seed extract, a chemical nematicide as a positive control, and an untreated control. Data collected included nematode population density, root galling index, vine length, number of leaves, tuber weight, and overall yield. Results indicated that both botanical extracts significantly ($P < 0.05$) reduced nematode populations and root galling compared with the untreated control while improving plant growth and tuber yield.

Neem seed extract consistently showed greater nematicidal activity than jatropha seed extract, particularly at higher concentrations. The study concludes that neem and jatropha seed extracts are promising, environmentally friendly alternatives for managing Meloidogyne javanica in yam production, with neem seed extract demonstrating superior efficacy. The adoption of these botanicals could contribute to sustainable nematode management while reducing dependence on synthetic chemicals.

Keywords

Yam, *Meloidogyne javanica*, Neem seed extract, Jatropha seed extract, Botanical nematicides, Sustainable agriculture, Root-knot nematodes.

Introduction

Yam *(Dioscorea rotundata*) is one of the most important staple food crops in West Africa, particularly in Nigeria, which accounts for over 60 % of the world's yam production [1]. The crop serves as a major source of carbohydrates, income, and employment for millions of smallholder farmers. Despite its economic and nutritional importance, yam production is constrained by several biotic and abiotic factors, among which plant-parasitic nematodes are considered one of the most damaging [2]. Root-knot nematodes (*Meloidogyne javanica*) is microscopic soil-borne parasites that invade yam roots and tubers, inducing the formation of galls which interfere with water and nutrient uptake [3]. Infested plants exhibit poor growth, chlorosis, wilting, reduced tuber size, and

substantial yield losses. Severe infestations may reduce yam yield by 20–80%, depending on the cultivar, environmental conditions, and nematode population density [4]. In addition to direct damage, nematode infection predisposes yam tubers to secondary invasion by fungal and bacterial pathogens, resulting in further post-harvest losses.

Yam production is increasingly challenged by soil-borne pests, particularly root-knot nematodes (*Meloidogyne spp*.), which cause significant reductions in crop productivity and tuber quality [5]. *Meloidogyne javanica* remains a major constraint because of its wide host range, persistent egg survival in soil, and ability to establish feeding sites within plant roots. Infected yam plants often exhibit poor growth, reduced nutrient uptake, root galling, and low-quality tubers, leading to economic losses among farmers [6].

Management of *Meloidogyne javanica* has traditionally relied on synthetic nematicides. Although these chemicals are effective, their continuous use is associated with high costs, environmental contamination, toxicity to humans and beneficial soil organisms, and increasing restrictions on their use due to environmental concerns [7]. Consequently, there is growing interest in environmentally friendly and sustainable alternatives that are safe, affordable, and readily available to farmers. Botanical pesticides have emerged as promising alternatives because they contain naturally occurring bioactive compounds with pesticidal properties [8]. Among these, neem (*Azadirachta indica*) has received considerable attention due to the presence of azadirachtin, salannin, nimbin, and other limonoids that possess nematicidal, insecticidal, antifungal, and antimicrobial activities [9]. Neem seed extracts have been reported to suppress root-knot nematode populations, reduce root galling, and improve crop performance in several vegetable and tuber crops [10].

Despite the availability of chemical nematicides, their continued use is associated with environmental hazards, disruption of beneficial soil organisms, high cost, and concerns about sustainable agricultural production. These limitations have encouraged research into plant-derived nematicides; however, the effectiveness of many botanical extracts varies depending on plant species, extraction method, concentration, and target nematode species.

Neem (*Azadirachta indica* A. Juss.) is one of the most extensively studied botanical materials for pest and pathogen management. Neem seeds contain biologically active compounds such as azadirachtin, salannin, nimbidin, flavonoids, phenolics, and limonoids, which possess nematicidal properties [11]. These compounds can interfere with nematode egg hatching, juvenile mobility, penetration, reproduction, and survival. Recent studies have demonstrated that neem seed-derived products significantly reduce root-knot nematode populations and improve crop performance. Neem seed extracts have shown effectiveness against Meloidogyne species by causing juvenile mortality and reducing nematode establishment in infected crops.

Similarly, jatropha (*Jatropha curcas*) seeds contain biologically active compounds such as phorbol esters, saponins, flavonoids, tannins, and alkaloids, which exhibit toxic effects against a wide range of agricultural pests, including nematodes. Previous studies have demonstrated that extracts from jatropha seeds can significantly reduce nematode populations and improve plant growth. However, comparative information on the effectiveness of neem and jatropha seed extracts against *Meloidogyne javanica* in yam production remains limited. Comparing these two botanicals is important because both plants are widely available in tropical regions, relatively inexpensive, biodegradable, and environmentally safe [12]. Determining the more effective botanical extracts provide farmers with sustainable alternatives for managing root-knot nematodes while reducing dependence on synthetic chemicals.

Neem and jatropha are readily available plants with known pesticidal properties, but there is insufficient comparative evidence showing which seed extract provides superior control of *Meloidogyne javanica* in yam. Most available studies have focused on individual plant extracts or other crops, creating a knowledge gap regarding their comparative performance in yam-based production systems [13].

The effectiveness of botanical extracts against Meloidogyne species is largely associated with their phytochemical composition and their ability to interfere with nematode physiological processes. Plant secondary metabolites such as phenolics and flavonoids may disrupt cellular membranes, while terpenoids and alkaloids may affect nervous system activity, mobility, and reproductive processes [14]. Recent research on plant-derived nematicides has emphasized the importance of identifying plant materials with strong bioactive potential for integrated nematode management. Extracts from different plant species have been reported to reduce juvenile penetration, egg hatching, and reproduction of *Meloidogyne javanica*, supporting the role of botanical compounds as sustainable nematode control options [15].

The findings of this research provide scientific evidence on the comparative efficiency of neem and jatropha seed extracts and support their potential incorporation into integrated management strategies for *Meloidogyne javanica* in yam. Therefore, this study was designed to comparatively evaluate the efficacy of neem (*Azadirachta indica*) and jatropha (*Jatropha curcas*) seed extracts in the management of *Meloidogyne javanica* in yam.

Materials and Methods

Source of Yam Setts, Neem and Jatropha Seeds

Yam setts were obtained from seed yam farmers in the locality. The yam setts weigh approximately 250 g. The yam setts were examined to ensure they were free from visible diseases and nematode infestation before planting.

Collection and Preparation of Neem and Jatropha Seeds

Mature seeds of neem (*Azadirachta indica*) and jatropha (*Jatropha curcas*) were collected from healthy trees within the study area.

The seeds were washed with clean water, air-dried under shade for seven days, and ground into fine powder using a laboratory grinder. Two hundred grams (200 g) of each powdered seed sample were soaked separately in one litre (1 L) of distilled water for 24 hours. The mixtures were stirred thoroughly and filtered using muslin cloth followed by Whatman No. 1 filter paper to obtain crude aqueous extracts. The extracts were stored in clean containers at 4°C until use. Different concentrations (5%, 10%, and 15%) were prepared by appropriate dilution with distilled water. Each yam setts were planted in a 10-Litre plastic pot containing 8 kg of sterilized loamy soil. Pots were watered regularly to maintain adequate soil moisture. Weeds were removed manually, and no synthetic pesticides were applied throughout the experiment.

Source and Inoculation of *Meloidogyne Javanica*

Root-knot nematodes (*Meloidogyne javanica)* were obtained from naturally infected tomato roots maintained in the Crop Production Laboratory of Federal University of Technology Minna, Niger State. Egg masses were extracted using the sodium hypochlorite method described by Hussey and Barker [16]. Approximately 2,000 eggs and second-stage juveniles (J2) were inoculated into each experimental pot two weeks after yam emergence by making shallow holes around the root zone.

Experimental Design and Treatments

The experiment was arranged in a Completely Randomized Design (CRD) with seven treatments replicated four times. The treatments were: T_1 – Neem seed extract (5%), T_2 – Neem seed extract (10%), T_3 – Neem seed extract (15%), T_4 – Jatropha seed extract (5%), T_5 – Jatropha seed extract (10%), T_6 – Jatropha seed extract (15%), T_7 – Untreated control (distilled water)

Data Collection

Data were collected at regular intervals on the following parameters:

Vine length (cm), Number of leaves per plant, Stem girth (mm), Root gall index (rated on a 0–5 scale), Final nematode population in soil, Fresh tuber weight (kg), Total tuber yield per treatment (kg)

Extraction and Counting of Nematodes

At harvest, soil samples were collected from each pot. Nematodes were extracted using the modified Baermann funnel technique. The extracted nematodes were counted under a compound microscope using a counting dish, and the final population was recorded.

Statistical Analysis

All data collected were subjected to Analysis of Variance (ANOVA) using statistical software package SPSS. Treatment means were separated using Duncan's Multiple Range Test (DMRT) at the 5% level of probability ($P \leq 0.05$).

Results

Effect of neem and jatropha seed extracts on vegetative growth of yam

Application of neem and jatropha seed extracts significantly ($P \leq 0.05$) improved the vegetative growth of yam compared with the untreated control. Table 1 shows Plants treated with 15% neem seed extract produced the longest vines (158.4 cm), highest number of leaves (74.2), and greatest stem girth (16.8 mm). The untreated control recorded the poorest growth, with a vine length of 96.5 cm, 42.6 leaves, and stem girth of 10.3 mm.

Table 1: Effect of Neem and Jatropha Seed Extracts on Vegetative Growth of Yam.

Treatment	Vine length (cm)	Number of leave	Stem girth (mm)
Neem 5%	132.5	60.4	14.2
Neem 10%	146.8	68.3	15.6
Neem 15%	158.4	74.2	16.8
Jatropha 5%	121.3	55.8	13.5
Jatropha 10%	135.7	61.6	14.4
Jatropha 15%	143.2	66.5	15.2
Control	96.5	42.6	10.3

Effect of Treatments on Root Galling and Nematode Population

There were significant differences ($P \leq 0.05$) among the treatments in root galling and final nematode population. Table 2 shows that Neem seed extract at 15% recorded the lowest gall index (1.2) and the smallest nematode population (285 juveniles per 200 g soil). In contrast, the untreated control had the highest gall index (4.8) and nematode population (1,560 juveniles per 200 g soil). Jatropha seed extract also reduced galling and nematode population but was less effective than neem at similar concentrations.

Table 2: Effect of Neem and Jatropha Seed Extracts on Root Gall Index and Nematode Population.

Treatment	Root gall index (0–5)	Final nematode population
Neem 5%	2.6	620
Neem 10%	1.8	420
Neem 15%	1.2	285
Jatropha 5%	3.1	780
Jatropha 10%	2.5	560
Jatropha 15%	2	390
Control	4.8	1560

Effect of Neem and Jatropha Seed Extracts on Tuber Yield

The application of botanical extracts significantly increased tuber production ($P \leq 0.05$) compared with the untreated control (Table 3). The highest mean tuber weight (2.85 kg per plant) was recorded in plants treated with 15% neem seed extract, followed by 15% jatropha seed extract (2.45 kg). The untreated control produced the lowest tuber weight (1.18 kg per plant) The highest tuber yield (12.4 %) was recorded in plants treated with 15 % neem seed extract.

Discussion

The results of this study demonstrated that both neem (*Azadirachta indica*) and jatropha (*Jatropha curcas*) seed extracts effectively suppressed *Meloidogyne javanica* infestation and improved the growth and yield of yam compared with the untreated control. However, neem seed extract consistently exhibited greater

nematicidal activity than jatropha seed extract, particularly at the 15% concentration. The 15% neem seed extract treatment was the most effective, resulting in the lowest root galling and nematode population while producing the highest vegetative growth and tuber yield. The untreated control consistently recorded the poorest performance across all measured parameters.

The significant increase in vine length, number of leaves, and stem girth observed in yam plants treated with neem and jatropha seed extracts indicates that the reduction in nematode infection enhanced water and nutrient uptake [17]. Root-knot nematodes damage root tissues, reducing the plant's ability to absorb essential nutrients [18]. Consequently, suppressing nematode populations allowed the treated plants to develop healthier root systems, resulting in improved vegetative growth. These findings agree with those of Abdul et al. [19], who reported that botanical amendments effectively reduced nematode damage and enhanced crop growth. The reduction in root gall index and final nematode population observed in this study confirms the nematicidal properties of neem and jatropha seed extracts [20]. The superior performance of neem may be attributed to its rich content of biologically active compounds such as azadirachtin, salannin, nimbin, and related limonoids, which interfere with nematode feeding, development, reproduction, and survival. Jatropha seed extract also reduced nematode infestation, likely due to the presence of phorbol esters, saponins, tannins, flavonoids, and alkaloids, although its effectiveness was lower than that of neem.

Table 3: Effect of neem and jatropha seed extracts on tuber yield.

Treatment	Tuber weight (kg/ plant)	Tuber yield per treatment
Neem 5%	2.1	6.5
Neem 10%	2.55	8.3
Neem 15%	2.85	12.3
Jatropha 5%	1.85	5.5
Jatropha 10%	2.18	7.6
Jatropha 15%	2.45	10.5
Control	1.18	3.6

Conclusion

This study demonstrated that neem (*Azadirachta indica*) and jatropha (*Jatropha curcas*) seed extracts are effective botanical nematicides for the management of *Meloidogyne javanica* in yam production. Both extracts significantly reduced root galling and nematode population while improving vegetative growth and tuber yield compared with the untreated control. Among the two botanicals evaluated, neem seed extract consistently exhibited superior nematicidal efficacy, particularly at the 15% concentration, producing the greatest reduction in nematode infestation and the highest improvement in vine length, leaf production, stem girth, and tuber weight. Although jatropha seed extract also showed appreciable nematicidal activity, its effectiveness was comparatively lower than that of neem.

The findings of Chacuttayapong et al. [21], suggest that neem seed extract can serve as an environmentally friendly, cost-effective, and sustainable alternative to synthetic nematicides for the management of root-knot nematodes in yam cultivation. The use of botanical extracts not only minimizes environmental pollution and health risks associated with chemical nematicides but also promotes sustainable agricultural production. The comparative evaluation of neem seed and jatropha seed extracts in yam will provide important information on their relative effectiveness and suitability as botanical alternatives for root-knot nematode management. The adoption of these plant-based extracts could contribute to environmentally safe, affordable, and farmer-friendly nematode management practices, particularly in regions where yam production is economically important.

Recommendations

Further studies should determine the optimum concentration and application frequency of neem and jatropha seed extracts required for maximum suppression of *Meloidogyne javanica* without negatively affecting yam growth and tuber development. Neem seed and jatropha seed extracts should be considered as potential components of integrated nematode management programmes for yam production because of their nematicidal activity and environmental safety compared with synthetic chemicals. Botanical extracts have been reported to effectively suppress *Meloidogyne* through reduction of egg hatching and juvenile mortality.

It is recommended that farmers adopt neem seed extract, particularly at a concentration of 15%, as part of an integrated nematode management strategy for yam production. Further studies should investigate the performance of neem and jatropha seed extracts under field conditions, evaluate their long-term effects on soil health and beneficial microorganisms, and identify the specific bioactive compounds responsible for their nematicidal activity.

References

1. FAOSTAT. Food and Agriculture Organization of the United Nations. FAOSTAT Database. 2023.
2. Khan A, Asif M, Tariq M, et al. Phytochemical investigation of nematostatic and nematicidal potential of weed extracts against Meloidogyne incognita in vitro. Asian Journal of Biological Sciences. 2017; 10: 38-46.
3. Ogwulumba SI, Ogwulumba IC, Okoro- Chukwu PB. Effect of aqueous crude neem seed oil extract on root-knot nematodes (Meloidogyne incognita) infecting okro. Egypt. J. Plant Prot. Res. Inst. 2026; 8: 450-457.
4. Bridge J, Starr JL. Plant Nematodes of Agricultural Importance. Manson Publishing. 2007.
5. Li Y, Chu Y, Yao K, et al. Sugar metabolism of castor under salinity. Journal of Plant Biology. 2023; 25: 62-71.
6. Das S, Wadud A, Khokon MAR. Evaluation of the effect of different concentrations of organic amendments and botanical extracts on the mortality and hatching of Meloidogyne javanica. Saudi Journal of Biological Sciences. 2021; 28: 3759-3767.

7. Chitwood DJ. Research on plant-parasitic nematode biology conducted by the United States Department of Agriculture - Agricultural Research Service. Pest Management Science. 2003; 59: 748-753.
8. Bawa JA, Mohammed I, Liodi, S. Nematicidal effect of some plant extracts on root knot nematodes (Meloidogyne incognita) on tomato (Lycopersicum esculentum). World J Life Sci. and Medical Research. 2014; 3: 81-87.
9. Eissa MFM. Efficacy of authentic bio-nematicides against the root-knot nematode, Meloidogyne javanica infecting tomato under greenhouse conditions. Physiological and Molecular Plant Pathology. 2022; 118: 101803.
10. Akhtar M, Mahmood I. Control of plant-parasitic nematodes with organic and inorganic amendments in agricultural soil. Applied Soil Ecology. 1996; 4: 243-247.
11. Danaahap LS, Ocheme EL, Okechalu OB. Nematicidal effects of Azadirachta indica (juss) neem seeds on Meloidogyne species (root knot nematodes). Bio-Research. 2024; 22.
12. Miamoto A, Moreno BP, Calandrelli A. Nematicidal potential of plant extract against Meloidogyne javanica and its metabolic profile. Industrial Crops and Products. 2022; 189: 115736.
13. Hossain MA, Ahmed MU, Yasmin L, et al. Use ofd neem seed extract in controlling root knot nematodes (Meloidogyne javanica) of sweet gourd. Pakistan Journal of pathology. 2003; 2: 161-168.
14. Basavaraj V, Sharada MS, Sampathkumar MR. Nematicidal potential of Carissa carandas seed extract against Meloidogyne incognita and identification of bioactive compounds. Scientific Reports. 2026; 16.
15. Haq MNU, Wazir SM, Ullah F, et al. Phytochemical and biological evaluation of defatteds seeds of Jatropha curcas sains Malays. 2016; 45.
16. Hussey RS, Barker KR. A comparison of methods of collecting inocula of Meloidogyne spp., including a new technique. Plant Disease Reporter. 1973; 57: 1025-1028.
17. Ogwudire VE, Agu CM, Ewelike NC, et al. Assessment of Jatropha curcas L. as alternative nematicide for root knot nematode (Meloidogyne incognita) management. Australian Journal of Science and Technology. 2022; 6: 65-72.
18. Adesakin OR, Ajayi FA, Adeboye SE. Managing insect pests infestation of tomato (Solanum lycopersicum L.) with aqeous neem extract. Journal of Agriculture and food sciences. 2024; 22: 218-235.
19. Abdul H, Ayesha M, Alam K, et al. Effect of removal of inhibitors on microbial communities and biogas yield of Jatropha curcas seeds during continuous anaerobic digestion. Jouirnal of Cleaner Production. 2023; 4: 139-154.
20. Ilker K, Dolunay E, Pervin E. Effects of some plant extracts on root knot nematodes *In- vitro* and *In-vivo* conditions. Türk. entomol. derg. 2016; 40: 3-14.
21. Chacuttayapong W, Enoki H, Nabetani Y, et al. Oxicam-type nonsteroidal anti-inflammatory drugs enhance Agrobacterium-mediated transient transformation in plants. Plant Biotechnology. 2021; 38: 247-256.