Research Article

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Potency of Nine Botanical Nematicides on Root Knot Nematode, *Meloidogyne Incognita* Affecting Cowpea vigna unguiculata Cultivar Oloyin L

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Abstract

Efficacy of nine different botanical nematicides were tested against root-knot nematodes, *Meloidogyne Incognita* affecting cowpea (*Vigna unguiculata*) cultivar oloyin in an open field experiment in a randomized complete block design with five replicates. The known effective synthetic nematicide, Furadan and the cowpea which bore no nematicides were included as controls. Based on comparism with known effective nematicide (Furdan), three *nematicides Azadirachta indica* (bark), *Salvadora persica*, and *Chromolaena odorata* were rated more effective as they showed 55% reduction in percentage number of eggs and percentage root galling over the control which were significantly same as the furadan. The remaining nematicides, *Capsicum annum, Zingiber officinale, Azadirachta indica* (leaf, seed and husk) and *Manihot esculenta* were moderately effective in reducing the percentage number of eggs and percentage root galling over the control which in turn differ significantly from the known effective nematicide furadan. Amongst the neems (neem leaf, neem seed, neem husk and neem bark) neem bark was the most effective and neem husk was the less effective. In terms of vigour, all the botanical nematicides were significantly same as the furadan control, except *Manihot esculenta* which differ significantly.

Keywords: Botanical, Efficacy, *Meloidogyne Incognita*, *Vigna unguiculate*

Introduction

Cowpea (*Vigna* unguicula L. Walp) is an annual herbaceous legume from the genus *Vigna* and also one of the world's important grain legume crops, widely grown in Africa, Eastern Europe, Australia, United States, Mediterranean area, Asia and the Carribean, due to its tolerance for sandy soil and low rainfall [1]. It requires very few inputs, as the plants root nodules are able to fix atmospheric nitrogen, making it a valuable crop for resource poor farmers and well-suited to intercropping with other crops. The whole plant is used as forage for animals, with its use as cattle feed likely responsible for its name.The production and importance of the crop have increased dramatically, reaching a world annual grain yield of 3. 7 million metric tons from an area of 10.4 million hectares, with an average grain yield of 0.354 metric tons/ha [2,3]. Nigeria produces 2.3 million metric tons annually on an area of 5.3 million ha [2].

Due to biotic constraints, the average grain yield (0.354 metric tons/ha) is poor compared with the potential yield of 2,000 kg/ha [4]. Among the biotic constraints is infection by root knot nematodes, especially Meloidgyne incognita.

It has been estimated that 59-94% in Nigeria [5]; 43% in West Africa [6] and 20-40% of global productivity are lost as a result of direct yield losses caused by pests and pathogen and if some of this food crops could be save from pest attack, it could be used to feed the malnourished in the country [7].

Root – knot nematodes, *Meloidogyne Incognita* constitute a major group of plant – parasite nematodes affecting the quantity and quality of the crop production in many annual and perennial crops [7]. Infected plants show typical symptoms including root galling, stunting and nutrient deficiency, particularly nitrogen deficiency [8]. Olowe, 2004 reported the M. javanica is restricted to the dry Savanna north of Nigeria. Conservative yield losses throughout the tropics are estimated at 6% equivalent to 6 million metric tons [9,10].

However, estimates from controlled greenhouse and field experiments indicate that root – knot nematodes can cause considerable yield reduction [3]. For example, in Nigeria *M. inognita* at

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a population level of 20,000/5 litre soil reduced the yields of Ife 1. Ibadan Local, Pusa Early Dwarf, Marzanino, Ronita, New Yorker and Rassol tomato by 89, 86, 84, 77, 74, 73 and 58% respectively (Ogunfowora, 1997b). on cowpea, yield losses ranging from 20% to 90% have been reported [11,10].

Although, it is clear from visible inspection that severely attached plants have a reduced vitality, produce less fruits and leading to death.

Therefore, the presence of this pest in plantations has to be controlled. The population of plant parasitic nematodes in the field can be minimized through several approaches such as using natural enemies [12], enhancing cultural practices, cultivating resistant cultivars [9] and applying pescticides.

Since the 1950's however, farmers have relied mainly on synthetic pesticides (Chemical control method) rather than on other approaches, because the management of root – knot nematodes with chemical nematicides is the most effective means of control but its adverse effects on the environment, non- target organisms, high mammalian toxicity and prohibitive cost have discouraged its use by farmers.

Therefore, it has become an important issue to find alternative control strategies, which are as effective as the synthetic nematicides, safer to farmers, consumers, and the environment and relatively easily available at low price [3].

One of the possible techniques is the utilization of nematicides from plant origin, known as botanical nematicides. Certain plants are able to kill or repel pests, disrupt their life cycle or discourage them from feeding [13,14]. Several plants have been identified with nematicidal or nematostatic property either in their seeds, fruits, leaves, barks, roots, oil, waste (liquid or solid) or in their root exudates. Majority of plant nematicides were under studied which were generally considered to be non – persistent under field condition as they are readily transformed by light, oxygen and micro organisms into less toxic product with no residual effects on product and environment [15,16].

In Nigeria, it has been estimated that over 140 plants are host to the knot nematode [9] which resulted in great reduction in crop yield. It is therefore obvious that there is a need for a control method that does not have phytotoxicity, cheap and easy to procure [3].

Therefore, the study was carried out to determine the efficacy of nine common local nematicidal plants in controlling the root – knot nematode *Meloidogyne Incognita* affecting cowpea (*Vigna unguiculata*), cultivar oloyin so that it can be recommended to peasant farmer.

Materials and Methods

Study Area

The experiment was carried out in an open field within the vicinity of Ondo State University of Science and Technology in Nigeria from August – December, 2017.

Source of the Nematicides

Nine different botanical nematicides which were grinded into powdery form were tested on *Meloidogyne Incognita* affecting cowpea (*Vigna unguiculata*) cultivar oloyin. The synthetic known effective nematicide (Furadan) against root knot nematodes, was included. The control bore no nematicides.

Planting

One hundred and sixty – five farm beds of 12 feet long and 2 feet wide were made with 3 feet furrow in between. Cowpeas (*Vigna unguiculata*) cultivar oloyin were planted at the rate of 3 seeds per hole at one-foot interval on each farm bed. Two weeks after planting, the seedlings were thinned down to one per stand.

Application of Botanical Nematicides

When the cowpea seedlings were 3 weeks old, 50g of each botanical nematicide was applied in a ring form at 5cm distant from each seedling except the furadan (3g). The cowpea used as control bore no nematicides. The nematicides were applied in a randomized complete block design with 5 replicates each. Each replicate was made up of 3 beds.

Agronomy Observation

Weekly observations were taken on plant growth vigour on a scale of 1-5 (1=poor stunted growth; 2=fair-retarded; 3=good-normal vegetative growth with yellowish green leaves; 4=very good-normal and strong full vegetative growth; 5=excellent – normal full and very strong vegetative growth with full green leaves).

Control of Insects

Starting from 35 days after planting, Gamalin-20 (25ml per 10 litre of water) was applied weekly till harvest.

Observation at Harvest

Fifty days after planting, the plants were uprooted and gently washed to prevent disintegration of the roots. The number of galls on each root was counted; the roots were stained in a 0.15g phloxine B/L of water solution for 15 minutes [15] to make the egg mass pronounced and then cut into fine pieces and eggs extracted by shaking in a 1% water solution of sodium hypochlorite for 3 minutes [4]. The suspension was passed through 100 (150µm) mesh sieve into 4 litres bucket containing 3 – litres of water. The suspension was allowed to settle overnight and the supernatant water was decanted into small volume and allowed to settle for another two hours and then decanted to 200ml and mixed properly by blowing air from aguarium pump. One ml aliquot is taken from the 299ml aliquot volume and egg counted under the stereoscopic microscope using counting dish. The number was then converted to the counts per original volume (200ml).

Statistical Analysis

The data were subjected to analysis of variance and the means were separated with Duncan multiple range test at p=0.05. The data on number of eggs was log transformed before analysis and retransformed for presentation.

Results

Considering the effect of botanical nematicides on percentage number of eggs, root galling and vigour caused by *M. incognita*, affecting cowpea (*Vigna unguiculata*) cultivar oloyin, over the control, and also based on the comparism with known effective nematicide (Furadan).

Table 1: Effect of botanical nematicides on number of eggs, number of galls and vigour of cowpea affected by M. incognita. Efficacy: Effective = 1-55% over the control; moderately effective = 56-70%: Poorly effective 71-100%. Figures in parenthesis indicate percentage over the control.

Treatment	Vigour Rating	Roots galls Number	Number of Eggs	Efficacy
Furadan (3g)	4.2000b	41.2a -43	8550.6a -43.3	Effective
Azadirachta indica (bark)	3.800b	45.96ab -47	9289.6ab -47.2	Effective
Salvadora persica	4.000b	49.22ab -50	9817.4ab -49.8	Effective
Chromolaena dorata	3.4000ab	52.9abc -54	10423.0ab -52.9	Effective
Capsicum annum	3.4000ab	58.16abc -59	10423.1ab -52.9	Moderately effective
Zingiber officinale	3.8000b	61.2abc -62.2	12302.6abc -62.5	Moderately effective
Azadirachta indica (leaf)	3.6000ab	68.2bc -69.8	13489.6abc -68.5	Moderately effective
Azadirachta indica (seed)	3.4000ab	68.3bc -69.9	13677.5abc -69.5	Moderately effective
Manihot esculenta	2.4000a	75.4cd -77.2	13867.5abc -70.4	Poorly effective
Azadirachta indica (husk)	3.2000ab	76.2cd	14588.14bc -74.1	Poorly effective
Control	3.4000ab	97.6d -100	19678.8c -100	

Azadirachta indica, *Salvadora persica* and *Chromolaena odorata*, were rated effective as they showed 55% reduction in percentage number of eggs and percentage root galling over the control which were significantly same as the Furadan (Table 1).

The nematicides, *Capsium annum, Zingiber officinale, Azadirachta indica* (Leaf and seed) were moderately effective as they showed 70% number of eggs, which also differ significantly from furadan an effective control respectively (Table 1).

The remaining nematicides, *Manihot esculenta* and *Azadirachta indica* (Husk) were poorly effective in controlling *M. incognita* as they showed percentage number of eggs and root galling greater than 70.

In terms of vigour, all the nematicides showed significant same as the furadan and control, except *M. esculenta* which differ significantly from others.

Means flanked by the same letter(s) are not significantly differently at P=0.05 according to Duncan multiple range test.

Vigour rating: 1 = Poor-stunted growth

2 = Fair-retarded growth

3 = Good-normal vegetative growth

4 = Very-good-normal and strong vegetative growth

5 = Excellent-normal full and very strong

Discussion

This study reveals the efficacy of some botanical nematicides on *Meloidogyne Incognita* affecting cowpea (V. *unguiculata*) cultivar oloyin.

Of all the botanical nematicides evaluated *Azadirachta indica* (bark) *Salvadora persica*, and *Chromolaena odorata* proved to be effective against root – knot nematodes *M. incognita* and showed not significant difference from the known effective nematicide, furadan. This also corroborates the work of Adegbite and [17] and (8).

The remaining nematicides showed moderate action in controlling *M. incognita* population. Present results of the nematicidal potential of *Azadirachta indica*, neem (bark, seed, leaf and husk) are supported by the study of [18], who also reported that fresh extracts of fruit, leaf, bark, root and gum inhibited hatching of *M. incognita*. Boiled water extracts of fresh leaves were reported to be toxic to *Pratylenchus brachyurus* [19]. In addition, Azadirachtins present in fruit, kernel, oil, cake and leaves of neem repel insects, from feeding, retard growth and make them lay fewer eggs if treated with water extracts. Along with azadirachtin, eliantriol and salanin present in A. indica have been reported to show anti – feeding as well as growth regulating activities [4].

The control that bore no nematicides showed poor performance in vigour and the root were heavily infested with large number of galls which is a characteristic symptom of root-knot nematode and the incidence shows that the root-knot nematodes is pathogenic on cowpea. The galled and damaged root will result in reduced surfaced area, reduced root/shoot ratio which will limit the capacity of the root system to explore the soil for water nutrient up take. This will markedly hinder the absorption of water, nutrient and minerals to the top plant and lead to suppressed and wilted plant, deficiency in nutrients and minerals, and consequential decreased chlorophyll synthesis and photosynthetic products.

Conclusion

The present study has shown that botanical nematicides may be useful for nematodes control, which will be an economical, environmentally and mammalian safe option and easy availability for control of nematodes.

The efficacy of the following tested botanical nematicides against root-knot nematodes (*Azadirachta indica* {bark}, *Salvadora persica, Chromolaena odorata, Capsium annum, Zingiber officinale, Azadirachta indica* {Leaf and seed}, *Manihot esculenta* and *Azadirachta indica* {Husk}) were rated effective to poorly effective respectively.

Conflict of Interests

No conflict of interests.

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References

1. Padulosi S, Ng NQ (1997) Origin, taxonomy and morphology of *Vigna unguiculata* (L.) Walp. In: An Advanced in Cowpea Research Co-publication of IITA and JIRCAS, IITA, Ibadan, Nigeria, pp. 1- 12.
2. Egunjobi OA, Ekundare GO (1981a) Cassava peeling as a soil amendment and its effects on maize yield in soil infested with *Pratylenchus brachyurus*. Nigeria Journal of Plant Protection 5:80-37. FAO 2007. Figure of production for the year 2006. Agricultural Data, FAO statiscal data base, Rome.
3. Nama CP, Sharma CP (2017) Bio-management of root-knot nematode, *Meloidogyne incognita* on Cowpea (*Vigna unguiculata* L.). Journal of Entomology and Zoology Studies 5(3): 50-52.
4. Hussey RS, Barker KR (1973a) A comparison of methods of collecting inocula of *Meloidogyne* spp. including a new technique. Plant Dis. Rep. 57:1025-1028. IITA 1982. Annual Report, 1982. IITA. Ibadan, Nigeria,217pp.
5. Olowe T (2004) Occurrence and distribution of root-knot nematodes in Nigeria. Nematology 6(6): 811-817.
6. Sasser JN, Freckman DW (1987) A world perspective on nematology: The role of the society. In: JA Veech and DW Dickson (Eds.), *Vistas on nematology* (pp. 7–14, 509 pp). Hyattsville: Society of Nematologists.
7. Aghale DN, Egbucha KC, Umeh OJ (2017) Plant parasitic nematode threat to Nigerian agricultural food security. International Journal of Advanced Research in Botany 3(3): 15-21.
8. Neeraj, Gurpreet S, Anil K, Sewak R, Vinod K (2017) Evaluation of Nematicidal Activity of Ethanolic Extracts of Medicinal Plants to *Meloidogyne incognita* (Kofoid and White) Chitwood under Lab Conditions. Int J Pure App Biosci 5(1): 827-831.
9. Caveness FE (1978) Root-knotnematodes on selected food crops in Nigeria. In: IMP Proceeding of the Second Research Planning Conference on Root-knot nematodes, *Meloidogyne spp* 20-24 Abidjan, Ivory-coast Pp 70-78.
10. Ayodele AA (2011) Assessment of Yield Loss of Cowpea (*Vigna unguiculata* L.) due to Root Knot Nematode, *Meloidogyne incognita* under Field Conditions. American Journal of Experimental Agriculture 1(3): 79-85.
11. Ogunfowora AO (1977b) The effects of different population levels of *Meloidogyne Incognita* on the yield of tomato (*Lycopersicon esculentum*) in South-Western Nigeria. Nigeria journal of Plant Protection 3: 61-67.
12. Adesiyan SO (1985) Comparative in vivo studies on possible nematicidal effects of spores of *Aspergillus niger*, *Penicillium sderotigenum* and *Fusarium oxysporum* on yam nematode. Nigeria Journal of Journal Protection 9: 25-36.
13. Martins G (2006) Nematodes: Alternative control NCTA Agricultural specialist ATTPA publication P. 287.
14. Bahraminejad S, Sadi AS, Hojat AA, Safee D (2014) Effect of plant extracts on the mortality of root-knot nematodes' J2, *Meloidogyne javanica*. Phytopathology and Plant Protection 48(4).
15. Ujvary I (2001) Pest control agents from natural products. In book: Hayes' Handbook of Pesticide Toxicology, pp.119-229. Academic Press.
16. Dickson DW, Ben Struble F (1966) A sieving staining technique for extraction of egg masses of *Meloidogyne incognita* from soil. Phytopathology 55: 497.
17. Adegbite A, Agbaje GO (2007). Efficacy of furadan (carbofuran) in control of root-knot nematode (*Meloidogyne incognita* Race 2) in hybrid yam varieties in South-Western Nigeria. World Journal of Agric Sc 3(2): 256-262
18. Siddiqui MA, Alam MM (1985) Further studies on the nematode toxicity of different parts of Margosa Persion lilac. Neem letter 2: 43-47.
19. Egunjobi OA, Afolami SO (1976) Effect of neem (*Azadirachta indica*) leaf extracts on populations of Pratylenchus brachyurus and on growth and yield of maize. Nematologica 22(2): 125-132.