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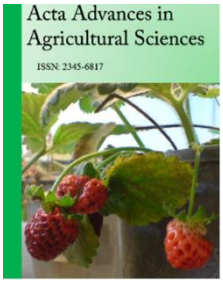

Research Article

Management of *Rotylenchulus reniformis* using *Jatropha curcas* and *Jatropha gossypiifolia* as an intercropping with sunflower in Egypt

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ABSTRACT

Influence of nematicidal activity of either *Jatropha curcas* or *J. gossypiifolia* as a intercropping with sunflower cv. Giza 1 (1, 2, 3 and 4 jatropha plants per pot) for control of *Rotylenchulus reniformis* was carried out under a greenhouse conditions . The nematode final population and the rate of reproduction were significantly ($P \leq 0.01$) affected by the number of both Jatropha species when grown with sunflower together. Also, a negative relationship was found with the seedlings number of both jatropha species and both the final nematode population and rate of nematode reproduction. The lowest nematode final population and rate of reproduction were determined at the highest number of both jatropha plants (4 plants per pot). The highest value of nematode reproduction (5.5) was found on sunflower plants grown alone, while, the lowest values (0.5 and 1.6) was found on sunflower plants grown with four plants of *J. curcas* and *J. gossypiifolia*; respectively. Eventually, *J. curcas* plants were more effective against the reniform nematode, *R. reniformis* than *J. gossypiifolia* did. Therefore, this type of control is considered easy, pollution-free and inexpensive.

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Introduction

The fast growing population in our country has necessitated increased food production and this in turn has put tremendous pressure on our environment. Nematodes comprise a large phylum of animals that includes plant and animal parasitic nematodes which obtaining nutrition only from the cytoplasm of living plant cells *Rotylenchulus reniformis* is a major phyto nematodes, is extremely polyphagus and attacks many annual and perennial crops affecting quality and quantity of the crop production. Nematodes are difficult to control because of their wide host range and high rate of reproduction, with females capable of producing up to thousand eggs. Chemical nematicides which used in reducing *R. reniformis* are often phytotoxic, cause environmental pollution endangering the life of many animals including fish (Landu and Tucker, 1984) and even contaminate ground water and leave

undesirable residues in edible parts of plants (Lue et al., 1984). Because of these inconveniences scientists identified natural products with nematicidal activity such as nematotoxic plants (Yassin and Ismail, 1994, Dhangar et al., 1995, Javed et al., 2008, Claudius- Cole et al., 2010, Abdelnabby and Abdelrahman, 2012 and Onyeke and Akueshi, 2012). Several benefits may result from the identification of the specific antagonistic phytochemicals to plant nematodes, whether they occur in a field or a laboratory. These compounds can be developed for use as nematicides themselves, or they can serve as model compounds for the development of chemically synthesized derivatives with enhanced activity or environmental friendliness (Chitwood, 2002). In this respect, *J. curcas* and *J. gossypiifolia* (physic nut or purging nut), perennial plant belonging to Euphorbiaceae family considered economic plants as multipurpose plants, the plant is drought resistant and used as ornamental purpose, as an oil crop, for cosmotic industry, and used as a medicinal plants by using their seeds against constipation, the sap for wound healing and leaves as tea against malaria (Adebowale and Adedire,2006, Hussein et al.,2012 and Taha et al.,2013). Also, the by-products are press cake a good organic fertilizer and oil contains also insecticide (Gubitz et al., 1999 and Hussein et al., 2012). Moreover, Jatropha plants either *J. curcas* or *J. gossypiifolia* have been found suppress the population of *Meloidogyne incognita* by releasing toxins into the soil when used their plant extracts, powdery leaves, adding fresh leaves or grown with susceptible crops as a interculture (Umeh and Ndana, 2010, Ugwouke et al., 2011, Ganai et al., 2013 and Ismail, 2014; respectively). Ugwouke et al. (2011) and Ganai et al. (2013) proved that powdery leaves or fresh leaves of *J.curcas* to be the best among other different treatments against *M. incognita* under both laboratory and greenhouse conditions. The aim of this work was to assess the effectiveness of various numbers of each two species of *J. curcas* and *J. gossypiifolia* as an intercropping with sunflower plants cv. Giza 1 against *R. reniformis* under greenhouse conditions.

Materials and Methods

Fifteen days old seedlings of sunflower CV. Giza 1 grown in sterilized soil were transplanted singly in 25 cm clay pots containing 3 kg sterilized sandy loam soil (1:1 w:w). The seedlings were inoculated with about 3000 unswollen females of *R. reniformis* per pot after four days from planting time. Three days after inoculation, one to four seedlings of each 21 days old physic nut or purging nut, *J. curcas* and *J. gossypiifolia* grown in sterilized soil were transplanted into the periphery of each pot with six replicates. **S**eedlings planted without jatropha plants served as a control. All pots were arranged in a randomized complete block design under a greenhouse conditions at 25 ± 5 ºC. Fifty five days after inoculation, sunflower plants were uprooted, the nematode numbers were determined. Juveniles in soil were extracted by sieving and decanting technique according to Barker (1985). Also, the nematode numbers from roots were extracted by incubation method based on Southey (1970). The rate of reproduction (RR) was determined according to Oostenbrink (1966) as follows: final nematode population (P_f) / initial nematode population (P_i).The obtained data were statistically analyzed by using the Fisher 's Least Significant Differences (LSD) based on Snedecor and Cochran (1980).

Results and Discussion

The two species of jatropha plants were found to be inhibited reproduction of *R. reniformis* **(**tables 1 and 2**)** as compared with sunflower plants grown alone. The evaluated numbers of jatropha plants significantly ($P \leq 0.01$) reduced the

Table1. *Effect of Jatropha curcas as an intercropping with sunflower cv. Giza 1 on development and reproduction of Rotylenchulus reniformis*

Treatments	Nematode numbers *				Rate of reproduction **
	In root	In soil	Total	Reduction (%)	
Sunflower alone (Control)	1745	14876	16621	-	5.5
Sunflower + one plant of *J. curcas*	800	6100	6900	58.5	2.3
Sunflower + two plants of *J. curcas*	750	4650	5400	67.5	1.8
Sunflower + three plants of *J. curcas*	605	2095	2700	83.8	0.9
Sunflower + four plants of *J. curcas*	134	1366	1500	91.0	0.5
LSD 0.05	127.1	596	951.6	-	-
LSD 0.01	152.9	709	1150.3	-	-

*Each value is a mean of six replicates. **Rate of reproduction = P_f / P_i, where P_f = final population, and P_i = initial population.

Table 2. *Effect of Jatropha gossypiifolia as an intercropping with sunflower cv. Giza 1 on development and reproduction of Rotylenchulus reniformis*

Treatments	Nematode numbers *				Rate of reproduction **
	In root	In soil	Total	Reduction (%)	
Sunflower alone	1745	14876	16621	-	5.5
Sunflower + one plant of *J.gossypiifolia*	1000	14090	15090	9.2	5.03
Sunflower + two plants of *J.gossypiifolia*	850	9350	10200	38.6	3.4
Sunflower + three plants of *J.gossypiifolia*	810	7890	8700	47.7	2.9
Sunflower + four plants of *J.gossypiifolia*	670	1130	4800	71.1	1.6
LSD 0.05	113.5	604.2	921.6	-	-
LSD 0.01	136.5	770.0	1249.6	-	-

*Each value is a mean of six replicates. **Rate of reproduction = P_f / P_i, where P_f = final population, and P_i = initial population.

nematode population on roots, number of juveniles in soil. Accordingly, P_f and RR values were greatly suppressed. Also, there was a positive relationship between number of jatropha plants and % reduction in P_f. In this respect, treatment with 4 plants of *J. curcas* and *J. gossypiifolia* were achieved the greatest reduction in P_f (91.0 % and 71.1%; respectively). In contrast, there was a negative relation between the number of both jatropha species plants and the RR which attained 5.5 folds with sunflower alone. However these values were decreased gradually as jatropha plants increased until achieved the lowest folds as 0.5 and 1.6 with sunflower plant growing together four plants of *J. curcas* or *J. gossypiifolia*; respectively (Tables 1 and 2).

This study state that there was significant ($P \leq 0.01$) increase in P_f and its RR around sunflower grown alone, however, in treatments having different numbers of either *J. curcas* or *J. gossypiifolia* (1-4 plants/ pot) with sunflower, the P_f and RR decreased (Tables 1 and 2). Eventually, *J. curcas* plants were more effective against *R. reniformis* than *J. gossypiifolia* did. These data indicate that the decrease in the nematode final population and rate of build-up by growing *J. curcas* or *J. gossypiifolia* was mainly attributed to the toxic nature of its root exudates. These findings are in conformity with those of Alam et al.(1977), Korayem and Osman (1992), Claudius- Cole et al.(2010) and Onyeke and Akueshi (2012). They reported that there are many plants which suppress the population of different plant - parasitic nematodes by releasing nematotoxins into the soil, not phytotoxic to the plants, rather they caused increased plant growth. Also, Debnath and Bisen (2008) found that jatropha plants can be used as a green manure, hence can be used as a soil amendment for improving soil properties. Various parts of *J. curcas* including seeds hold potential for use as a source of oil, animal feed or medicinal preparations (Openshaw, 2000). Taha et al. (2013) mentioned that peroxidase, polyphenol oxidase and esterase are the main enzymes present in *J. curcas*. Also, they reported that these compounds play a photoprotective role and are considered as bioactive constituents. Researchers correlated different enzymes with the percentage of oil in seeds of *Jatropha* and found accessions which have greater laccase enzyme activity showed greater oil percentage (kumar et al., 2006). Selection for peroxidase and polyphenol oxidase enzymes activities will improve the nutritive quality of *Jatropha*. Also, different enzyme activities and their role in several crops and trees for enhancement of the development process have been reported by Andrews et al. (2000) and Tarkka et al. (2001). Moreover, *J. curcas* and *J. gossypiifolia* have been found suppress the population of *M. incognita* by releasing toxins into the soil when used their plant extracts, powdery leaves , adding fresh leaves or grown with susceptible crops as an interculture (Umeh and Ndana,2010, Ugwouke et al.,2011, Ganai et al.,2013 and Ismail, 2014; respectively). Generally, nematicidal phytochemicals are safe for the environment (Chitwood, 2002).These compounds include repellents, attractants, hatching stimulants or inhibitors and nematotoxicants, either constitutive or formed in response to nematode presence (Chitwood, 2002).

Present findings assume potential importance in developing plant-based natural nematicides for nematode control.

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References

1. Abdelnabby H M, Abdelrahman S M (2012) Nematicidal activity of selected flora of Egypt. Egyptian Journal of Agronematology. 11:106-124.
2. Adebowale K O, Adedire C O (2006) Chemical composition and insecticidal properties of the underutilized *Jatropha curcas* seed oil. African J. Biotechnology 5(10): 901-906.
3. Alam M M , Saxena S K , Khan A M (1977) Influence of interculture of marigold and margosa with some vegetable crops on plant growth and nematode population. Acta. Bot. Indica 5:33-39.
4. Andrews J, Malone M, Thompson D S,Ho L C, Burton K S (2000) Peroxidase isoenzyme patterns in the skin of maturing tomato fruit. Plant Cell Environment 23: 415-422.
5. Barker K R (1985) Nematode extraction and bioassays. In: Barker K R, Carter C C, Sasser J N, editors. An advanced treatise on *Meloidogyne* – Vol. II. Raleigh (USA): North Carolina State University Graphics. P. 19-35.
6. Chitwood D J (2002) Phytochemicals based strategies for nematode control. Ann. Rev. Phytopathol., 40:221-249.
7. Claudius-Cole A O, Aminu A E, Fawole B (2010) Evaluation of plant extracts in the management of root-knot nematode *Meloidogyne incognita* on cowpea, *Vigna unguiculata* L. (Walp). Mycopathology 8:53-60.
8. Debnath M, Bisen P S (2008) "*Jatropha curcas* L.: A Multipurpose Stress Resistant Plant with a Potential for Ethno Medicine and Renewable Energy". Current Pharmaceutical Biotechnology 9(4): 288-306.
9. Dhangar D S, Gupta D C and Jain R K (1995) Effect of marigold (*Tagetes erecta*) intercropped with brinjal in different soil types on disease intensity of root-knot nematode (*Meloidogyne javanica*). Indian J. Nematology 25(2): 181-186.
10. Ganai M A, Rehman B, Parihar K, Asif M and Siddiqui M A (2013) Phytotherapeutic approach for the management of *Meloidogyne incognita* affecting *Abelmoschus esculentus* (L.) Moench. Archives of Phytopathology and Plant Protection 46: 1-7.
11. Gubitz G M, Mittelbach M M,Trab M (1999) Exploitation of the tropical oil seed plant *Jatropha curcas* L. Biore Source Technology 67: 73-82.
12. Hussein M M, Thalooth A T, Tawfik M M, Gobarah E and Mohamed M H (2012) Impact of mineral and organic fertilizers on vegetative growth of *Jatropha curcas* L in sandy soil. Appl. Botany 49: 9714-9717.
13. Ismail A E (2014) Growing *Jatropha curcas* and *Jatropha gossypiifolia* as a interculture with sunflower for control of *Meloidogyne javanica* in Egypt. International J. Sustainable Research (In press).
14. Javed N , Gowen S R , El-Hassan S A , Inam-ul-Haq M , Shahina F , Pembroke B (2008) Efficacy of neem (*Azadirachta indica*) formulations on biology of root-knot nematodes (*Meloidogyne javanica*) on tomato. Crop Prot. 27:36-43.
15. Korayem A M , Osman H A (1992) Über nematizide Wirkungen der Henna-Pflanze *Lawsonia inermis* gegen den Wurzelnematoden Meloidogyne incognita. Anzeiger fur Schädlingskunde Pflanzenschutz Umweltschutz 65:14-16.
16. Kumar R V, Yogendra K T,Yadav V P, Ahlawat S P, Handa A K, Jit A (2006) Population variation and interrelationships between laccase enzyme activity and oil percentage of *Jatropha curcas* L. Indian J. Agrofor., 8: 47-53.
17. Landau M, Tucker J R (1984) Acute toxicity of EDB in Aldicarb to two young estuarine fish species. Bull. Env. Toxicol. 33: 129-132.
18. Lue L P, Lewis C C, Melcchor V E (1984) The effect of aldicarb on nematode population and its persistence in carrot, soil and hydroponic solution. J. Env. Sci. Health,B 19: 343-354.
19. Onyeke C C , Akueshi C O (2012) Infectivity and reproduction of *Meloidogyne incognita* (Kofoid and White) Chitwood on Africa yam bean, *Sphenostylis stenocarpa* (Hochst *Ex*. A. Rich) Harms accessions as influenced by botanical soil amendments. African J. of Biotechnology 11:13095-13103.
20. Oostenbrink M C (1966) Major characteristics of the relation between nematodes and plants. Wageningen, The Netherlands, Mededlingen van Landbouwhogeschool. 66:1-46.
21. Openshaw K (2000) A review of *Jatropha curcas*: an oil plant of unfulfilled promise. Biomass Bioenergy 19: 1-15.
22. Snedecor G W, Cochran W G (1980) "Statistical Methods" 7th Edition, Iowa State University Press, Iowa.
23. Southey J F (1970) Laboratory methods for work with plant and soil nematodes. Technical Bulletin No. 2. London (UK): HMSO. 148pp.
24. Taha L S, Ibrahim S M M, Eid R A, Hussein M M (2013) Effect of pre-emergence treatment of *Jatropha curcas* L seeds with some spices extracts on germination, growth, physiological and enzymatic activity. Australian J. Basic and Applied Sciences 7(1): 556-561.
25. Tarkka M T, Nyman T A, Kalkkinen N, Raudaskoski M (2001) Scots pine expresses short-root- specific peroxidase during development. European J. Biochemistry 268: 86-92.

26. Ugwouke K I, Ukwueze B O, Ogwulumba S I (2011) Powdery leaf extracts for control of root knot nematode in African yam bean. African Crop Science Journal 19(2): 131-136.
27. Umeh A, Ndana R W (2010) Effectiveness of *Jatropha curcas* and *Jatropha gossypiifolia* plant extracts in the control of *Meloidogyne incognita* on okra. International J. of Nematology 20(2): 226-229.
28. Yassin M Y, Ismail A E (1994) Effect of *Zinnia elegans* as a mix-crop along with tomato against *Meloidogyne incognita* and *Rotylenchulus reniformis*. Anzeiger fur Schadlingskunde Pflanzenschutz Umweltschutz 67:41-43.