An eco-friendly approach for the management of root knot nematode affecting Chickpea

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ABSTRACT

Management of phytoparasitic nematodes with plant products has been supported in favour of the increased awareness of environmental hazards affecting both flora and fauna associated with pesticides. A glasshouse experiment was conducted to control the effect of root knot nematode, *Meloidogyne incognita* on the plant growth parameters of chickpea, *Cicer arietinum* L. var. "Avarodhi", a highly proteinaceous crop by the different concentrations of leaf extract of Persian lilac, *Melia azedarach.* Results revealed that the plants treated with higher concentrations of leaf extracts of *M. azedarach* showed the least impact of *M. incognita* as compared to the other concentrations. Plants inoculated alone with the 1000 second stage juveniles (J2) of *M. incognita* showed highest reduction in plant growth parameters of shoot and root length (cm), fresh and dry weight (g), number of flowers and pods, total chlorophyll content and nitrate reductase activity with increased root knot index. Plants treated with lower concentrations of leaf extract also showed significant control over the reduction in plant growth parameters. These treatments also reduce the root knot index to a significant level. These studies may go a long way and act as a biocontrol agent and will be an asset in the clean and pollution free environment.

Keywords: root knot nematode, *Meloidogyne incognita,* Chickpea, leaf extract, *Melia azedarach*.

INTRODUCTION

Chickpea, *Cicer arietinum* L. (Family-Fabaceae) is the important pulse crop. This is an important source of dietary protein, vitamin, some minerals and is extensively used as a protein adjunct to starch diets. Plant is refrigerant and leaves are astringent, useful in bronchitis. This crop has been reported to be infected with various forms of diseases. Plant parasitic nematode (*Meloidogyne* spp.) showed a great threat among all. *Meloidogyne* spp., root knot nematode is one of the most harmful nematode pests in both tropical and subtropical crop production regions and cause extensive economic damage worldwide [1]. Root-knot in chickpea has been reported in various states of India [2,3]. Nematode not only suppresses the plant growth but also interferes in the nodulation, nitrogen fixation and adversely affects the overall yield. Modern way of nematode control is totally based on the nematicides as higher population growth demands increase crop production. But on the other hand these nematicides not only toxic to the root-knot but also accumulate in plant. These nematicides often lead to environmental pollution and even the depletion of stratospheric zone [4]. Hence, there is an urgent need for an eco-friendly substitute for nematode control. Plant parts/products proved to be the promising alternative means and showed toxicity to pest up to a certain extent and their application offers complete economic advantage. Biocontrol of nematode has been emphasized to control chemical means of management, as the use of nematicides are

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hazardous to environment which in some cases further leads to biomagnifications. Many naturally occurring compounds are known to possess nematicidal activity [5]. Plant parts possess nematostatic as well as nematicidal property [6,7]. Application of oil cakes was found as organic amendment to control nematode attacking chickpea [8]. Some plant latex also shown to possess some nematicidal property [9]. The aim of present study was to determine the antinemic activity of leaf extract of bakain, *M. azedarach* on root knot nematode, *M. incognita* affecting chickpea, *C. arietinum.*

MATERIALS AND METHODS

A glasshouse experiment was conducted selecting chickpea var. "AVARODHI" as a host plant and root-knot nematode, *Meloidogyne incognita* (Kofoid and White) Chitwood as pathogen. Two hundred seeds of chickpea var. avarodhi were surface sterilized with 0.1% solution of mercury chloride ($HgCl_2$) and then washed thoroughly with double distilled water. Six seeds were then sown in each clay pots (15 cm in diameter) containing steam sterilized soil (7 clay: 2 sand: 1 farmyard manure), pH - 7.2. Each pot were than treated individually with different concentrations, viz., 10, 20, 40, 80 and 100 ml leaf extract of *Melia azedarach*. For culturing nematodes, egg masses of *M. incognita* were handpicked with sterilized forceps from the heavily infected roots of *Solanum melongena.* These egg masses were washed in double distilled water, placed in 15 mesh sieve (8 cm in diameter) containing double layered tissue paper in petriplates in water. These were incubated at 28±2°C to obtain freshly hatched second stage juveniles (J2) of *M. incognita*. Hatched juveniles were collected from petriplates in 100 ml beaker.

Aqueous extract of chopped leaves of *Melia azedarach* was prepared and different dilutions were made, viz., 10, 20, 40, 80 and 100 ml. Each pot was then treated with these individual dilutions and 1000 J2 second stage juvenile of *M. incognita* [T6 - untreated inoculated (1000J2), TC - untreated uninoculated (control)]. Each treatment was replicated four times. The plants were irrigated regularly. Mature plants were uprooted 60 days after inoculation. Roots were washed thoroughly with running tap water. Plant growth parameters length (shoot and root) in centimeter, weight (fresh and dry) in grams, number of flowers, number of pods, number of nodules and root-knot index were recorded. Chlorophyll content [10] in mg/g and nitrate reductase activity [11] in $\mu mh^{-1}g^{-1}$ of leaves was also determined. Significance of differences was statistically tested by least significant digit at 5% and 1% level.

RESULTS AND DISCUSSION

It was found that Chickpea var. Avarodhi was susceptible to the root-knot nematode *M. incognita*. All the treatments significantly reduced the intensity of root-gall disease of Chickpea (Table 1). Shoot and root length decreased in all the inoculated plants but there is non-significant reduction in plants germinated from the plants treated with the higher concentration(100 ml) of leaf extract of *M. azedarach* (T1). Highest plant length was recorded in untreated uninoculated (TC) plants. Plants treated with 80 ml concentration (T2) and other flower extract also showed control over reduction in plant length as compared to the length of inoculated untreated (T6) plants (Table 1).

In case of fresh and dry weight (T6) plants showed the highest impact of nematode infestation. Plants (TC) were recorded to have the highest fresh and dry weight. Plants (T1) as compared to other treated plants are least influenced by nematode. All the plant growth parameters were shown to have positive effect when treated with the leaf extract of *Melia azedarach* against *M. incognita*. Number of flower and overall yield of plants were most affected in case of untreated inoculated plants (T6) (Table 1).

Table 1. Effect of different concentrations of leaf extract of *Melia azedarach* on Chickpea var. Avarodhi against *Meloidogyne incognita*.

Treatments Dose/1000J2	Plant length (cm)	Plant fresh weight (g)	Plant dry weight (g)	Chlorophyll (mg g^{-1})	NRA ($\mu m h^{-1} g^{-1}$)	Number of pods	Number of Flowers	Number of Nodules	Root-knot index
M .azedarach (100ml)	67.94	27.53	6.46	2.462	0.434	29.51	23.63	4.09	1.66
M. azedarach (80ml)	61.54	25.18	5.84	2.401	0.415	27.75	21.86	3.64	2.03
M. azedarach (40ml)	56.78	23.84	4.91	2.016	0.368	24.83	18.65	3.03	2.54
M. azedarach (20ml)	51.56	21.56	4.72	1.878	0.249	21.88	16.84	2.63	2.95
M. azedarach (10ml)	42.74	20.24	4.37	1.705	0.191	19.97	12.43	1.99	3.29
T (IC)	37.43	16.82	3.72	1.006	0.071	10.75	6.25	1.28	4.60
T (C)	75.00	30.71	6.74	2.773	0.496	37.75	30.25	4.60	-
LSD (*p*=0.05)	5.11	2.14	0.476	0.187	0.031	2.28	1.76	0.286	0.246
LSD (p=0.01)	7.17	3.00	0.667	0.262	0.044	3.20	2.46	0.401	0.346

Values are mean of four replicates; T(IC) Control = Untreated Inoculated Control; T (C) Control = Untreated Uninoculated Control; NRA = Nitrate Reductase Activity.

Chlorophyll estimation and nitrate reductase activity (NRA) showed that the amount of total chlorophyll decreased in all inoculated plants. Highest nitrate reductase activity was shown by plants (TC) but (T1) also showed non-significant reduction. Therefore it was concluded that the severe infection caused by *Meloidogyne* spp. could be lowered by the plant products in view of eco-friendly environment. This has an advantage against expensive and hazardous chemicals as nematicides. Plants product proved as cheap and degradable source. This paves the way for the healthy and pollution free sustainable environment.

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