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Usages of Botanical Extracts for the Management of Root-Knot Nematode, *Meloidogyne incognita* in Chickpea

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Glass- house experiment was conducted to test the nematicidal effect of flower extracts of some locally available plants. The flower extracts of five plants are selected for pot treatments to determine efficacy against nematode infection in chickpea var. Avarodhi. The results reveal that the nematicidal efficacy of flower extracts of *Calotropis procera* were shown highest potential impact against juveniles (J_2) of root-knot nematode, *Meloidogyne incognita* as compared to the tested flower extracts of *Tagetes erecta, Lantana camara, Thevetia peruviana and Nerium indicum*. However, the extracts of *Tagetes erecta, Lantana camara, Thevetia peruviana and Nerium indicum* were also significantly reduced the infection in roots as comparision to untreated inoculated control. The plant growth parameters including chlorophyll content and nitrate reductase activity are highly reduced in the untreated inoculated control, while the treated plants are shown the significant improvements in plant growth parameters. The obtained results proved that above tested floral extracts with integrated approach would also be more useful to control nematode infection in economic crops and will be an asset in the clean and pollution free environment.

Key words: Chickpea, *Meloidogyne incognita*, flower extracts.

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. are widely spread nematode, limiting the world's total agricultural productivity (Sasser *et al.*, 1982; Taylor *et al*., 1982). Root-knot in chickpea has been reported in various states of India (Jamal, 1976; Khan & Siddiqui, 2005). 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. (Wheeler *et al.,* 1979). So there is an urgent need for an eco-friendly substitute for nematode control.

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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 hazardous to environment which in some cases further leads to biomagnifications . Many naturally occurring compounds are known to possess nematicidal activity (Chitwood, 2002) as for example polythienyls in *Tagetes* spp.(Kyo *et al.,* 1990).Plant parts possess nematostatic as well as nematicidal property(Akhtar,2000;Tariq & Siddiqui,2005). Application of oil cakes were found as organic amendment to control nematode attacking chickpea (Yadav *et al*., 2006).Some plant latex also shown to possess some nematicidal property (Siddiqui *et al*., 1987).

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 100 ml flower extract of *Calotropis procera,Tagetes erecta, Lantana camara, Thevetia peruviana and Nerium indicum.*

For culturing nematodes, egg masses of *Meloidogyne incognita* (Kofoid and white) Chitwoodwere 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^{0}C to obtain freshly hatched second stage juveniles (J2) of *M. incognita*. Hatched juveniles were collected from petriplates in 100 ml beaker.

Experiment was designed as follows

T1- *Calotropis procera* (80ml) +1000 J2
T2- *Tagetes erecta* (80ml) +1000 J2
T3- *Lantana camara* (80ml) +1000 J2
T4- *Nerium indicum* (80ml) + 1000 J2
T5- *Thevetia pervuiana* (80ml) +1000 J2
T6 -Untreated inoculated (1000J2)
T7 - 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 & root) in centimeter, weight (fresh & dry) in grams, number of flowers, number of pods, number of nodules and root-knot index were recorded. Chlorophyll content (Mackkeney, 1941) in mg/g and nitrate reductase activity (Jaworski, 1971)in$\mu mh^{-1}g^{-1}$ of leaves were also determined. . Data was analyzed by SPSS 12.00 Software (SPSS. Inc., 1989-2006, USA) ANOVA. Significance of differences were statistically tested by least significant digit at 5 and 1%.

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. 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 flower extract of *C.procera* (T1). Highest plant length was recorded in untreated uninoculated (TC) plants. Plants treated with *T.erecta* (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,Fig. 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 flower extract of *C. procera, T. erecta, L. camara, T. peruviana and N. indicum,* against *M.incognita*. Number of flower and overall yield of plants were most affected in case of untreated inoculated plants,(T6) (Table 1).

Chlorophyll estimation and nitrate reductase activity (NRA) showed that the amount of total chlorophyll decreased in all inoculated

Table 1. Effect of flower extract of plant on Chickpea var. Avarodhi against *Meloidogyne incognita*

Treatment	Plant length (cm)	Plant fresh weight (g)	Plant dry weight (g)	Chlorophyll (mg g^{-1})	NRA (µmh^{-1}g^{-1})	Number of Flowers	Number of pods	Number of Nodules	Root-knot index
T1	65.64	26.20	6.22	2.224	0.384	28.16	21.31	3.99	1.78
T2	62.34ns	24.01*	5.66*	2.216ns	0.375ns	27.07ns	16.64**	3.41**	2.17**
T3	55.83**	22.38**	4.88**	1.983*	0.298**	23.64**	15.52**	2.62**	2.83**
T4	53.76**	21.67**	4.65**	1.866**	0.239**	21.48**	12.61**	2.08**	3.05**
T5	52.47**	19.49**	4.18**	1.675**	0.183**	19.52**	11.45**	1.94**	3.51**
T6	37.43**	16.82**	3.72**	1.006**	0.071**	10.75**	6.25**	1.28**	4.60**
TC	75.00**	30.71**	6.74*	2.773**	0.496**	37.75**	30.25**	4.60**	0.00**
LSD (p=0.05)	5.18	2.07	0.47	0.179	0.028	2.23	1.55	0.27	0.26
LSD (p =0.01)	7.26	2.90	0.65	0.252	0.040	3.12	2.17	0.38	0.36

Values are mean of four replicates,
UI Control= Untreated Inoculated Control, UU Control= Untreated Uninoculated Control
NRA=Nitrate Reductase Activity

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

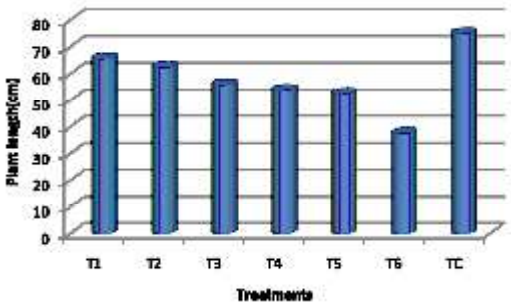

Fig. 1. Histograms showing the effect of flower extracts of different plants on plant length of Chickpea var. Avarodhi against *Meloidogyne incognita*

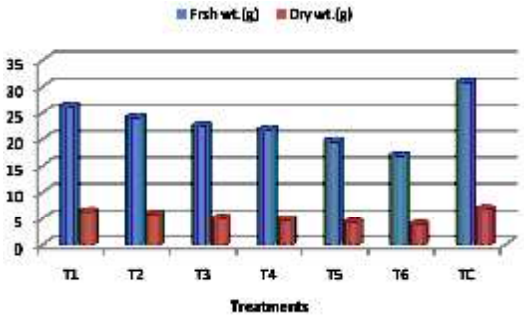

Fig. 2. Histograms showing the effect of flower extracts of different plants on plant weight of Chickpea var. Avarodhi against *Meloidogyne incognita*

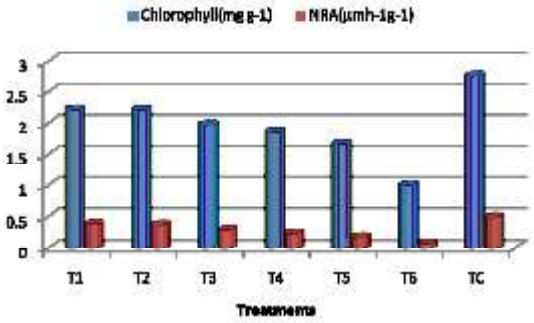

Fig. 3. Histograms showing the effect of flower extracts of different plants on Chickpea var. Avarodhi against *Meloidogyne incognita*

chemicals as nematicides. Plants product proved as cheap and degradable source. This paves the way for the healthy and pollution free sustainable environment.

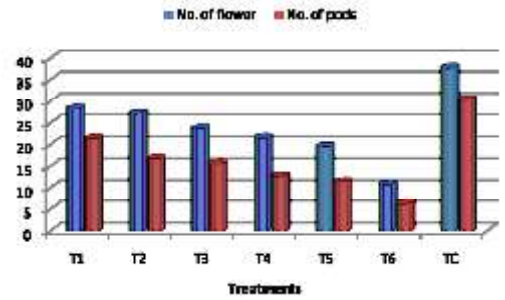

Fig. 4. Histograms showing the effect of flower extracts of different plants on Chickpea var. Avarodhi against *Meloidogyne incognita*

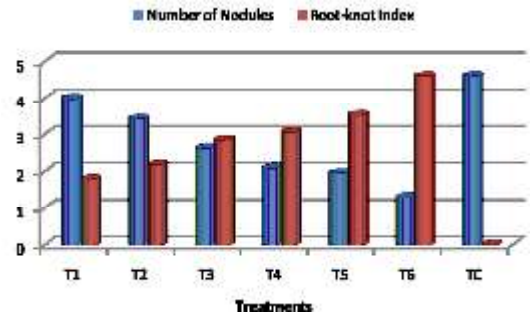

Fig. 5. Histograms showing the effect of flower extracts of different plants on Chickpea var. Avarodhi against *Meloidogyne incognita*

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