INT. J. BOIL. BIOTECH., 18 (1): 119-122, 2021.

NEMATODES OF CORIANDER (*CORIANDRUM SATIVUM* L.) AND THEIR MANAGEMENT USING A NEWLY DEVELOPED PLANT-BASED NEMATICIDE

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ABSTRACT

Three nematodes namely *Tylenchorhynchus annulatus, Hoplolaimus pararobustus* and *Xiphinema* sp. were found associated with coriander and apparently were responsible for the poor growth of coriander. To find an effectively management strategy for the nematodes, a pot experiment was conducted in a wire mesh chamber where two nematicides namely carbofuran (a popular chemical nematicide) and a newly formulated plant-based nematicide Turtob-F were tested. Turtob-F at 9 and 12 g/pot two different doses effectively controlled all three nematode species while carbofuran was most effective against the nematode populations.

Keywords: Coriander, Plant nematodes, pot experiment, Turtob-F

INTRODUCTION

In Pakistan the character of agriculture differs in all the four provinces depending mainly on soil type, temperature and rainfall.

Since the 1970's chemical nematicides have developed for commercial use. The last fumigant nematicide was withdrawn from the market over the last five years. It has now become apparent that these nematicides were unsafe for users as well as the environment. Organic amendments derived from animal or plant material are widely being used for the control of plant nematodes. When decomposing materials release toxic compound rapid decrease in nematode population may occur (McSorley, 2011).

Nematodes usually feed upon root cell of plants withdrawing nutrients from roots, which leads to damage to the plant due to losses in its productivity (Nyaku *et al.,* 2017). Jang *et al.* (2014) suggested that the most common symptoms of nematodes to plants are chlorosis, wilting, reduction in height of plant, injury to plasma membrane, swollen roots and gall formation and an impact on overall yield.

Organic amendments for the control of plant nematodes have been highly recommended. The most effective amendments are the ones with C:N ratios and high protein or amine-type N content. Organic amendments are useful because they feed the plant and soil simultaneously instead of just plant. Organic materials such as compost is reliable and effective tool to ameliorate structure and both biological (Ros *et al.,* 2003) and chemistry fertility (Scotti *et al.,* 2013) as well as suppress soil borne pathogens including nematodes (Khan *et al.,* 2004; 2008; 2011).

Turmeric (*Curcuma longa* L.) is an herbaceous plant and is native of Southeast Asia. Turmeric active compound curcumin has major antiflammatory and antioxidant properties besides various biological properties. Neeraj *et al.* (2017) reported the effect of aqueous extracts of different plants namely marwa tulsi (*Origanum majorana*); mint (*Mentha arvensis*); rhizome of turmeric (*Curcuma longa*) and fruit of angola (*Phyllanthus emblica*) on hatching of *Meloidogyne incognita* larvae. Extracts of turmeric gave significant mortality 80.6 at 1.5 dilution, respectively. Yu and Potter (2008) used nicotine in vitro against nematodes *Caenorhabditis elegans, Meloidogyne incognita, Heterodera schachtii* from strawberry and tobacco fields. Nicotine inhibited the cyst hatching of *H. glycines* and eggs of *M. incognita* and *M. hapla* strongly. The toxicities of nicotine against nematodes were highly variable ranging from toxic to most plant nematodes to non-toxic on *P. penetrans.*

Due to benefits of organic amendments on nematode control which would ultimately lead to reduction in the application of chemical nematicides and achievement of sustainable agriculture in the future an experiment was carried out in pots to test the ability of organic amendment Turtob-F in three different doses to suppress nematodes in natural infected soils of coriander. The effect of treatments (amendments) on the dynamics of the selected nematodes was investigated.

MATERIALS AND METHODS

The experiment was conducted at a Sakran Nursery, Balochistan, Pakistan in earthen pots filled with 200ml of sandy loam soil. Six samples were taken from a field showing poor growth of coriander located 1.5 km from the site of the experiment. The nematode population density present in the soil was *Tylenchorhynchus annulatus* 41.50 ± 2.44; *Hoplolaimus pararobustus* 89.83 ± 8.63 and *Xiphinema* sp. 82.66 ± 9.46. These three nematodes comprised almost 70 percent of total plant nematodes in the field. Later thirty pots were filled with multipurpose compost soil. After 15 days of treatment, ten coriander (*Coriandrum sativum* L.) seeds were sown per pot which after germination were thinned to four per pot and kept in wire mesh chamber Turtob-F (a nematicide containing 75% turmeric, 21% tobacco and 4% captan produced by Pakistan Council of Scientific and Industrial Research Complex in collaboration with Crop Diseases Research Institute, P.A.R.C. Karachi).

For preparation of treatments Tobacco sand leaves (*Nicotiana tabacum* L.) were dried at 58°C ± 2°C for 6 weeks. The dried leaves were converted into a powder using a Wiley mill (Thomas Scientific).

Turmeric (*Curcuma longa* L.) rhizome was dried for 6 weeks crushed into powder form and used. Carbofuran a chemical nematicide a.i. 44% Agricultural products group of FMC corporation, Philadelphia, PA, USA) belonging to carbamate group of pesticide was used. The treatments and control were replicated six times each.

A fungicide Captan a general use pesticide (GVP) that belongs to the Phthalimidae class of fungicides was added to control fungal disease inhibiting or killing the fungus causing the disease. The doses of Turtob were 6, 9 and 12 g / pot while carbofuran was applied at the rate of 1 g / kg from which soil was taken to fill the pots. Untreated pots were kept as control. Each sample was processed using a modified Cobb's decanting and selective sieving method (Ravichandra, 2015). The plant nematodes were counted under a stereoscopic binocular microscope by shaking the nematode counting suspension thoroughly and transferring 2 mL aliquots to a counting dish. Quantitative and qualitative analysis was carried out and ANOVA was performed with two factors: species and treatments.

RESULTS

Tylenchorhynchus anuulatus was effectively controlled by carbofuran followed by Turtob-F dose 3 (p at the most 0.05) population of *Hoplolaimus pararobustus* was also remarkably controlled equally by carbofuran and Turtob-F dose 3 ($p < 0.05$). *Xiphinema* sp. was most effectively controlled by carbofuran followed by Turtob dose 3 and 2 (Table 1). The ANOVA table (Table 2) showed that treatments were highly significant ($p < 0.001$) but species were non-significant. However the interaction of species × treatment was found to be significant ($p < 0.05$).

Table 1. Nematode population following various treatments (Number in 200 mL of soil).

Nematodes	After 4 months				
	Treatments				
	Control	Carbofuran	Turtob-F (Dose 1)	Turtob-F (Dose 2)	Turtob-F (Dose 3)
Tylenchorhynchus annulatus	91.0 ± 17.3	7.33 ± 3.72	102.8 ± 10.61	11.83 ± 2.52	7.5 ± 2.96
Hoplolaimus pararobustus	89.6 ± 13.92	7.5 ± 3.35	107.0 ± 6.84	55.5 ± 9.09	7.5 ± 2.96
Xiphinema sp.	106.66 ± 10.82	1.5 ± 1.147	78.0 ± 18.32	67.16 ± 8.82	7.83 ± 3.15

Table 2. ANOVA for two factor data.

Source of variation	SS	df	MS	F	P
Treatments	149624.06	4	37406.016	67.97	0.001
Species	1648.46	2	824.233	1.497	n.s
T × S	10640.53	8	1330.066	2.417	0.05
Error	41269.83	75	550.2	–	–
Total	203182.9	89			

DISCUSSION

Both the doses 2 and 3 of Turtob-F reduced the population of *Tylenchorhynchus annulatus* Golden, 1971; *Hoplolaimus pararobustus* (Schuurmans Stekhoven and Teunissen, 1938) Filipjev and Schuurmans Stekhoven, 1941 and *Xiphinema* Cobb, 1913 as compared to control similar to the study of Renco *et al.* (2009). Turmeric release carbon compounds from root favours interactions of gram negative microbial population in the rhizosphere compared to the bulk soil (Kumar *et al.,* 2017). The major ingredients in turmeric are curcuminoids demelhoxycurcumin and bisdemelhoxycurcumin (Dosoky and Setzer, 2018). Wiratno *et al.* (2009) found that plant extracts assayed for nematicidal activity against *Meloidogyne incognita.* The extracts of tobacco, clove, betelvine and sweet flap were most helpful in killing nematode.

Turmeric active compound curcumin has a major antiflammatory and antioxidant properties besides various biological properties. Neeraj (2017) suggested that aqueous extracts of turmeric gave mortality of *Meloidogyne incognita* juveniles, depending on the concentration of extracts.

Tobacco plant contains unfavorable chemicals, including nicotine. In addition of nicotine, toxic chemicals like lead and cadmium are often found in soil where tobacco plant growth and fertilizers often nitrates. Active components probably include a mixture of phenols with known pesticidal properties working in an interactive manner.

Leffingwell (2001) stated that almost 3000 chemical constituents have been identified in tobacco leaf. The physical and chemical properties of leaf tobacco are influenced by genetics soil type, agricultural practices, water conditions. Plant disease, stalk position and finally harvesting and curing procedures, thus if any of this changes chemical composition is altered (Tso, 1990). Al-Sandooq *et al.* (2019) reported that Ginger rhizome extract (GE), Pumpkin seed extract (PE) and Curcuma rhizome extract (CE) all demonstrated active restrictions in penetration and root knot juveniles in root tissue, the activity of these three plant extracts against root knot juveniles may be due to activation of own defense mechanism which leads to produce compounds phytotoxins and proteins around the sites of penetration and thus restrict the development.

CONCLUSION

Because of successful control achieved by the organic amendment (Turtob-F) it can be recommended that organic products such as Turtob-F or other combinations of nematicidal plant can be used for effective management of nematodes. For further studies effect of Turtob-F on soil bacteria shall also be studied.

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(*Accepted for publication December 2020*)