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SHORT COMMUNICATION

ECO-FRIENDLY MANAGEMENT OF CEREAL CYST NEMATODE (*HETERODERA AVENAE*) IN WHEAT (*TRITICUM AESTIVUM*)

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SUMMARY

Wheat and barley occupy the most prominent position in terms of production and acreage in developing countries. Plant-parasitic nematodes are a well-recognized constraint to production of cereals in fields. Cereal cyst nematode, *Heterodera* spp., is known worldwide as parasites of wheat and grasses. Cereal cyst nematode can cause significant economic yield losses alone in combination with other biotic and abiotic factors. The damage caused by this nematode can be enormous when it occurs in a disease complex, particularly in areas subject to water stress. For managing this nematode, an experiment was conducted in earthen pots of 1 kg soil capacity under screen house condition during 2017-18. There were four treatments with three replications of each. Castor cake (10 g/pot) was mixed in soil 10 days before sowing (DBS). Neem oil @ 10 ml/kg seed was used as seed treatment. Among all these treatments, minimum number of cysts was observed in neem oil @10 ml/ kg seed treatment followed by castor cake @ 10 g/pot (10 DBS) and subsequently improved the plant growth parameters of wheat.

Key words : Cereal cyst nematode, wheat, management, neem oil and castor cake

India is an agriculture-oriented country and we depend on cereal as our food requirement. Among the cereals, wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*) occupy the most prominent position in terms of production, acreage, and source of nutrition, particularly in developing countries (Nicol *et al*., 2011). In India, during the 2020-21 *Rabi* season, wheat has been cultivated in 31.76 million hectares and barley covered 0.61 million hectares, constituting around 25 per cent of the total crop acreage (Director's Report, AICRP on Wheat and Barley, 2020-21). Productivity of wheat and barley is often compromised due to various environmental factors under abiotic stress and many types of insect-pest including nematodes under biotic stress. Among nematodes, cyst nematode genus *i.e.* Heterodera is one of the earliest discovered genera of plant-parasitic nematodes. In India, *Heterodera avenae* is the important species in wheat crops where it causes major economic losses causing "Molya Disease" in north Indian states. Plant-parasitic nematodes alone cause 10 % annual cereal crop losses (Kumar *et al*., 2021). In wheat, avoidable losses due to cereal cyst nematode, *Heterodera avenae*, in Rajasthan and Haryana (the major molya disease affected states) were calculated at Rs. 8967.52 million during 2014-15.

Since, *H. avenae* causes severe yield losses, efforts in the recent past have been initiated on the management of this nematode through organic amendments, host resistance, bio-agents and chemical. The application of organic matter to soil is known to have beneficial effects on soil nutrients, soil physical condition, soil biological activity, and crop performance. Application of organic materials to soil can cause a change in soil microflora and microfauna including soil nematodes. Nematodes, are the most ample and varied group of soil fauna. They are ever-present habitants of all soil types with high population densities. The changes in soil nematode fauna can results in an increase in the number of beneficial nematodes such as bacterial or fungal feeders and decrease and/or suppression in the occurrence of economically important plant parasitic nematodes. Present investigation was undertaken to develop effective and eco-friendly management practices for cereal cyst nematode, *Heterodera avenae* in wheat. This experiment was conducted in screen house conditions in Department of Nematology, CCSHAU, Hisar. Infested soil was collected from a farmer's field in Kharakheri village of Fatehabad district. The collected soil was washed by Cobb's Sieving and decanting technique; on 60 mesh sieve (pore size 250

µm). The initial inoculums level was adjusted to 10 cysts per kg soil. Sowing of susceptible wheat var. HD-2967 was done in Nov 2017 and five seeds of this variety were sown in pots. After one week of emergence thinning was done and two plants were maintained in each pot. Four treatments *viz*. T_1: Untreated check, T_2: Neem oil as seed treatment @ 10ml/kg seed, T_3: Castor cake @ 5g/kg soil 10 days before sowing + Neem oil @ 5ml/kg seed and T_4: Castor cake @ 10g/kg soil 10 days before sowing were replicated thrice in CRD design (Table 1). Castor cake was mixed in soil 10 days before sowing while neem oil @10 ml/kg seed was used as seed treatment. The pots without any castor cake and neem oil were treated as control. In general agronomic practices like watering and weeding was dome regularly. 110-120 days after sowing, each plant was uprooted carefully from soil. The roots were retrieved carefully and kept in a basin of water to clear it from adhering soil particles and recorded the observation such as plant growth characteristics (shoot length, root length, fresh shoot weight and fresh root weight) and also on nematode parameters such as number of cysts/plant. The root population was calculated on plants directly and soil population was counted by Cobb's Sieving and decanting technique.

Amongst all treatments, minimum number of cysts was observed in neem oil @10 ml/kg seed treatment followed by castor cake @ 10 g/pot, 10 days before sowing. While maximum number of cysts was recorded in control. Maximum fresh shoot weight (3.31 g) was observed in castor cake @10 g/pot, 10 DBS followed by neem oil @10 ml/kg seed treatment (2.99 g). Maximum root length (38 cm) was observed in castor cake @10 g/pot, 10 DBS followed by neem oil @10 ml/kg seed treatment (34 cm). Maximum shoot length (27 cm) was observed in by neem oil @10 ml/kg seed treatment followed by castor cake @10 g/pot, 10 DBS (25 cm) and minimum shoot length (19 cm) was recorded in control. Minimum growth parameters were recorded in control while castor cake @10 g/pot, 10 DBS subsequently improved the plant growth parameters of wheat.

TABLE 1
Effect of various treatments on cereal cyst nematode

Treatment Details	No. of cysts/ plants
Control check	61
Neem oil @10 ml/kg seed treatment	40
Castor cake @ 5 g/pot , 10 DBS + Neem oil @ 5 ml/kg as seed treatment	53.5
Castor cake @10 g/pot, 10 DBS	42

The use of organic amendments is effective and environmentally safe management of plant-parasitic nematodes and many other crop pests and pathogens (Atolani and Fabiyi 2020). Our results are in combination with that of Rajvanshi and Bishnoi (2013) who conducted an experiment in which six treatments were undertaken i.e. seed treatment with neem based formulations (Neem seed kernel power (NSKP) v/w 10% -Neemark v/w- 10%, Neem oil-10 mi/kg seed) and chemicals i.e. seed soaking (Carbosulfan 25 EC-2%) along with treated check (carbofuran 3G @1.5 kg a.i./ha) and untreated control (Farmer's practice). It was found that the number of cysts per 200 c/c soil were recorded in carbosulfan (18.6) that is at par with NSKP (19.0) followed by neemark (21.6), neem oil (31.0) and untreated check (43.3). All the treatments were showed significantly higher grain yield and reduced number of CCN counts per 200 cc soil over untreated check. Ammonia, glucocynate and allyl isothiocyanate are the factors involved in nematode

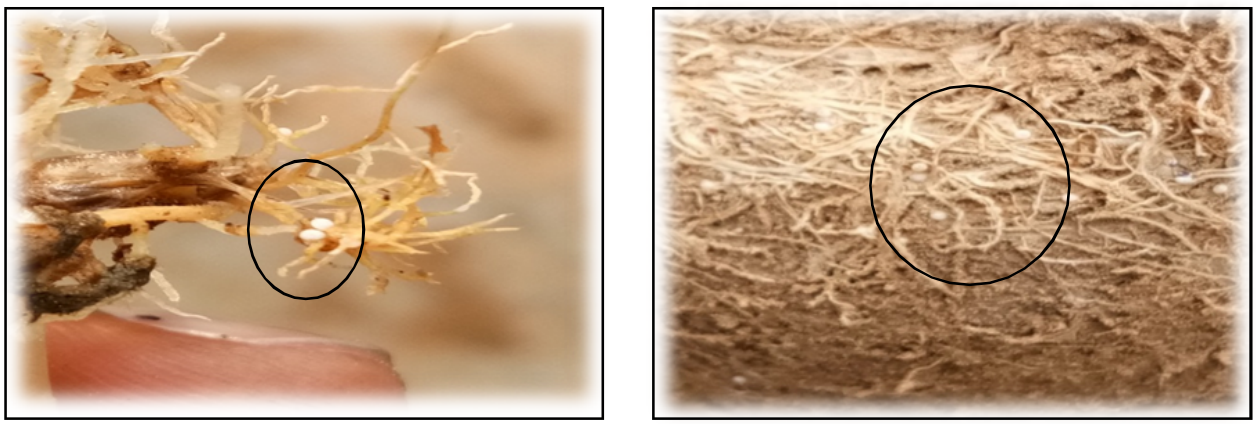

Plate. 1&2: Left: White female attach to the roots, Right: White cysts in bottom of pots.

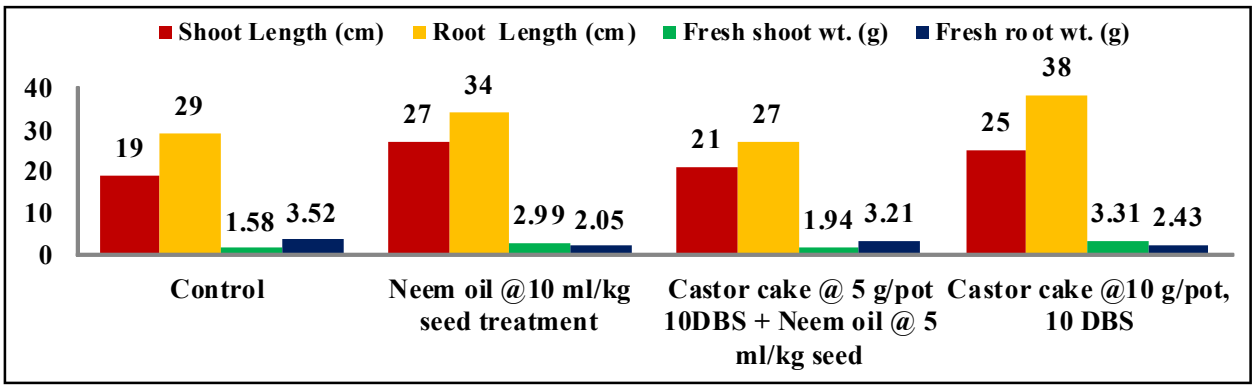

Fig. 1. Effect of organic amendments treatments on plant growth parameters of wheat.

control when organic amendments are applied (Srivastava 2002). Sitaramaiah and Singh (1978) who concluded that the least proliferation of nematodes in the plots treated with neem cake was reported on account of the liberation of fatty acid during decomposition, which is detrimental to the nematode. Neem cake is a non-edible, cheap and easily available oil cake. Besides being non-toxic and nonhazardous, it leaves no as such residual effects on the plant. Substances released as a result of decomposition of organic amendments do possess nematicidal properties. The neem cake has been noticed to be highly suppressive for the nematode soil population. Our results have been in accordance with the findings of others (Khan and Rathi 2001). Akhtar and Malik (2000) reported that organic soil amendments enhance the activities of microorganisms that are antagonistic to plant-parasitic nematodes. The decomposition of organic matter results in accumulation specific compounds that may be nematicidal. Control of plant-parasitic nematodes may be due to improvements of soil structure and fertility, alteration of the level of plant-resistance, release of nematoxic compounds and promote the growth of parasites (fungi and bacteria) and other nematode antagonistic soil organism.

CONCLUSIONS

The findings of our study showed that oil cakes used as organic amendments showed promising nematicidal activity and offered possibilities as non-chemical alternatives in the control of cereal cyst nematode. It remains to verify the potential benefits of oil cakes as soil amendments under field conditions through integrated nematode management. Then oil cakes soil amendments could have the potential to become part of an integrated approach to replace nematicides.

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