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Incidence of Plant-Parasitic Nematodes Associated with Polyhouses under Protection Cultivation in Haryana

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Abstract A survey of polyhouses in different districts of Haryana was conducted during 2015-16 to determine the incidence of important plant parasitic nematodes on vegetable crops mainly, cucumber (*Cucumis sativus*), tomato (*Lycopersicum esculentum*), chili and bell peppers (*Capsicum frutescens*) grown in polyhouses under protected conditions. Soil and root samples were collected from each polyhouse and analyzed mainly for the presence of plant parasitic nematodes. During the survey, nine important plant - parasitic nematodes genera viz., *Meloidogyne incognita, Pratylenchus* spp. *Rotylenchulus* spp. *Hoplolaimus* spp. *Helicotylenchus* spp. *Tylenchorhynchus* spp. *Ditylenchus* spp. were detected from soil samples. The infestation of each species was highly variable from polyhouse to polyhouse and within the polyhouse. However, root-knot nematode, *Meloidogyne incognita* was found to be the major plant parasitic nematode under protected conditions. Frequency of occurrence of root knot nematode was recorded to be 63.15% and population density range was 30-10000j2/200cc soil.Visual observations showed that foliage growth was not uniform in the polyhouse and stunted growth, chlorotic leaves and wilted plants with fewer fruits were in patches.

Keywords *Meloidogyne incognita, Pratylenchus* spp. *Rotylenchulus* spp. *Hoplolaimus* spp. *Helicotylenchus* spp.

Introduction

Haryana is a landlocked state in northern India. It is between 27°39′ to 30°35′ N latitude and between 74°28′ and 77°36′ E longitude. The altitude of Haryana varies between 700 and 3600 ft mean sea level. Polyhouse technology has vast scope in the state for growing off season vegetables, ornamentals and fruit nurseries. Further, shrinking land holdings, field work associated drudgeries and increased cost of cultivation with less yields in most of the areas is attracting the educated youths to adopt this technology for quality produce and high returns over

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per unit area. As a result, more and more area under polyhouse cultivation is being added every year. Growing of horticultural crops in polyhouses under protected cultivation is becoming very popular among the farmers throughout the country. Large numbers of polyhouses are being erected in Haryana under the ages of National Horticulture Mission to grow short duration crops. The farmers are getting very good returns from this technology, largely due to the utilization of vertical area of the field, protection from insectpests and diseases and controlled environmental conditions. Though in the polyhouses, crops are grown under protected conditions, yet the crops are not protected even under protected conditions. Polyhouse cultivation involves intensive cultivation of crops, optimum use of fertilizers and frequent use of irrigation, but continuous growing of the same crop with high day temperature and relative humidity within the greenhouse, polyhouse and low tunnel along with poor plant hygienic conditions inside and outside the green house increase problem of soil borne pests and diseases including plant parasitic nematodes [1] which results in the availability of ideal conditions for the growth and multiplication of these pests. In polyhouses, three types of crops are grown, viz. vegetable crops such as cucumber, capsicum, tomato, chilli, okra, gherkins, musk-melon, watermelon, ornamental crops such as carnation, roses, gerbera, chrysanthemum and fruit crop like strawberry, are being grown under protected conditions. Such protected environment provides suitable and congenial microclimate for the multiplication of various biotic stresses such as nematodes, insects, diseases. During preliminary survey in some of the polyhouse in Haryana crops were observed to be severely infested with root knot nematode (*Meloidogyne incognita*). The present studies were planned with the objectives to map out the incidence of *M. incognita* and also to record other plant parasitic nematodes associated with crops and to estimate frequency of occurrence and population density being incurred by root knot nematode mainly in Polyhouse in Haryana.

Materials and Methods

Soil samples from the rhizophere of plants of different crops (along with their roots) (Table 1), vegetable and ornamental crops being raised under polyhouses in different districts of Haryana were collected during 2015-16. Nematodes were processed separately from roots and soil for each of the samples collected. The soil samples (200cc) were analysed by Cobb's decanting and sieving technique followed by modified Baermann method [2] for nematode population [3]. The nematode suspensions were collected in beakers, allowed settling for two hours and the supernatant poured off. The final volume, which was *ca* 1-1.5 ml for each suspension, was poured into a 7 ml vial and hot (70 °C) formalin (4%) added. The vials were maintained in a fridge at 4 °C until nematodes were identified and their population densities assessed. For the estimation of root population, roots were cut into small bits (about 0.5 cm long) and stained in boiling lactophenol, containing 0.1% acid fuchsin. After washing the excess of stain in water, the roots were put into lactophenol for overnight and were observed under microscope. During survey, 3-5 plants from each polyhouse were uprooted randomly and examined for knowing the severity of galling, if present. Galling severity was rated as : Very high (>75% of the roots galled), high (50 to 75% of the roots galled), medium (25 to 50% roots galled) and low (up to 25% roots galled). Data on nematode population, galling severity at the crop end and yields were recorded and compared. The roots were rates for nematode galling on a 0-5 scale (0=no galling, 1=trace infections with a few small galls, 2 = <25% of roots galled, 3. =25—50% of roots galled, 4 = 50—75% of roots galled, 5 = >75% of roots galled) for the identification of root knot nematode perineal pattern would observed was done.

Results and Discussion

Survey results of nematodes associated with different crops in two districts (Rewari and Jajjhar) of Haryana are detailed in Table 1. It can be seen from the table polyhouse growing five crops (Sweet pepper, tomato, cucumber, carnation, gerbera and chili) were surveyed. Three genera of plant parasitic nematode i.e. *M.incognita, Pratylenchus* spp. and *Helicotylenchus* spp. were recorded to be predominant. Out of these three nematode species were recorded to be present in all the districts with varying frequencies whereas *Pratylenchus* spp. was encoun-

Table 1. Frequency of occurrence and population density of root-knot nematode in different districts of haryana.

Districts	Total number of samples collected	*Meloidogyne incognita* Number of infested samples	Frequency of occu-rrence (%)	Density range	*Pratylenchus* spp. Number of infested samples	Frequency of occu-rrence (%)	Density range	*Helicotylenchus* spp. Number of infested samples	Frequency of occu-rrence (%)	Density range	Other plant parasitic nematodes
Rewari	19	13	68.42	30-10000	6	31.67	40-80	2	10.52	35-400	*Longidorus* spp. *Tylenchorhynchus* spp. *Psilenchus* spp. *Hoplolaimus* spp. *Hirschmanniella* spp. *Ditylenchus* spp.
Jajjhar	24	11	57.89	40-8990	8	42.10	25-100	3	15.57	30-150	*Tylenchorhynchus* spp. *Hoplolaimus* spp. *Longidorus* spp.
Average			63.15%			36.83%			13.04%		

tered in this districts also. The population density of *M. incognita* in different districts ranged from30-10000 J/200cc soil (incidence =63.15%).The soil population (per 200 cc soil) of *Pratylenchus* spp. and *Helicotylenchus* spp.varied from 40-80 (incidence =36.83%) and 35-400 (incidence = 13.04%). Severity of galling of root knot nematode was rated as very high, high, medium, and low in 31, 41, 31 and 48 polyhouses, respectivly observed on the roots. During survey, we came across certain observations i. e. (i) some of the farmers were using high dosages of carbofuran/phorate for the control of nematodes indiscriminately without bothering for the residue problem. (ii) In general, the nematode infestation was less in newly operationalised greenhouses and more in the older ones (iii) Very high galling of roots along with infection of other microorganisms (nematodebacteria/fungi complex) was found to be associated with the poor crop stand in some cases (iv) Farmers do not have the awareness about the nematode problems in their crops. As mentioned above *M. incognita*, *R. reniformis* and *Helicotylenchus* spp. were found to be the major plant parasitic nematodes associated with nurseries as well as with crops in the greenhouse crops being grown in the State. All these nematode genera are reported to be economically important in greenhouse cultivation [4—11]. The information on the quantification of losses in polyhouse tomato is scanty. Losses in this crop ranging from 14 to 44% by Charchar and Argo [5] and 25 to 45% by Sharma et al. [10] have been documented. The presence of three plant parasitic nematodes including *Meloidogyne incognita*, *Helicotylenchus dihystera* and *Pratylenchus* spp. in the main crops with their populations ranging from 8 to 5604 J2, 15 to 2560 and 5 to 795 individuals/200 cc soil, respectively. *M. incognita* was observed to most alarming. Avoidable losses due to this nematode in greenhouse tomato were estimated to be 11.31% during 2008-09 [12]. The presence of nine species of plantparasitic nematodes viz., *Aphelenchus avenae, Helicotylenchus dihystera, Hoplolaimus columbus, Meloidogyne javanica, M. incognita, Pratylenchus penetrans, Radopholus similis, Tylenchorhynchus claytoni* and *Xiphinema* sp. Frequency and density of each species were highly variable from field to field and within the fields [13]. Major plant parasitic nematodes are widely distributed on vegetable crops cultivated under polyhouses in the Harayana. This information on nematode occurrence on vegetable crops will be helpfull for growers for planning and administering nematode management strategies to reduce the nematode populations below their threshold levels (Table 2). This study also demonstrated that the presence of many economically important

Table 2. Occurrence of root-knot nematode in different districts of haryana.

Dist	No. of villages surveyed	Incidence No. of polyhouse surveyed	No. of polyhouses infested with root-knot nematode	Infested polyhouse (%)	Intensity of root-knot infestation
Rewari	10	21	14	66.66	High
Jajjhar	12	25	13	52.00	Moderate

plant-parasitic nematodes are associated with Haryana vegetable plantings but particularly those within polyhouses where replanting is commonly on a fast cycle. This study further suggests that magnitude of nematode problem in polyhouses planted crops needs serious consideration to tackle by the use of useful nematode management strategies.

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