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Phytoparasitic nematodes associated with chickpea crop in Bundelkhand region of Uttar Pradesh and Madhya Pradesh

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Chickpea is one of the most important pulse crops grown in India. It is cultivated as a post rainy season crop over an area of 8.21 m ha with production of 7.8 m tonnes. Its average productivity is 911 kg/ha (Anonymous 2008). Bundelkhand is the major pulse growing semi arid area of Uttar Pradesh and Madhya Pradesh. The rainfall in this region is variable and ranges from 650-950 mm annually. The soils of this area are mostly black and heavy with more clay. In this region, chickpea is grown over an area of about 0.62 m ha with production of 0.51 m tonnes (Anonymous 2009). The productivity of chickpea is 823 kg/ha which is low compared to national average productivity of 911 kg/ha. Pest and diseases are important factors responsible for the low productivity of chickpea (Grewal 1988). This crop is attacked by number of insect pests, diseases and nematodes. Among nematodes, root-knot nematodes have been reported to infested chickpea in different part of India (Ali and Sharma 2003, Sharma *et al*. 1992) causing severe damage to the crops mainly in lighter soils. The information on nematode parasites of chickpea in Bundelkhand region is lacking. Therefore, study was undertaken to find out the phytoparasitic nematodes associated with chickpea in this region.

A survey was carried out covering districts of Hamirpur, Mahoba, Banda, Jalaun, Jhansi and some adjoining districts such as Kanpur and Fatehpur in Uttar Pradesh and Tikamgarh district in Madhya Pradesh during 2008-2011. The samples were collected during the months of January-February when the crop was in flowering stage. From each field, five random soil samples up to depth of 15-30 cm were collected. Soil was mixed thoroughly to make composite sample. Root samples of 10-20 g were collected from 4 to 5 randomly selected plants. About 250 g soil along with root samples was collected in polyethylene bags, properly labelled and taken to Nematology Laboratory, Indian Institute of Pulses Research, Kanpur for further analysis of samples for identification and quantification of plant parasitic nematodes. In total, 77 samples were collected from chickpea fields. Each soil sample was thoroughly mixed and a 100 cm^3 sub-sample was processed for nematode extraction using Cobb's modified decanting and sieving technique (Southey 1986). The nematode genera present and their density was recorded under stereoscope microscope by taking one ml nematode suspension in counting dish thrice and averaging and multiplying with total volume of nematode suspension. Absolute and relative frequencies, absolute and relative densities and prominence values (PV) for all nematode genera in Bundelkhand region and district wise for three prominent genera were calculated as per the formulae given by Norton (1978). Chickpea roots collected from different fields were stained in boiling acid-fuschin lactophenol for 30 to 45 seconds depending up on the

Table 1 Nematode genera encountered in chickpea fields in Bundelkhand region with their frequency, relative frequency, absolute and relative densities and prominence values

Nematode genera	Absolute density (Nematodes/ 100 cc soil)	Relative density (%)	Absolute frequency (%)	Relative frequency (%)	Prominence value
Pratylenchus	574.7	48.7	54.5	18.1	424.4
Tylenchorhynchus	210.3	17.8	61.0	20.3	164.3
Hoplolaimus	166.9	14.2	39.0	12.9	104.2
Tylenchus	91.6	7.8	45.5	15.1	61.7
Helicotylenchus	43.8	3.7	22.1	7.3	20.6
Filenchus	25.0	2.1	19.5	6.5	11.0
Basiria	20.8	1.8	11.7	3.9	7.1
Aphelenchus	13.3	1.1	16.9	5.6	5.5
Rotylenchulus	10.7	0.9	13.0	4.3	3.9
Scutellonema	14.2	1.2	6.5	2.2	3.6
Boleodorus	10.4	0.9	3.9	1.3	2.1
Basirolaimus	8.8	0.7	3.9	1.3	1.7
Hemicycliophora	1.4	0.1	1.3	0.4	0.2
Paratylenchus	1.4	0.1	1.3	0.4	0.2

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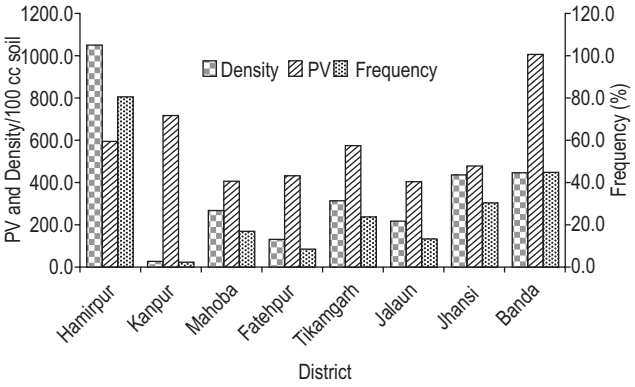

Fig 1 District wise frequency, density and prominence values of *Pratylenchus* in chickpea

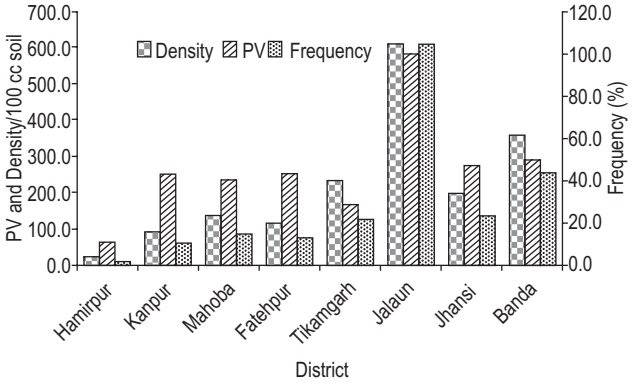

Fig 3 District wise frequency, density and prominence values of *Hoplolaimus* in chickpea

hardiness of the roots. Excess stain was removed by adding plain lectophenol and kept for at least 48 hours before observing under microscope for nematode infection.

Fourteen nematode genera observed in soil samples collected from chickpea fields were identified as *Pratylenchus, Tylenchorhynchus, Hoplolaimus, Tylenchus, Helicotylenchus, Filenchus, Basiria, Aphelenchus, Rotylenchulus, Scutellonema, Boleodorus, Basirolaimus, Hemicycliophora and Paratylenchus. Pratylenchus* was observed as the most prominent nematode (PV 424.4) compared to all other nematode genera observed in the soil samples. Its absolute and relative frequencies of occurrence were 48.7 and 18.1%. The absolute and relative densities 574.7 nematodes/100 cc soil and 46.7% were highest among all the nematode genera recorded in soil samples (Table 1).

District wise analysis of prominence values, frequencies and densities of *Pratylenchus*, *Tylenchorhynchus* and *Hoploalimus* showed that *Pratylenchus* was most prominent in Hamirpur district (PV 805.5) followed by Banda (PV 440.0) and Jhansi districts (PV 297.1). It was minimum (PV 18.7) in Kanpur district (Fig 1). The frequency of occurrence of *Pratylenchus* was recorded highest (100%) in Banda followed by Kanpur (71.4%) and Hamirpur (59.3%). Highest density of *Pratylenchus* (1046.4 nematode/ 100 cc soil) was recorded in Hamirpur followed by in Banda (440 nematodes/100 cc soil) and Jhansi (433 nematodes/100 cc soil). Contrary to *Pratylenchus*, *Hoplolaimus* was observed least prominent in Hamirpur with prominence value 7.4, frequency 11% and density 22 nematode/100 cc soil. It was most prominent in Jalaun district with prominence value 640, frequency 100% and density 640 nematode/100 cc soil (Fig 2). *Tylenchorhynchus* was most prominent in Jhansi district with prominence value 227.4, frequency 52.9% and density 312.6 nematodes/ 100 cc soil followed by Fatehpur where its prominence value was 206, frequency 85.7% and density 222.9 nematodes/100 cc soil. It was least prominent in Tikamgarh district of Madhya Pradesh with prominence value 59.9, frequency 42.9% and density 91.4 nematodes/100 cc soil (Fig 3).

Tylenchorhynchus was observed second most prominent nematode genus after *Pratylenchus* with prominence value 164.3, absolute frequency 61.0% and absolute density 210.3 nematode/100 cc soil. *Hoplolaimus* was observed in 39% of samples and absolute density was recorded 166.9 nematodes/100 cc soil. Its prominence value was 104.2. Other nematode genera were present in few samples with very low density. *Tylenchorhynchus* spp. have been reported associated with chickpea in India, Syria, Pakistan, Netherland, Spain, Kenya, Tunisia and Morocco, whereas *Hoplolaimus* sp. associated with chickpea is reported from India only (Nene *et al.* 1996). Although, high populations of *Tylenchorhynchus* and *Hoplolaimus* are observed in chickpea field, but how much damage they are causing to

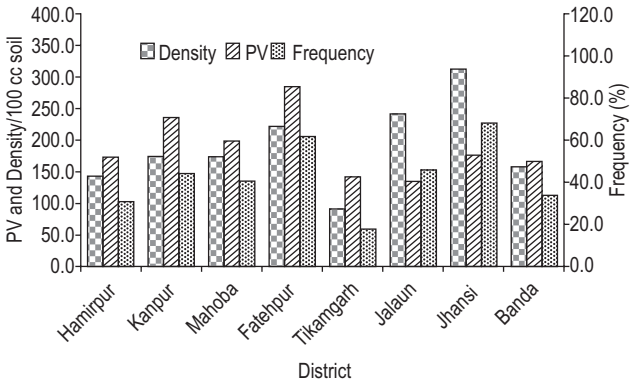

Fig 2 District wise frequency, density and prominence values of *Tylenchorhynchus* in chickpea

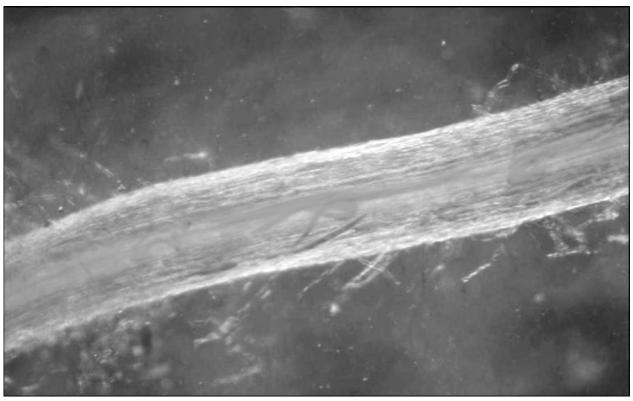

Fig 4 *Pratylenchus* observed inside the chickpea root

Fig 5 Root infested with *Pratylenchus*

Fig 6 Field infested with *Pratylenchus*

chickpea plants is not known and needs to be worked out.

Pratylenchus were observed infecting chickpea roots (Fig 4). Black spots and reduction in root biomass was observed in roots infected with *Pratylenchus* (Fig 5) which resulted retarded and sparse growth of chickpea plants. Drying of lower leaves was common in infested chickpea fields (Fig 6). Similar observations due to *Pratylenchus* infection have been made by Castillo *et al.* (2008). They reported *Pratylenchus* damage in patches with affected plants showing stunting, chlorosis of leaves, root necrosis and reduction in root growth and shoot weight under field conditions. High population of *Pratylenchus* in chickpea fields were observed during the survey in the region which is mostly rainfed. The presence of high population in rain fed area support the observation by Thompson *et al*. (2008) that once high population of *P. thornei* are established in a field, they can survive very long fellow periods, particularly in subsoil and can rapidly increase to damaging levels on susceptible host crops.

Root-knot nematodes, the most widely distributed nematodes were not observed in any of the soil samples collected from Bundelkhand. Light and sandy textured soils favour root-knot nematodes. In Bundelkhand, chickpea is grown mostly on black and clayey soils which may be unfavourable to the development of root-knot nematodes. *Pratylenchus* has also been earlier reported in chickpea grown in heavy soils from Madhya Pradesh (Tiwari *et al*. 1992) and Vidarbha region of Maharashtra (Varaprasad and Sharma 1997). Wheat, chickpea, mungbean and maize are good host of *P. thorne* (Thompson *et al*. 2008). *Pratylenchus* being wide spread in chickpea fields with root infection needs to be worked upon to find out its management to avoid losses caused due to this nematode. Along with other management options, use of crop rotation for managing this nematode needs very critical evaluation as both pulses and cereals are hosts of this nematode contrary to root-knot nematodes where cereals being poor or non-hosts are rotated with pulses.

SUMMARY

A survey under taken to find out phytoparasitic nematodes associated with chickpea in Bundelkhand region of Uttar Pradesh and Madhya Pradesh revealed fourteen nematode genera associated with chickpea. Nematode genera associated were *Pratylenchus, Tylenchorhynchus, Hoplolaimus, Tylenchus, Helicotylenchus, Filenchus, Basiria, Aphelenchus, Rotylenchulus, Scutellonema, Boleodorus, Basirolaimus, Hemicycliophora and Paratylenchus. Pratylenchus* was most prominent nematode genera observed with prominence value 424.4, Absolute frequency 48.7% and absolute density 574.7 nematode/100 cc soil. This was followed by *Tylenchorhynchus* and *Hoplolaimus*. *Pratylenchus* was also observed in roots of chickpea. The root infection in field was evident with sparse and patchy growth with drying of basal leaves. *Pratylenchus* was most prominent in Hamirpur district prominence value 808.5 followed by in Banda and Jhansi districts with prominence value 440 and 297.1, respectively. *Tylenchorhynchus* was most prominent in Jhansi followed by in Fatehpur and Jalaun districts with prominence values 227.4, 206.3 and 153.7, respectively. Similarly, *Hoplolaimus* was most prominent in Jalaun district with prominence value 609.0 followed by in Banda and Jhansi districts with prominence values 254.6 and 134.8, respectively.

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