NEMATODE SURVEY OF CHICKPEA PRODUCTION AREAS IN RAJASTHAN, INDIA

S.S. Ali[1] and S.B. Sharma[2]

[1] *Indian Institute of Pulses Research, Kanpur - 208 024, India*
[2] *International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Patancheru - 502 324, India*

Summary. Random surveys were taken in chickpea fields in Rajasthan, which is an important pulse growing state in India. Infestations due to *Meloidogyne incognita* and *M. javanica* were observed in sandy soils of Jaipur, Jhunjhunu and Swai Madhaopur both in rainfed and irrigated situations estimating 20-30% yield loss. Monocropping of chickpea supported higher populations of root-knot nematodes than cereals-chickpea cropping system. *Heterodera swarupi* was reported for the first time on chickpea and its incidence was recorded from Ajmer, Alwar, Bikaner, Jaipur, Nagaur, Sikar, Jhunjhunu, Swai Madhopur and Tonk districts. The lesion nematodes (*Pratylenchus thornei* and *Pratylenchus* spp.) were predominant in north eastern region and were associated with *Rhizoctonia bataticola*. District wise distribution of pathogenic species are also provided.

Chickpea is a widely cultivated cool-season grain legume in India and accounts for more than 43% of the world's chickpea production. It is mainly grown in soils with residual moisture in the post rainfall season as a sole crop or as a crop mixed with wheat, mustard and sorghum. Rajasthan State is an important chickpea growing region in India with over one million ha cultivated thus ranking third both in area and production (Anonymous, 1995).

Many species of plant parasitic nematodes are present in the major chickpea growing regions of India and some of these species are highly damaging to chickpea production (Sharma *et al.*, 1993; Ali, 1995). In Rajasthan, three species of the root-knot nematodes (*Meloidogyne* spp.) have been reported to be associated with chickpea (Mathur *et al.*,1969; Ali, 1995). There is, however, a lack of information on the distribution and abundance of plant parasitic nematodes in the major chickpea growing regions of Rajasthan.

The objective of this study was to investigate the distribution of plant parasitic nematodes that are potentially important to chickpea cultivation in Rajasthan.

MATERIALS AND METHODS

Surveys were conducted in the major chickpea growing districts of Rajasthan in February 1996. The 11 districts that were identified for surveys included Ajmer, Alwar, Bikaner, Churu, Ganganagar, Jaipur, Jhunjhunu, Nagaur, Swai Madhopur, Sikar and Tonk. More than 80% of the total chickpea production in Rajasthan (Anon., 1995) are raised in these districts. The survey covered physiographic zones of arid western plains, irrigated north western plains, transitional plains of inland drainage, semi-arid eastern plains, and flood-prone eastern plains of Rajasthan. The soil type in these districts ranged from desert sandy soils to clay loam. The maximum temperature ranges from 38 °C to 49 °C, in Churu, Sikar and Bikaner districts while, the minimum temperature falls below zero degree. Chickpea cultivars GNG 146 wilt resistant, GNG 149 *Aschochyta* blight resistant, GNG 114, Kabuli gram, RS 10, RS 11 and local land races are widely cultivated in the surveyed districts.

Soil and root samples were collected at random from the rhizosphere of chickpea plants in February when the plants were in the flowering stage at most of the 141 locations. The samples were collected from individual fields from villages within tehsils (administrative subunit of a district) of each of the 11 districts. Samples were drawn from cropping systems prevailing in the region like pearlmillet (*Pennisetum glaucum* L.), chickpea (*Cicer arietinum* L.)–mungbean [*Vigna radiata* (L.) Wilczek], groundnut (*Arachis hypogaea* L.)-chickpea, mothbean [*Vigna acontifolia* (Jacq) Marechal]-chickpea + sesame (*Sesamum indicum* L.), chickpea + mustard (*Brassica rapa* L.), fallow-chickpea. Composite samples were collected 15-20 cm deep with a 20 cm long soil sampler. Each soil sample comprised 5-10 soil cores while root samples consisted of 10-15 g of randomly selected roots. When the samples were being collected, the farmers and villagers were interviewed to collect data on previous crop history, cropping pattern, fertilizer, irrigation and pesticide inputs. Wherever possible, data on easily identifiable pests and diseases were also collected.

In the laboratory, nematodes were extracted from 100 cm^3 soil samples by sieving and decanting method and modified Baermann funnels. Cysts were collected from soil and roots on a 180-µm pore (80 mesh) sieve. The cysts of *Heterodera* spp. were hand-picked and eggs and juveniles in the cysts were counted. Root-knot nematode females (*Meloidogyne* spp.) were extracted from the galls and species identification was based on perineal pattern morphology. The nematode populations were identified and their numbers were assessed using a binocular microscope.

Data on nematode population densities were analysed to assess the average density of each nematode species, and frequency of occurrence in each district.

RESULTS

Species of nematodes found in chickpea rhizosphere were *Aphelenchoides* sp., *Basiria* sp., *Boleodorus* sp., *Criconemoides* sp., *Heterodera swarupi* Sharma *et al.*, *Helicotylenchus dihystera* (Cobb) Sher, *H. indicus* Siddiqi, *H. retusus* Siddiqi *et* Brown, *Helicotylenchus* spp., *Hoplolaimus* spp., *Hemicriconemoides cocophilus* (Loos) Chitwood *et* Birchfield, *Macroposthonia ornata* (Raski) De Grisse *et* Loof, *Malenchus* spp., *Meloidogyne incognita* (Kofoid *et* White) Chitw., *M. javanica* (Treub) Chitw., *Merlinius brevidens* (Allen) Siddiqi, *Merlinius* sp., *Paratylenchus* spp., *Pratylenchus thornei* Sher *et* Allen, *Pratylenchus* spp., *Rotylenchulus reniformis* Linford *et* Oliveira, *Tylenchorhynchus mashhoodi* Siddqi *et* Basir, *Tylenchorhynchus* spp., *Tylenchus* spp. and *Xiphinema* sp. Species of *Meloidogyne, Rotylenchulus, Tylenchorhychus, Helicotylenchus, Hoplolaimus* and *Merlinius* were ubiquitous and were found in almost all the districts except in desert sandy soil.

M. javanica was widespread in the eastern region of the state. While roots infected with *M. incognita* were generally devoid of rhizobium nodules. Severe damage to chickpea roots due to root-knot nematode infection was observed in the northeastern region and irrigated north western plains.

The highest number of root-knot nematodes was recovered from Jaipur district which was identified as the most heavily infested (100% frequency) followed by Jhunjhunu district with 66% frequency, although the percentage of root-knot infested root samples were 78% in Swai Madhopur. The lowest root-knot nematode population was recovered from Bikaner.

Lesion nematodes (*Pratylenchus thornei* and an unidentified *Pratylenchus* sp.) were predominant mainly in the northeastern region and flood-prone eastern plains of the state. Lesion nematodes were extracted in large numbers from roots having extensive dark brown and black areas. These nematodes are a limiting factor to chickpea cultivation in Ajmer, Ganganagar, Jhunjhunu, Nagaur, Alwar, Tonk and Jaipur districts. In Swai Madhopur 92.8% frequency of occurence of infestation of lesion nematodes was recorded, while Sikar district was least infested by this nematode.

At least four species of cyst nematodes were found in soil samples. Preliminary investigations based on cone top morphology revealed that the cysts were of *Heterodera avenae* Wollenweber, *H. cajani* Koshy, *H. graminis* Stynes and *H. zeae* Koshy, Swarup *et* Sethi. Unidentified cysts later described as *Heterodera swarupi* (Sharma *et al.*, 1998) were found attached to the roots of chickpea in one location in Ajmer. Pathogenicity tests in the glasshouse showed that chickpea is a good host for this species. *H. swarupi* was dominant in Alwar, Jhunjhunu, Ajmer. Its highest population was recovered from Alwar district while minimum from Swai Madhopur and Tonk districts respectively.

Reniform nematode infestations on chickpea were greater in Jhunjhunu district followed by Ajmer district while it was absent in desert sandy soils of Bikaner and Churu districts.

The average population of the stunt nematode (*Tylenchorhynchus* sp.) was highest in Ajmer district while minimum in Bikaner district. The spiral nematodes (*Helicotylenchus* sp.) were very widespread and recorded in all the districts sampled.

DISCUSSION

Chickpea is one of the major pulse crop of the winter in India and is highly susceptible to root-knot, lesion and reniform and other ectoparasitic nematodes (Ali, 1995) with an estimated 20-25% yield loss in Rajasthan. Root-knot nematode is also posing a threat to the cultivation of chickpea in other chickpea growing regions of the country where 15-20% yield losses are incurred (Ali, 1992; 1995).

Lesion nematodes are predominant where chickpea is grown as a monocrop in loamy and clay soils or pearl millet-chickpea cropping system in rainfed situations or when chickpea is intercropped with mustard in irrigated conditions (Ali, 1995; 1997). Lesion nematodes are emerging as a new problem in the cultivation of this crop and are associated with dry root-rot of chickpea caused by *Rhizoctonia bataticola* in Churu, Bikaner, Ganganagar, Nagaur and Sikar districts of Rajasthan.

H. swarupi was reported for the first time on chickpea in Rajasthan (Sharma *et al.*, 1998). The incidence of the chickpea cyst nematode, *H. swarupi*, on chickpea was reported from Ajmer, Alwar, Bikaner, Jaipur, Jhunjhunu, Nagaur, Swai Madhopur, Sikar and Tonk districts of Rajasthan and in high number at a few places indicating that chickpea may be a good host.

ACKNOWLEDGEMENT

The senior author thanks Mr. Naimuddin, Pulse Pathologist of the Institute, for isolation and identification of *Rhizoctonia bataticola* from chickpea root samples. He is grateful to the Director, Indian Institute of Pulses Research, Kanpur, India, for providing facilities and encouragement the present investigation.

LITERATURE CITED

Ali S.S., 1992. Estimation of yield losses in certain pulse crops due to root-knot nematode. First Afro-Asian Nematology Symposium, Afro-Asian Society of Nematologist. Aligarh Muslim University, Aligarh, India Nov. 29-Dec. 3, (Abstr.) p. 39.

Ali S.S., 1995. Nematode problems in chickpea. Indian Institute of Pulses Research, Kanpur, India 184 pp.

Ali S.S., 1997. Status of nematode problems and research in

India. Pp. 74-82. *In*: Diagnosis of key nematode pests of Chickpea and Pigeonpea and their management (S.B. Sharma ed.). International Crops Research, Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh, India.

Anonymous, 1995. Distribution Area and Production of Gram. Part-II, Statistical Table 1. *Agricultural Situation in India.* (1991-92), *52*: 367-370.

Mathur B.N., Handa D.K. and Singh H.G., 1969. Note on the occurrence of *Meloidogyne arenaria* as a serious pest of *Cicer arietinum*. *Madras Agricultural Journal*, *56*: 744.

Sharma S.B., Siddiqui M.R., Fazul Rahman P., Ali S.S. and Ansari M.A., 1998. Description of *Heterodera swarupi* sp. n. (Nematoda: Heteroderidae), a parasite of chickpea in India. *International Journal of Nematology*, *8*: 111-116.

Sharma S.B., Singh O., Pundir R.P.S. and McDonald D., 1993. Screening of *Cicer* species and chickpea genotypes for resistance to *Meloidogyne javanica*. *Nematologia Mediterranea*, *21*: 165-167.

Accepted for publication on 9 June 2003.