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Diversity of nematodes population in cumin (*Cuminum cyminum*) crop in semi arid regions of Rajasthan, India

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ABSTRACT

The survey was conducted in cumin crop at farmer's field of Ajmer district of Rajasthan, India during 2013-14 and 2014-15 to assess the crop suffered from multiple nematodes infestation. Total 90 cumin (*Cuminum cyminum* L.) plant samples were collected in two years from 18 villages across 5 development blocks. Among all collected samples, 63 were found infested with different species of nematodes. Highest numbers of samples contain nematodes populations recorded from Pisangan block of Ajmer district, whereas minimum number of samples infested with nematodes population was found in Kekri block. There were three different species of nematodes associated with cumin root namely *Pratylenchus thornei, Hoplolaimus indicus* and *Meloidogyne incognita.* The nematode species *P. thornei* and *H. indicus* were found for first time in cumin field causing damage to the root of the plant.

Key words: Cumin, *Cuminum cyminum*, *Hoplolaimus indicus*, *Pratylenchus thornei, Meloidogyne incognita*

Seed spices are low volume, high value and export oriented crop and earn significant amount of foreign exchange. Cumin (*Cuminum cyminum* L.) is one of most significant seed spice crop grown in semi arid area of the country. India occupies first in production and consumption of cumin in the world. It contributes about 70% in the total world production. The export of cumin during 2014-15 from India crossed more than ₹ 1600 crore (Singh and Solanki 2015).The area under cumin cultivation during 2012-13 was 593980 ha with production of 394328 tonnes. In India, Rajasthan and Gujarat are major cumin producing state contributing more than 90% of total cumin production in India (Singh *et al.* 2013). Cumin crop suffer from numbers of insect pests and diseases and nematode problem which causes significant yield losses at field level. Root knot nematode (*Meloidogyne* spp.) has been reported on cumin and fennel crop (Kant *et al.* 2013 and Patel 2011). Recent outbreak of diseases like yellowing, drying are known symptom of nematodes population in the soil of affected fields. The present investigation was a survey conducted for two years in cumin fields to determine the presence of nematodes population and affecting plant health in a major producing area of semi arid Rajasthan that fall under semi arid eastern plain zone of central plateau and hill region of India.

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MATERIALS AND METHODS

The study of nematodes population from cumin fields was undertaken in Ajmer district of Rajasthan. The samples cumin crop plants were collected at vegetative stages of crop during January months. The samples were collected from five development block covering 12 villages. Total 32 samples were collected during 2013-14 and 58 samples during 2014-15 (Table-1). The cumin plant showing wilting/drying symptoms were uprooted and taken to laboratory under aseptic poly pouches for studies. The selected plants roots were cut and placed in plastic vials of 250ml, for further studies in the laboratory. The roots showed swell/knot formation were collected and placed separately in the vials. The all infested roots/plants were first examined for their physical appearance and growth in relation to healthy plants. The all roots of a plant were cut in 5 cm in size using scissors and placed in 50 ml of water for release of nematode populations. The roots were soaked in distilled water for 24 hour and kept at $30^0 \pm 1^0$C in BOD incubator for nematodes release. Five ml of water suspension of each sample was taken for study of nematode count under stereo binocular microscope at 10 x magnification. Numbers of gall formation on roots/lesion formation counted separately on 5 cm of roots of infested plants. Thus the average numbers of

Table 1 Area wise sample collection of cumin field

Development block	Village	No. of Samples collected	
		2013-14	2014-15
Pisangan	Pabuthan	4	5
	Lidi	2	3
	Rampura	3	4
	Makrera	1	4
	Budhwara	2	2
	Dabala	1	3
Masuda	Masuda	2	4
	Bagaliyawas	2	3
	Shergardh	1	4
Nasirabad	Sanodh	3	4
	Derathu	2	5
Vijaynagar	Mathaniya	1	2
	Ratakot	1	3
	Dolatapura	1	2
Kakari	Jugpura	2	3
	Ajagara	1	3
	Bokla	1	2
	Anandpura	2	2
Total		32	58

nematodes population per development block were worked out. Samples of isolated nematodes population were sent to Department of Nematology, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India for identification of nematode species in cumin roots.

RESULTS AND DISCUSSION

The study of nematodes population diversity on cumin crop was examined across all five development block of Ajmer district of Rajasthan. Cumin plants collected from all five development block the district. Total 90 samples were collected during 2013-14 and 2014-15, in which 33 samples collected from Pisangan block,16 from Masuda block, 17 from Nasirabad block,10 from Vijay Nagar block and 16 from Kekri block (Table 2). The result showed that across all surveyed areas nematodes population were recorded from cumin roots samples. Among the total collected samples, 63 samples were found infested with different species of nematodes. Highest number of samples contain nematodes populations were recorded from Pisangan block (100%) followed by Nasirabad block (88.23%), whereas minimum number of samples infested with nematodes population was in Kekri block (25%)

Nematode infestation showed more than on species of nematodes associated with damage of cumin roots. There was three different species of nematodes found associated with cumin root (Table 3). Maximum population of nematodes observed from collected samples were root lesion nematodes *Pratylenchus thornei.* It was recorded from four development block with maximum population level of 13 nematodes/5 ml sample of root suspension. In Kekri block this species was not noticed in both the years of observation. The cumin roots infested by lesion nematodes were showed discoloration; turn to brown in colour, lack of branching in primary root and disintegration of root tissues were main symptoms. There was more than one damage marks observed on single root. *P. thornei* has been observed for the first time on cumin crops. The root lesion nematodes, *Pratylenchus* spp., are widely distributed and have very wide host ranges. Several species of the genus are responsible for substantial yield losses in many agriculturally important crops. In wheat crop, it has caused extensive root damage, and thereby lower nutrient and water response to the plant (Thompson *et al.* 2012 and Whisha *et al.* 2014). The yield loss in wheat due to *P. thornei* has been reported to cause 40 per cent yield loss in Mexico (Nicol and Ortiz-Monasterio 2004) and 70% in USA (Smiley *et al.* 2005). It is also serious pest of direct seeded rainfed and aerobic rice (Pankaj *et al.* 2012). In chickpea it causes 29 per cent loss (Dwivedi *et al.* 2008) and in sunflower it has found as one of the important nematode problems (Singh *et al.* 2009).

Lance nematode *Hoplolaimus indicus* was also recorded for the first time on cumin from large lesion marked roots samples. The nematodes were found to remain associated with the roots even after samples kept in water for 24 hour. The lance nematodes were counted by carefully dissecting the root samples through forceps in water. Lance nematodes were recorded from three development block and only five samples were found, infested by this nematode with maximum of 2 nematodes/5cm sample. The infested roots showed wrinkle formation and light brown patches on primary roots. *Hoplolaimus* spp., root-knot, reniform and cyst nematode have been reported on the roots of the pigeonpea plants from Uttar Pradesh and Gujarat (Sharma *et al.*1993 and 1996). High population of *H. indicus* were found in citrus grove and causes decline in yield (Reddy and Singh 1979).

Root knot nematode *Meloidogyne incognita* recorded from three development block in 20 samples and highest gall formation of 11/5cm root and 8 nematodes/5ml suspension from Masuda block. The knot formation was observed on both primary and secondary roots and roots turn to light brown in colour. The cumin plants infested with root knot nematodes showed stunted growth and chlorotic leaves. Sharma and Trivedi (2005) reported cumin crop infected with M. *incognita* and *Fusarium* complex in Rajasthan. Similarly dill and fenugreek crops have been reported susceptible to *M. incognita (*Khan and Rizvi 2013).

The soil type of Ajmer district is based on sandy loam and clay loan. In Pisangan, Nasirabad and Masuda block have sandy loam type soil, whereas Vijaynagar and Kekri block have clay loam type soil. Total 64 samples collected form sandy loam soil in which 56 samples (87.5%) were observed with nematodes presence. In this soil type all three species of nematodes population were observed. In clay loam 26 samples were collected and out of which only 7 samples (26.9%) showed nematodes infestation. *Hoplolaimus indicus* isolated only from clay loam soils (Table 4). Riley *et al.* (2009) reported higher *P. thornei* population in sand and loam type of soil in pastures land. Wheat crop in clay soils has been found to have more *P.*

Table 2 Area wise Infestation of nematodes in different cumin plant samples of Ajmer district

Development block	Village	No. of sample collected	No. of root sample infested with Nematodes	No. of sample collected	No of root sample infested with Nematodes
		2013-14		2014-15	
Pisangan	Pabuthan	4	4	5	5
	Lidi	2	2	3	3
	Rampura	3	3	4	4
	Makrera	1	1	4	4
	Budhwara	2	2	2	2
	Dabala	1	1	3	3
Masuda	Masuda	2	2	4	2
	Bagaliyawas	2	1	3	1
	Shergardh	1	1	4	1
Nasirabad	Sanodh	3	3	4	4
	Derathu	2	2	5	5
Vijaynagar	Mathaniya	1	0	2	1
	Ratakot	1	0	3	1
	Dolatapura	1	1	2	0
Kakari	Jugpura	2	1	3	1
	Ajagara	1	0	3	0
	Bokla	1	1	2	1
	Anandpura	2	0	2	0
Total		32	25	58	38

Table 3 Population of nematodes in different samples

Development block	Nematode samples	Nematode associated	Nematode species in number of sample	Average no. of galls / 5 cm roots		Average no. of nematodes / 5 ml. suspension	
				2013-14	2014-15	2013-14	2014-15
Pisangan	34	*Meloidogyne incognita*	9	7	10	5	7
		Hoplolaimus indicus	2			2	2
		Pratylenchus thornei	23			7	13
Masuda	8	*Meloidogyne incognita*	2	5	11	8	6
		Hoplolaimus indicus	1			1	1
		Pratylenchus thornei	5			7	9
Nasirabad	14	*Meloidogyne incognita*	3	4		6	
		Hoplolaimus indicus	1			2	2
		Pratylenchus thornei	11			6	9
Vijaynagar	3	*Meloidogyne indicus*					
		Hoplolaimus indicus					
		Pratylenchus thornei	3			5	7
Kekri	4	*Meloidogyne indicus*	4	4	7	8	4
		Hoplolaimus indicus					
		Pratylenchus thornei					

Table 4 Soil type in relation to nematodes infestation in cumin.

Soil type	No. of sample taken	No. of infested sample	% infestation
Sandy loam	64	56	87.5
Clay loam	26	07	26.9

Table 5 Plant characterization in relation to nematodes infestation.

No. of samples	Leaf type/ colour	Root appearances	Plant vigour	Nematodes associated
18	Pale yellow, curled leaves	Wrinkle formation and light brown patches on primary root Stubby growth	Stunted growth	*Pratylenchus thornei*
35	Pale yellow	Wrinkle formation and light brown patches on primary root Stubby growth	Stunted growth	*Hoplolaimus indicus* and *Pratylenchus thornei*
11	Pale yellow/ straw coloured	Knot formation, light brown in colour	Stunted growth	*Meloidogyne indicus*

thornei infestation in southern Ontario where infested plants often show severe stunting, and wheat heads from infested plants are shrunken and contain less grain (Thorne 1961).

The samples were collected from the cumin plants that showed abnormal growth pattern. There were three types of plant appearance noticed in the field (Table 5). Plant have stunted growth, pale yellow and curled leaves recorded root lesion nematodes *Pratylenchus thornei* association. The plants that have stunted growth and pale yellow leaves showed *Hoplolaimus indicus* and *Pratylenchus thornei* in samples. Whereas *Meloidogyne incognita* recorded samples showed stunted plants growth and pale yellow/straw coloured leaves. Pankaj *et al.*(2012) reported rice crop infected with *P.thornei* showed retarded growth, chlorotic leaves and roots with many branches and necrotic lesions throughout the cortex. Eggplant infected with root knot nematodes *M. incognita* showed reduced root and shoot length (El-Sherif, 2010). Optimum temperature for *P. thornei* is 22 °C (Thompson *et al.* 1999) and its activity, multiplication as well as damage to crop are reduced at temperature below 15 °C (Van Gundy *et al.* 1974, Perez *et al.* 1970).

REFERENCES

Dwivedi K, Upadhyay K D, Verma R A and Ahmad F. 2008. Role of bioagents in management of *Pratylenchus thornei* infecting chickpea. *Indian Journal of Nematology* **38**(2): 138–140.

El-Sherif A G, Refaei A R, El-Nagar M E and Salem M M H. 2010. Impact of certain oil-seed cakes or powder in comparison with oxamyl or urea on *Meloidogyne incognita* infecting eggplant. *Archives of Phytopathology and Plant Protection* **43**(1): 88–94.

Kant K, Meena S R and Sharma Y K. 2013. Root knot infestation in cumin crop. *Seed Spices-E-Newsletter* **5**(5): 2.

Khan, M R and Rizvi T F. 2013. Pathogenicity of *Meloidogyne incognita* on spinach, dill soa and fenugreek, and effect of *Trichoderma* species. *Annals of Plant Protection Sciences* **21** (1): 143–7.

Nicol J M and Ortiz-Monasterio I. 2004. Effect of root lesion nematode on wheat yields and plant susceptibility in Mexico. *Nematology* **6**: 485–93.

Pankaj, Ganguly A K and Pandey R N. 2012. Severe damage caused by the root-lesion nematode, *Pratylenchus thornei*, in aerobic rice in India. *Nematologia Mediterranea* **40:** 79–81.

Patel A D. 2011. Nematodes diseases of seed spices and their management. (*In*) *Recent Advances in Seed Spices*, pp 163-5. Ravindra Babu Y, Jaiman R K, Patel K D, Patel N B and Tikka S B S (Eds). Daya Publishing House, New Delhi.

Perez B J G, Van Gundy S D, Stolzy L H, Thompson I J and Liard R J. 1970. *Pratylenchus thronei,* a nematode pest of wheat in Sonora, Mexico. *Phytopathology* **60**: 1307.

Reddy P P and Singh D B. 1979. Nematode problems in citrus in India. *PANS* **25**: 409–19.

Riley I T, Nobbs J M, Herdina and McKay A C.2009. *Pratylenchus* species in pastures in the South East Region of South Australia. *Australasian Plant Disease Notes* **4:** 89–90.

Sharma S B, Ali S S, Patel H V, Patel S K and Patel D J.1993. Prevalence of plant parasitic nematodes associated with pigeon pea in Gujarat State in India. *Afro-Asian Journal of Nematology* **3**(1): 55–9.

Sharma S B, Ali S S, Upadhyay K D and Ahmad F. 1996. Potential nematode constraints of pigeonpea in Uttar Pradesh in northern India. *Afro-Asian Journal of Nematology* **6**(2): 151–5.

Sharma, N and Trivedi P C. 2005. Microbial Bioagents: Economic multiplication and management of fungal nematode complex of cumin. *Indian Journal of Biotechnology* **4**: 419–21.

Singh B and Solanki R K. 2015. Status of seed spices research and development in India. *Indian Journal of Agricultural Sciences* **85**(2): 151–6.

Singh B, Vishal M K, Ranjan J K and Solanki R K. 2013. Seed spice manages Indian economy. *Indian Horticulture* **58**(6): 3–5.

Singh S, Tyagi S and Prasad D. 2009. Distribution pattern of plant parasitic nematodes infesting sunflower. *Annals of Plant Protection Sciences.* **17**(2): 443–6.

Smiley R W, Whittaker RG, Gourlie J A and Easley S A. 2005. Suppression of wheat growth and yield by *Pratylenchus neglectus* in the Pacific Northwest. *Plant Diseases* **89**: 958–68.

Thompson J P, Mackenzie J and Sheedy G H. 2012. Root-lesion nematode (*Pratylenchus thornei*) reduces nutrient response, biomass and yield of wheat in sorghum–fallow–wheat cropping systems in a subtropical environment. *Field Crops Research* **137**: 126–40.

Thompson, J P, Brennan, P S, Clewett, T G, Sheedy, J G and Seymour, N P. 1999. Progress in breeding wheat for tolerance and resistance to root lesion nematode (*Praylenchus thornei*). *Australasian Plant Pathology* **28**: 45–52.

Thorne, G. 1961. *Principles of Nematology,* pp 203-48. McGraw-Hill Book Company Inc., New York.

Van Gundy, S D Perez, J G Stolzy, L H and Thompson, I J. 1974. A pest management approach to the control of *Pratylenchus thornei* on wheat in Mexico. *Journal of Nematology* **6**: 107–16.

Whisha J P M, Thompsonb J P, Clewett S T, Lawrence J L and Woodb J. 2014. *Pratylenchus thornei* populations reduce water uptake in intolerant wheat cultivars. *Field Crops Research* **161**: 1–10.