Print ISSN: 0976-2876 Online ISSN: 2250-0138

Available online at: http://www.ijsr.in

INDIAN JOURNAL OF SCIENTIFIC RESEARCH

DOI:10.32606/IJSR.V14.I1.00002

Received: 10-05-2023 Accepted: 25-07-2022 Publication: 31-08-2023

Indian J.Sci.Res. 14 (1): 07-12, 2023 Original Research Article

OCCURRENCE OF HOST SPECIFIC RACES OF ROOT-KNOT NEMATODE IN *Beta vulgaris* (BEETROOT) GROWING IN PILIBHIT DISTRICT OF WESTERN UTTAR PRADESH

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ABSTRACT

A study was conducted to identify the races of *Meloidogyne* spp. (*M. incognita, M. arenaria* and *M. javanica*) associated with *Beta vulgaris* growing in Pilibhit. The frequency of occurrence of *M. javanica* was greater than *M. incognita* and *M. arenaria*. Two Races of *M. javanica* (Race 1 and 2), three Races of *M. incognita* (Race 2, 3 and 4) and one Race of *M. arenaria* (Race 1) showed their association to beetroot. The information gathered from this study forms the basis for studying the host parasite interactions and is helpful in plant breeding programs for developing beetroot cultivars resistant to races of *Meloidogyne* spp. The dominance of *M. javanica* Race 1 might be attributed to the agro climatic conditions which favor its persistence in these areas whereas the absence of particular races is due to the host resistance offered by *B. vulgaris* to these races and the unfavourable climatic conditions of the localities.

KEYWORDS: *Meloidogyne incognita, M. arenaria, M. javanica*, *Beta vulgaris*, Races

The beetroot, *Beta vulgaris* L. (Chenopodiaceae) is a good source of vitamins (B1, B2, B3, C), minerals, calcium and iron (Kanner *et al*., 2001). It contains purplish red Betalain pigments which are laden with antioxidants and known for their health benefits. The beetroot cultivation is done in all the temperate, tropical and subtropical areas of the world. The world beetroot production was reported as 241985317 mt. in the year 2005 (Anonymous, 2018). Total area that accounts for beetroot cultivation in India is about 5000 ha which produces 90,000 tons of beetroot annually (Thamburaj and Singh, 2001).

Besides other soil microbes infecting beetroot, nematodes have also been reported as pests of *B. vulgaris* (Koike *et al.*, 2006) and causes around 10.9% annual losses worldwide (Sasser, 1989).The root knot nematodes have been regarded as the most important phytopathogenic nematodes because of their wide host range and cosmopolitan distribution. Around 3000 plants are hosts to root knot nematodes (Hussey and Janssen, 2002) and vegetables are the worst sufferers. This is the first report of occurrence of races of *M. incognita, M. arenaria* and *M. javanica* associated with beetroot from India.

There are fewer reports on the occurrence of plant parasitic nematodes in *B. vulgaris* (Sikora, 1972; Sitaramaiah, 1984; Kumar *et al*., 2003; Anamika and Simon, 2010; Steyn *et al*., 2014, Mashela, 2017, Akyazi and Felek, 2020). The information concerning the occurrence and distribution of physiological races of *Meloidogyne* spp. in *B. vulgaris* is very scarce. The prevalence of *M. incognita* race 2 in *B. vulgaris* genotypes was reported from South Africa (Steyn *et al*., 2014).

Every local population of a nematode species has a substantial amount of genetic variation which is related to its host specificity. The first report of variability in the host range of four important *Meloidogyne* spp. was given by Sasser (1952). The studies on prevalence of different physiological races in *M. javanica, M. arenaria* and *M. incognita* have been carried out by researchers worldwide (Goplen *et al.* 1959; Sasser 1972; Southards and Preist 1973; Hartman and Sasser, 1985; Robertson *et al*., 2006; Robertson *et al.* 2009; Devran and Sogut 2011; Zubeyir and Sogut, 2011; Uysal *et al.* 2017) on different vegetables.

In India, different physiological races of *M. javanica, M. arenaria* and *M. incognita* were identified from different plants and vegetables (Raja and Gill, 1982; Khan and Khan, 1991; Khan *et al.* 1994; Ganaie and Khan 2016; Akhter and Khan 2018). Routaray and Das (1982) reported races 1 and 2 of *M. incognita* from Orissa. Later on, Krishnappa, (1982) found three races of *M. incognita* and race 1 was ubiquitous in different agro-climatic zones of India. Bajaj *et al.* (1986) reported Races 1, 2 and 4 of *M. incognita* from Haryana. Khan *et al.* (2003) recognized two races of *M. javanica* (race 1 and 2) from Uttar Pradesh. *M. incognita* race 2 was reported

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from vegetables growing in West Bengal by Khan (2001). Two races of *M. incognita* (race 2 and 3) were reported (Khan and Murmu, 2004) from different crops. *M. javanica* race 2 was found infesting safed musli in West Bengal (Khan *et al.,* 2008). Kumar *et al*., (2008) observed race 2 and 4 of *M. incognita*, *M. javanica* race 1 and *M. arenaria* race 2 from Haryana. Khan *et al*. (2014) reported a single race of *M. arenaria* (race 2), 3 races of *M. javanica* (race 1, 2 and 3) and 4 races of *M. incognita* (race 1, 2, 3 and 4) from different parts of India. The aim of this basic research carried out in the Section of Plant Pathology and Nematology, Botany Department, AMU (Aligarh) is to collect information on the species and races of *Meloidogyne* associated with beetroot through traditional methods as there is very little to no data available in this regard. The occurrence of variability within the nematode populations hampers our efforts to manage them. Therefore, the Identification of host specific races is an important step in developing nematode resistant varieties of vegetable plants against a particular nematode species.

MATERIALS AND METHODS

A survey of fifteen localities (Banoa, Barkhera, Bilsanda, Bisalpur, Deoria, Dharampur, Jaitpur, Jamania, Kadher Chaura, Khandelpur, Kiratpur, Parewa, Puranpur, Saraur, Shivnagar and Tukunian) of Pilibhit district (Western Uttar Pradesh) was carried out and root samples were collected from *B. vulgaris* infected with *Meloidogyne* species. About 10 infected plants were randomly collected from each locality and 5 g galled roots were randomly collected from each plant. The galled roots were mixed thoroughly and five egg masses / isolates of root-knot nematode were collected from each locality separately.

The culture of 75 isolates collected from 15 localities were maintained on tomato plants in a net house and labeled properly. The nematode was allowed to multiply and a subculture of each population was build up by successively inoculating the fresh tomato seedlings.

The perineal pattern of root knot females and morphology of second stage juveniles (J_2) were used to identify the different *Meloidogyne* spp. The identification of the species was done by comparing the J_2 juveniles and perineal pattern of females with the description given by Eisenback *et al.* (1981).

The nematode populations (isolates) were tested for the identification of races of *M. incognita, M. javanica* and *M. arenaria* by using six differential host plants as suggested by Hartmann and Sasser (1985). Two thousand freshly hatched J_2 juveniles of *Meloidogyne* species from each population were inoculated separately to the seedlings of differential hosts. Three replicates of each differential host were inoculated with root knot nematode.

Table 1: Response of races of *Meloidogyne incognita, M.arenaria* and *M. javanica* to the North Carolina differential host test plants

Meloidogyne species and Physiological Races.	**Differential Host Plants**					
	Cotton cv. Deltapine 61	**Tobacco cv. NC 95**	**Pepper cv. Early California Wonder**	**Peanut cv. Florunner**	**Tomato cv. Rutgers**	**Watermelon cv. Charleston Gray**
M. incognita						
Race-2	-	+	+	-	+	+
Race-3	+	-	+	-	+	+
Race-4	+	+	+	-	+	+
M. arenaria						
Race-1	-	+	+	+	+	+
M. javanica						
Race-1	+	+	-	-	+	+
Race-2	+	+	+	-	+	+

(+) indicates a susceptible host; (-) indicates a resistant host

The number of egg masses and galls / root system were counted after 60 days of inoculation. The host plants that showed an average number of galls and egg masses upto 10 were labeled as resistant (–), whereas, the planst with an average galls and egg masses of more than 11 were labeled as susceptible (+). The data was compared with the Table– 1 for the identification of races. The races of *M. arenaria* and *M. incognita* were recognized by the method proposed by Hartman and Sasser (1985), while that of *M. javanica* were recognized by the method suggested by Sharma *et al.* (1995). The frequency of occurrence of races was also calculated.

RESULTS

The results presented in Table- 2 showed that the three species of *Meloidogyne* viz., *M. incognita*, *M. javanica* and *M. arenaria* were recorded from the roots of *B. vulgaris*. Out of 16 surveyed localities root knot nematode was present in 15 localities. The frequency of occurrence of *M. javanica* was greater than *M. incognita* and *M. arenaria.* Amongst the different races of *M. javanica* recorded from *B. vulgaris*, Race 1 was present in 12 localities and Race 2 was present in 3 localities. Three races of *M. incognita* were recorded of which Race 2 was present in 4 localities, Race 3 was present in only one locality and race 4 was found in 3 localities. On the other hand, *M. arenaria* Race 1 was recorded from only one locality.

Out of 75 isolates of *Meloidogyne* spp. collected from beetroots growing in different surveyed areas of Pilibhit, 54, 16 and 5 isolates belongs to *M. javanica*, *M. incognita* and *M. arenaria*, respectively. Amongst the 54 isolates of *M. javanica*, 43 isolates were designated as Race 1 and 11 isolates as Race 2 of *M. javanica*. Out of 16 isolates of *M. incognita*, 9 isolates were designated as Race 2, 2 isolates as Race 3 and 5 isolates as Race 4. However, the remaining 5 isolates were designated as Race 1 of *M. arenaria*.

The greatest frequency of occurrence of *M. javanica* infecting *B. vulgaris* (72%) was observed in different localities of Pilibhit district followed by *M. Incognita* (21.3%) and *M. arenaria* (6.7%). This clearly indicated that amongst the *Meloidogyne* species, *M. javanica* was most prevalent in comparison to *M. incognita* and *M. arenaria*. Amongst the races of *M. javanica*, race 1 showed the highest frequency of occurrence which was recorded as 57.3%, whereas, the frequency of occurrence of race 2 was found as 51.4%.The frequency of occurrence among the races of *M. incognita*, was highest for race 2 (12%) followed by Race 4 (6.7%) and race 3 (2.7%). Moreover, the frequency of occurrence of Race 1 of *M. arenaria* was recorded as 6.7% (Table-2).

Table 2: Occurrence of races of *Meloidogyne* spp. infecting *Beta vulgaris* in Pilibhit district of Western Uttar Pradesh

Number of races of *Meloidogyne* species								**Total number of races of *Meloidogyne* spp.**
Races of *M. incognita*				**Races of *M. javanica***			**Race of *M. arenaria***	
R2	R3	R4	Total number of races	R1	R2	Total number of races	R1	
9 (12.0%)	2 (2.7%)	5 (6.7%)	16 (21.3%)	43 (57.3%)	11 (14.7%)	54 (72%)	5 (6.7%)	75

Figures in parenthesis are the frequency of occurrence of races of *Meloidogyne* species calculated against total number of races of *Meloidogyne* spp

The frequency of occurrence of *M. javanica* (72%) was greatest followed by *M. incognita* (21.3%) and *M. arenaria* (6.7%). Hence, *M. javanica* was the most dominant species. Amongst the races of *M. javanica*, race 1 (57.3%) showed the highest frequency of occurrence than race 2 (51.4%).The frequency of occurrence of the races of *M. incognita*, was recorded highest for race 2 (12%) followed by Race 4 (6.7%) and race 3 (2.7%). The frequency of occurrence of Race 1 of *M. arenaria* was recorded as 6.7% (Table-2).

DISCUSSION

The results are in agreement with the workers who noticed that *M. javanica* was the predominant species amongst the species of root knot nematode occurring on vegetables as well and ornamental plants

(Haseeb and Pandey, 1987; Das and Das, 2000; Esfahani, 2009; Sahu *et al*., 2011) but the results are contrary to the researchers who reported that the frequency of occurrence of root-knot disease caused by *M. incognita* was comparatively more than caused by the other species of root-knot nematode (Nath *et al*., 1996; Srivastava *et al*., 2012; Singh *et al*., 2012; Ganaie and Khan, 2016; Uysal *et al*., 2017; Akhter and Khan, 2018). The results are in accordance with Khan *et al.* (2003), Kumar *et al.* (2008), Robertson *et al*. (2009), Devran and Sogut (2011) and Akhter and Khan (2018) who reported higher frequency of occurrence of *M. javanica* Race 1 on different crops.

Our results are supported by the findings of Taylor *et al.* (1982), Sasser and Carter (1985) and Khan and Khan (1991) who stated that Race 3 of *M. incognita* was the least encountered race on different hosts of *M. incognita*. In the present study, the Race 1 of *M. arenaria* was present. These results are contrary to Sasser (1980) who noted *M. arenaria* Race 2 as the most frequently occurring than Race 1. Similarly, Khan and Khan (1991) detected that Race 2 of *M. arenaria* was more pronounced in vegetables of eight surveyed districts of Uttar Pradesh including Aligarh. The findings of Ganaie and Khan (2016) also showed that Race 2 of *M. arenaria* was dominantly present than race 1 in Aligarh District of Western Uttar Pradesh.

CONCLUSION

Amongst the surveyed areas *M. incognita* Race 1 and *M. arenaria* Race 2 were completely absent, it may be attributed to the cause that beetroot might be resistant to these races or both these races may be absent in the surveyed localities. The dominance of *M. javanica* Race 1 might be due to the favourable agro climatic conditions of these areas whereas the absence of particular races is due to the host resistance offered by *B. vulgaris* to these races and the unfavourable climatic conditions of the localities.

The information regarding the prevalence of biological races in phytopathogenic nematodes is necessary as it forms the basis for the studies on host-parasite relations and is helpful in plant breeding programs. Thus, the outcome of this basic study may provide a baseline for conducting further research in developing suitable strategies for the management of these races of root-knot nematode in beetroot.

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