

Occurrence, Distribution and Community analysis of plant parasitic nematodes associated with Green gram in Coastal Districts of Odisha, India

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ABSTRACT

Estimation of mean nematode population/200cc soil samples revealed the presence of *Meloidogyne incognita* (380.33), *Rotylenchulus reniformis* (132.10), *Hoplolaimus indicus* (19.55), *Helicotylenchus dihystra* (89.32), *Tylenchorhynchus mashhoodi* (47.10), *Hirschmanniella oryzae* (10.40), Dorylaimids (48.74) and Rhabditids (27.60) exhibiting varying population densities. Among different plant parasitic nematodes, *Meloidogyne incognita* has the highest frequency of occurrence (319) with absolute frequency (62.54%) followed by *Rotylenchulus reniformis* (57.84%), *Hirschmanniella oryzae* (44.71%), *Helicotylenchus dihystra* (43.92%), *Tylenchorhynchus mashhoodi* (36.66%), *Hoplolaimus indicus* (22.35%) in decreasing order. More over, *Meloidogyne incognita* was found the most prominent species with highest prominence value (300.77) followed by *Rotylenchulus reniformis* (100.46) with the lowest prominence value (6.95) recorded in *Hirschmanniella oryzae*. Among free living nematodes, Dorylaimids were having highest frequency of occurrence (503) with absolute frequency (98.62%), highest density (48.74) and prominence value (48.39) followed by Rhabditids.

Key words : *Vigna radiata*, Distribution, Community analysis, prominence value, *Meloidogyne incognita*.

In Odisha, Green gram is extensively cultivated in coastal districts in residual moisture after the kharif crop. There are several constraints for low productivity of green gram such as production constraints (inadequate supply of quality seed, fertilizer, proper irrigation, growing of pulses in marginal lands of rainfed area, non adoption of intercropping and inadvertent climatic condition etc.), the marketing constraints (Distress sale, lower minimum support prices compared to cost of production, non-accessibility to market, post harvest losses and non availability of proper storage facilities etc.) and the institutional constraints (less emphasis on transfer of technology related to pulses), but the major cause of low productivity of Green gram is the biological constraints where the Plant parasitic nematodes reduce the green gram yield about 8.9% in India (Jain *et al.*, 2007). Plant parasitic and free living nematodes are the important members of the nematode community. Information regarding the association of plant parasitic nematodes with green gram crop is important in view of crop production and pest management strategy. Therefore, the present investigation was contemplated to study the Occurrence, Distribution and Community analysis of plant parasitic nematodes associated with green gram in coastal districts of Odisha, India.

Materials and Methods :

Survey of seven coastal districts (Balasore, Bhadrak, Puri, Khorda, Ganjam, Kendrapada, Jagatsinghpur) of Odisha state was conducted during the year 2015-16 to determine occurrence of various plant parasitic nematodes associated with green gram crop. Diseased fields were selected on the basis of above ground symptoms of the crops. Composite soil samples were collected and processed within a week after the collection. Altogether 510 soil samples were collected during mid cropping season from the rhizosphere of green gram. Extraction of the nematodes was done by Cobb's sieving and decanting method followed by modified Baermann's technique to obtain clean nematode suspension obtained. Killing of nematodes and fixing in formalin glycerol fixative was used followed by storing the fixed nematode suspension in wet collection bottle. The estimation of nematode population / 200cc soil sample was done in a multi chambered counting dish under a stereoscopic binocular microscope. Infected roots were stained in acid fuchsin- lacto phenol solution and observed for the presence of nematodes. Females of root knot nematode were dissected out from the galled roots and the perinial sections were prepared for species identification. Plant parasitic nematode communities were analyzed for computing absolute frequency, relative frequency, absolute density, relative density and prominence value as per the following formulae given by Norton (1978).

$$1) \text{ Absolute frequency} = \frac{\text{Number of samples containing species}}{\text{Total number of samples collected}} \times 100$$

$$2) \text{ Relative frequency} = \frac{\text{frequency of a species}}{\text{Sum of frequency of all species}} \times 100$$

$$3) \text{ Absolute Density} = \text{Number of individuals of species per unit volume of soil}$$

$$4) \text{ Relative Density} = \frac{\text{Number of individuals of a species in a sample}}{\text{Total of all individuals in a sample}} \times 100$$

$$5) \text{ Prominence value (pv)} = \text{Absolute density} \sqrt{\text{Absolute frequency}}$$

Results and Discussion :

During the year 2015-16, 510 soil samples were collected from the rhizosphere area of green gram plants in coastal districts of Odisha state (Table 1). The analysis of nematode communities revealed the association of six plant parasitic nematodes and two free living nematodes with green gram plant. Among different plant parasitic nematodes, *Meloidogyne incognita* was having the highest frequency of occurrence (319) with absolute frequency 62.54% followed by *Rotylenchulus reniformis* (57.84%), *Hirschmanniella oryzae* (44.7%), *Helicotylenchus dihystra* (43.92%), *Tylenchorhynchus mashhoodi* (36.66%), *Hoplolaimus indicus* (22.35%) in decreasing trend. The relative frequency of root knot nematode was recorded

as maximum (15.52%) followed by *Rotylenchulus reniformis* (14.35%), *Hirschmanniella oryzae* (11.09%), *Helicotylenchus dihystera* (10.90%), *Tylenchorhynchus mashhoodi* (9.10%) and *Hoplolaimus indicus* (5.54%). *Meloidogyne incognita* occurred in high densities, which was 380.33 nematodes / 200cc soil followed by *Rotylenchulus reniformis* (132.10), *Helicotylenchus dihystera* (89.32), *Tylenchorhynchus mashhoodi* (47.10), *Hoplolaimus indicus* (19.55) and *Hirschmanniella oryzae* (10.40).

Among these plant parasitic nematodes, *Meloidogyne incognita* was only found above the pathogenic level which caused disease incidences in green gram in coastal districts of Odisha. Other nematode species reflecting low densities were below the pathogenic level. Highest relative density was recorded in *Meloidogyne incognita* (50.36%) followed by *Rotylenchulus reniformis* (17.49%), *Helicotylenchus dihystera* (11.82%), *Tylenchorhynchus mashhoodi* (6.23%), *Hoplolaimus indicus* (2.58%) and *Hirschmanniella oryzae* (1.37%). In consideration to prominence value, *Meloidogyne incognita* exhibited the highest prominence value (300.77) acting as the most prominent species followed by *Rotylenchulus reniformis* (100.46), *Helicotylenchus dihystera* (59.19), *Tylenchorhynchus mashhoodi* (28.51), *Hoplolaimus indicus* (9.27) with the lowest prominence value (6.95) recorded in *Hirschmanniella oryzae*.

Table 1. Occurrence and Distribution of nematode species associated with green gram in coastal districts of Odisha, India.

District Name	No. of sample collected	Soil sample containing nematode species (No.)							
		Mi	Rr	Hi	Hd	Tm	Ho	Do	Rh
Khurda	70	58	60	32	60	15	46	70	70
Puri	60	22	26		15	12	20	60	60
Balasore	100	52	75	10	45	64	56	100	85
Ganjam	100	75	66	72	78		12	100	100
Bhadrak	80	58	35			42	48	80	40
Jagatsinghpur	50	24	15			32	18	45	26
Kendrapada	50	30	18		26	22	28	48	32
Total	510	319	295	114	224	187	228	503	413

Table 2. Prominence, frequency of occurrence and population density of nematode species associated with green gram in coastal districts of Odisha, India.

(Total soil sample collected -510)

Nematode associated	No. of sample containing a species	Absolute frequency (%)	Relative frequency (%)	Absolute density	Relative density (%)	Prominence value
<i>Meloidogyne incognita</i> (Mi)	319	62.54	13.97	380.33	50.36	300.77
<i>Rotylenchulus reniformis</i> (Rr)	295	57.84	12.92	132.10	17.49	100.46
<i>Hoplolaimus indicus</i> (Hi)	114	22.35	4.99	19.55	2.58	9.27
<i>Helicotylenchus dihystra</i> (Hd)	224	43.92	9.81	89.32	11.82	59.19
<i>Tylenchorhynchus mashhoodi</i> (Tm)	187	36.66	8.19	47.10	6.23	28.51
<i>Hirschmanniella oryzae</i> (Ho)	228	44.71	9.99	10.40	1.37	6.95
<i>Dorylaimids</i> (Do)	503	98.62	22.03	48.74	6.45	48.39
<i>Rhabditids</i> (Rh)	413	80.98	18.10	27.60	3.65	24.56
Total	2283	447.62	100	755.14	99.95	578.1

Among free living nematodes, Dorylaimids were having highest frequency of occurrence (503) with absolute frequency 98.6% followed by Rhabditids (80.98%). Dorylaimids exhibited highest density (48.74) and prominence value (48.39) followed by Rhabditids. Mishra and Chakrabarti (2001) reported about the association of root knot nematode, cyst nematode, lesion nematode, reniform nematode and various ectoparasitic nematode groups with all the pulse crops in Pulse producing areas of India. Singh (2015) reported that thirteen nematode genera (*Hoplolaimus*, *Tylenchorhynchus*, *Helicotylenchus*, *Tylenchus*, *Heterodera cajani*, *Pratylenchus*, *Basiria*, *Aphelenchus*, *Meloidogyne*, *Filenchus*, *Boleodorus*, *Rotylenchulus* and *Scutellonema*) were associated with pigeon pea from a survey in Bundelkhand region of Uttar Pradesh, India. Ali *et al.* (2006) studied the community analysis of plant parasitic nematodes associated with pulse crops (chickpea, lentil, pigeon pea, field pea) in district Hamirpur, Uttar Pradesh by collecting 174 soil samples. The community analysis revealed the presence of *Hoplolaimus indicus*, *Tylenchorhynchus mashhoodi*, *Xiphinema americanum*, *Filenchus sp.* Roy *et al.* (2007) reported the occurrence, distribution and community analysis of plant parasitic nematode associated with leguminous vegetable crops in ten districts of West Bengal. Analysis of soil samples showed the occurrence of *R.reniformis*, *Meloidogyne*, *Tylenchorhynchus*, *Criconemoides*, *Helicotylenchus*, *Pratylenchus*, *Hoplolaimus* and *Hirschmanniella*. Rathour *et al.* (2010) conducted a survey of 10 districts (Gwalior, Jabalpur, Mandasaur, Ujjain, Bhind, Dhar, Satna, Rewa, Panna and Chhatarpur) of Madhya Pradesh state to record the plant parasitic and other beneficial soil nematodes associated with various vegetable, cereal, oilseed, pulse, fruit, medicinal and cash crops. Analysis of nematode communities revealed the occurrence of *Meloidogyne incognita*, *Rotylenchulus reniformis*, *Aphelenchoides composticola*, *Helicotylenchus dihystra*, *Tylenchorhynchus indicus*, *Aphelenchus avenae*, *Hoplolaimus indicus*, *Dorylaimids* and *Rhabditids*. Neog *et al.*(2012) surveyed Dhemaji district of Assam found presence of eight plant parasitic nematodes on vegetables and pulses. From the results of

the present work cited above and the reports of other nematologists, it is clearly apparent that community analysis of nematodes associated with green gram is the first of its kind in Odisha as well as other states of India, although various scientists studied the association of nematodes in various pulse crops other than green gram. Moreover, most of the nematologists concentrated their study on community structure of plant parasitic nematodes only ignoring free living beneficial nematodes present in the soil. As soil is the habitat of both plant parasitic and free living beneficial nematodes, community analysis of nematodes in green gram exhibited very interesting result in respect of free living beneficial Dorylaimids and Rhabditids which were having highest frequency of occurrence in order of 98.92% and 80.98% as compared to plant parasitic nematodes. Since, free living beneficial Dorylaimids and Rhabditids are the indicators of soil health amending the soil in addition of organic matter in to soil might have reflected their frequent occurrence in majority of soil samples as compared to plant parasitic nematodes. But among plant parasitic nematodes, root knot nematode (*Meloidogyne incognita*) being the sedentary endoparasitic nematode species remaining completely confined within plant root in secluded environment and deriving continuous nutrition from plant tissues showed an exception resulting higher frequency of occurrence (62.54%), density(380.33) and prominence value (300.77). Thus, root knot nematode (*Meloidogyne incognita*) was found the only prominent economically important plant parasitic nematode species above the economic threshold level affecting green gram in coastal districts of Odisha.

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