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Occurrence and Redescription of Some Common Nematodes on Mostly Grown Vegetables in Kashmir Valley, India

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Abstract: The present work embodies findings of a survey done during the period 2018- 2020 to find out biodiversity of tylenchid nematodes parasitic on some mostly grown vegetables of Kashmir valley. Four species of nematodes belonging to the order Tylenchida Thorne, 1949 were found to be enormously prevalent and are described herein with alterations from the original probably because of habitat change. *Spinacia oleracea* (Spinach) and *Allium cepa* (Onion) were taken for the study. *Merlinius microdorus* (Geraert, 1966) Siddiqui, 1970; *Boleodorus cylindricus* Dhanachand, Renubala and Anandi, 1993; *Pratylenchus sativus* Kaul, 1985 and *Helicotylenchus graminophilus* Fotedar and Mahajan, 1974 were met with the varied intensity on these hosts. The morphological variations are significantly noted under remarks with the individual species under observations.

Keywords: Spinach, Onion, Kashmir, Phytonematodes, Morphology

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Introduction

Tylenchida Thorne, 1949 is an order of Nematodes or nemas (greek nemas, nematos= thread, eidos= likeness, resembling) of the subclass Tylenchia Inglis, 1983, class Secrenentea Von Linstow, 1905, Phylum Nematode Rudolphi 1808. Tylenchida are popularly called as Tylenchs or Tylenchids comparable with Aphelenchs or Aphelenchids. The tylenchida are the largest and

economically the most important group of plant parasitic nematodes. The plant parasitic Tylenchida are also known as eelworms, phytonematodes, phytohelminthes or simply plant nematodes. They have exploited all plant organs including flowers and seeds, but mostly they attack roots. They utilize chemical activity of bacteria, which hydrolyze carbohydrates, split proteins, cellulose and

other organic substances of plant origin. The phytophagous nematodes are common pests of saffron crop and loss caused by them is often due to their high densities. These small worms are equipped with a protrusible hollow stylet which is thrust into plant tissues for obtaining nutrition after the dissolution of the cell contents. Important surveys known so far on plant parasitic nematodes in India are by Prasad (1960); Siddiqui (1963) Swarup *et al.* (1964) Prasad and Chawla (1965); Prasad *et al.* (1965) and Khan and Basir (1965).

In this study we report the occurrence of some nematodes on vegetables grown in Kashmir valley, India.

Materials and Methods

Composite root and soil samples were drawn from plants individually at 0-15 cm depths. A composite root sample of 1 g from many plants were taken and observed for nematode population. Similarly, a composite soil sample of 200 g was processed with Cobb's sieving and Baermann's funnel method and assessed for nematode populations. The samples were taken from all the regions of the valley. 300 mesh sieve of pore size 53 μ m was used. Nematode suspension was killed and fixed in one operation by using equal amount of double strength hot Formalin-acetic acid-alcohol (FAA) solution. The fixed material was left as such for 24 h. Nematodes were thus collected and dehydrated in glycerine-alcohol solution containing 95 parts of 70% alcohol and 5 parts of glycerine. Slides were prepared from the specimens. Nematodes were identified and counted under stereomicroscope.

Abbreviations used are: L- total body length in mm; a - body length divided by greatest body width; b-body length divided by

distance from anterior end to junction of oesophagus and intestine; b' - body length divided by distance from anterior end to posterior end of oesophageal glands; c - body length divided by tail length; c' - tail length divided by body width at anus or cloaca; DGO - dorsal gland orifice; V - distance of vulva from anterior end $\times 100 \div$ body length; G1 - overall length of anterior gonad $\times 100 \div$ body length; G2 - overall length of posterior gonad $\times 100 \div$ body length; ABD - total anal body diameter.

Results and Discussion

During this study the following four species were noticed on the said hosts with the morphological variations:

(i) *Boleodorus cylindricus* Dhanachand, Renubala and Anandi, 1993

Female: L= 0.62- 0.66, a= 38.2- 42.4, b= 4.2- 5.4, c= 4.8- 6.4, c'= 8.2-9.4, V= 60.2-66.2, stylet= 4.1- 5.9, G1= 28.4- 34.8, G2= 2- 3.2, Tail= 89.4- 106.7, ABD= 6.4- 8.2.

Male: L= 0.52- 0.62, a= 38.4- 44.6, b= 4.8- 6.2, c= 5.2- 6.2, c'= 8.2-9.4, , stylet= 4.6- 5.4, Spicules= 13- 14.6, Tail= 81.6- 90.8, ABD= 8.2- 9.8.

Female: Straight to slightly ventroid body upon fixation, cylindrical, tapering towards both the extremities. Finely and transversely striated cuticle. Elevated lip region with transverse indistinct striations. Lateral lines with 4 incisures. Stylet slender, 4.1 - 5.9 μ m long with posteriorly directed basal knobs. Orifice of dorsal oesophageal gland situated at 43 - 56% of oesophagus. Basal bulb cylindrical, 14.4 - 18 μ m long. Distinct cardia. Excretory pore situated in the region of basal oesophageal bulb. Nerve ring situated in the region of basal anterior end of body. Vulva post-equatorial, mono-prodelphic

reproductive system, ovary outstretched and oocytes arranged in single row. Post vulval uterine sac about one body-width long. Filiformous tail, 89.4 - 106.7 μm long ending into a rounded terminus.

Male: Body similar to female. Spicule paired 13 - 14.6 μm long. Gubernaculum small, 2.3 - 4.9 μm in length. Bursa 20.4 - 26.2 μm long, adanal. Tail 81.6 - 90.8 μm long with rounded tip.

Habitat and locality: The specimens were collected in the soil around roots of *Allium cepa* (Onion) from wagam area of Budgam.

Remarks: The morphological details of the present specimen conform well with those given by Dhanachand *et al.* (1993) though variations are found in the lengths of body, stylet, oesophagus and tail.

(ii) *Helicotylenchus graminophilus* Fotedar and Mahajan, 1974

Female: L= 0.57- 0.83, a= 22- 30.1, b= 3.8- 5.4, b'= 3.2- 5.7, c= 34.3- 42.1, c'= 2- 2.3, V= 63.3- 73.6, G1= 16- 32, G2= 2.1- 4.3, Stylet= 23- 31.4, Excretory pore= 125- 134, Tail= 16.8- 18, ABD= 12- 16.2

Description: Loose spiral shaped body upon fixation. Coarsely annulated cuticle, 1.4 μm wide at mid-body. Cephalic framework anteriorly blunt with indistinct sclerotisation with a width of 4.2 - 5.0 μm . Highly sclerotised internal framework of lip region. Anteriorly flat stylet knobs, 5.1 μm wide and 3.4 μm high. Amphidelphic reproductive system, oval spermatheca with absence of spermatozoa. Lateral fields occupying 1/4th of body diameter and consists of 4 incisures. Phasmids 9.5 - 10.1 μm from tail terminus located at the centre of lateral field.

Male: Not found

Habitat and locality: The specimens were collected in the soil around roots of *Allium cepa* (Onion) from Hilar area of Ananthnag.

Remarks: The present specimens are in conformity in dimensions and structures with those described by Fotedar and Mahajan (1974) except with slightly shorter body length and posteriorly located vulva.

(iii) *Pratylenchus sativus* Kaul, 1985

Female: L = 0.45 - 0.47 mm, a = 25.2 - 25.7, b = 3.9 - 4.51, c = 21.01 - 22.0, v = 83 - 84%, Spear = 16.09 - 18 μm Tail= 16- 27, ABD= 5- 8.4

Body is tapering towards both the extremities, more abrupt posteriorly to blunt tail. Lateral field with four incisures. Head low, flattened anteriorly set off from the body contour by a distinct constriction and bear 2 labial annules. Labial framework well developed, buccal spear is also well developed, measuring 16.09-18 μm with anterior surfaces of basal knobs slightly slopping forwards. Procorpus is slightly longer than Isthmus. Median oesophageal bulb well developed, oval in outline, measuring 14 x 9 μm from the anterior end. Oesophageal glands overlap intestine ventrally as a long lobe, more than two widths long. Vagina extending to nearly half of body width. Vagina leads into muscular uterus which bears spherical spermatheca filled with sperms. Tail subcylindrical, 2.3 - 2.5 times as long as anal body diameter, with unstriated narrowly rounded terminus.

Male: Not found

Habitat and locality: The specimens were collected in the soil around roots of *Spinacia*

oleracea (Spinach) from Sindbal area of Ganderbal.

Remarks: The species collected from *Spinacia oleracea* (Spinach) is a first time report of its occurrence on this host in this region of India as it was reported by Kaul (1985) on *Eruca sativa*. The original dimensions vary to the present in values of V i.e. 83 per cent in the present specimens as compared to 81.38 per cent in the original description.

(iv) *Merlinius microdorus* (Geraert, 1966) Siddiqui, 1970

Female: L = 0.53-0.55 mm, a = 25-33, b = 4.8-5.1, c = 12-17, c' = 3.9-4.0, v = 55.5-60.9, Stylet = 11.4-13.7 μ m

Male: L = 0.52 mm, a = 33.9, b = 5.2; c = 17, c' = 4.4, Stylet = 11.9 μ m, spicules = 22 μ m, Gubernaculum = 7.6 μ m

Female body slightly arcuate on fixation. Cuticle and subcuticle with distinct transverse striae, 1.5-2.0 μ m at mid-body. Lateral field with six incisures forming elevated longitudinal bands which in surface view obscure, lip region hemispherical, offset by a depression, about 4.5 – 6.0 μ m wide.

Spear of medium strength, conus non-tubular and needle like, 11.4 – 13.7 μ m in females and 11.9 μ m in males. Basal knobs moderately developed, rounded posteriorly. Isthmus about three median bulb length long, encircled by nerve ring just anterior to its middle. Excretory pore at the base of Isthmus to opposite middle of basal bulb. Reproductive system amphidelphic, ovaries symmetrical, outstretched, with oocytes in a single row, spermatheca rounded. Vulva transverse, Rectum just under one anal body width long, not overlapped by intestine. Phasmids in the posterior half of tail. Spicules almost straight

with a slight curvature of tip, about two thirds of tail length.

Habitat and locality: Soil around the roots of *Spinacia oleracea* (Spinach) from Putshai, Lolab.

Remarks: The present specimens have smaller values of stylet i.e. 11.9 μ m in males as compared to that of the original dimensions and descriptions by Siddiqui, 1970. The species is already met on *solanum tuberosum* and *Malva rotundifolia* but its occurrence on *Spinacia oleracea* (Spinach) is a first time host record.

Merlinius microdorus (Geraert, 1966) Siddiqui, 1970 ; *Boleodorus cylindricus* Dhanachand, Renubala and Anandi, 1993; *Pratylenchus sativus* Kaul, 1985 and *Helicotylenchus graminophilus* Fotedar and Mahajan, 1974 were encountered on examining the soil and root samples of *Spinacia oleracea* during the period of study. *Boleodorus cylindricus* Dhanachand, Renubala and Anandi was met with the highest percentage of frequency of 90% as well as highest proportion of absolute density of 37% and lowest value of 24% in case of *Merlinius microdorus* (Geraert, 1966) Siddiqui, 1970 and *Pratylenchus sativus* Kaul, 1985. The mean intensity value of the said genera are respectively 66, 60, 72 and 81 (Table 1; Fig. 1).

The present study revealed that the Tylenchid genera buildup on *Allium cepa* were *Merlinius microdorus* (Geraert, 1966) Siddiqui, 1970 ; *Boleodorus cylindricus* Dhanachand, Renubala and Anandi, 1993; *Pratylenchus sativus* Kaul, 1985 and *Helicotylenchus graminophilus* Fotedar and Mahajan, 1974 with their absolute frequency of 100%,

Table 1: Community analysis of plant parasitic nematodes associated with *Spinacia oleracea* (Spinach)

Genus	AF (%)	RF (%)	RD (%)	AD (%)	RPV (%)	MI
<i>Merlinius microdorus</i> (Geraert, 1966) Siddiqui, 1970	70	21.4	20.5	24	18.8	66
<i>Pratylenchus sativus</i> Kaul, 1985	80	24.4	20.9	24	20.5	60
<i>Helicotylenchus graminophilus</i> Fotedar and Mahajan, 1974	86.6	26.5	27	31.5	27.5	72
<i>Boleodorus cylindricus</i> Dhanachand, Renubala and Anandi, 1993.	90	27.5	31.5	37	33	81

AF= Absolute frequency, RF= Relative frequency, RD= Relative Density, AD= Absolute density, RPV= Relative prominence value, MI= Mean Intensity

AF= Absolute frequency, RF= Relative frequency, RD= Relative Density, AD= Absolute density, RPV= Relative prominence value, MI= Mean Intensity

Fig. 1 : Graphical presentation of various ecological parameters of different genera on *Spinacia oleracea* (Spinach)

Table 2: Community analysis of plant parasitic nematodes associated with *Allium cepa* (Onion)

Genus	AF (%)	RF (%)	RD (%)	AD (%)	RPV (%)	MI
<i>Merlinius microdorus</i> (Geraert, 1966) Siddiqui, 1970	100	22.5	13.4	20.4	14.4	39
<i>Boleodorus cylindricus</i> Dhanachand, Renubala and Anandi, 1993	90	20.3	24.3	37	25	81
<i>Pratylenchus sativus</i> Kaul, 1985	96.6	21.7	15.4	23	16.3	48
<i>Helicotylenchus graminophilus</i> Fotedar and Mahajan, 1974	83.3	18.7	23	35	22.5	84

AF= Absolute frequency, RF= Relative frequency, RD= Relative Density, AD= Absolute density, RPV= Relative prominence value, MI= Mean Intensity

AF= Absolute frequency, RF= Relative frequency, RD= Relative Density, AD= Absolute density, RPV= Relative prominence value, MI= Mean Intensity

Fig. 2: Graphical presentation of various ecological parameters of different genera on *Allium cepa* (Onion)

Fig. 3: *Merlinius microdorus* (Geraert, 1966) Siddiqui, 1970

Fig. 4: *Helicotylenchus graminophilus* Fotedar and Mahajan, 1974

Fig. 5: *Boleodorus cylindricus* Dhanachand, Renubala and Anandi, 1993

Fig. 6: *Pratylenchus sativus* Kaul, 1985

90%, 96.6% and 83.3%, respectively (Table 2; Fig. 2). Figures 3-6 depict morphology of the nematodes recorded in this study.

The present results in regard with the survey and population analysis part on this host is in good conformity with the work of other researchers over different parts of the world. A general survey of plant parasitic nematodes associated with Sweet potato in Niger was carried out by Haougui *et al.* (2011) whose findings validate the present variables. Bhattacharya *et al.* (2012) studied the biodiversity of plant parasitic nematodes of Cashew Plantations in Tripura, India and reported similar results. Plant parasitic nematodes associated with vegetables growing in greenhouses in south eastern Anatolia region, Turkey were studied by Tan and Kilic (2012) depicted similar results. Reports by Fotedar and Mahajan (1972); Fotedar and Handoo (1977); Kaul (1985); Manjrekar and Talgeri (1969); Mahajan (1973) conform well with the present results.

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