Journal of Scientific Research and Reports

Volume 31, Issue 1, Page 287-299, 2025; Article no.JSRR.128637
ISSN: 2320-0227

Community Analysis of Plant Parasitic Nematodes in the Rhizosphere of Vegetable Crops in Jorhat, Assam

Arkadeb Chatterjee [a*] and Debanand Das [a]

[a] Department of Nematology, Assam Agricultural University, Jorhat, Assam, India.

Authors' contributions

This work was carried out in collaboration between both authors. Author AC conducted the experiment, managed the literature researches, performed the statistical analyses and wrote the manuscript. Author DD designed the study and validated the investigation. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/jsrr/2025/v31i12768

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/128637

Original Research Article

Received: 29/10/2024
Accepted: 31/12/2024
Published: 17/01/2025

ABSTRACT

The study aimed to analyze the community composition, abundance, and distribution of plant-parasitic nematodes in the rhizosphere of vegetable crops in the Jorhat district of Assam, with a focus on identifying dominant nematode species and assessing their impact on crop health. A comprehensive approach employing nematode sampling, identification, and statistical analysis to evaluate nematode population. The study was conducted in five locations (Alengmora, Teok, Jorhat, Titabar, and Mariani) of the Jorhat district, Assam, India, from 2021 to 2022. A total of 146 composite soil and root samples were collected from the rhizosphere of 39 vegetable crops. Nematodes were extracted and morphologically identified nematode species were classified into eight genera, and community metrics such as absolute frequency, relative frequency, absolute density, relative density, prominence value, and plant-parasitic index were calculated following

**Corresponding author: E-mail: arkadeb.chatterjee.amj20@aau.ac.in;*

Cite as: *Chatterjee, Arkadeb, and Debanand Das. 2025. "Community Analysis of Plant Parasitic Nematodes in the Rhizosphere of Vegetable Crops in Jorhat, Assam". Journal of Scientific Research and Reports 31 (1):287-99. https://doi.org/10.9734/jsrr/2025/v31i12768.*

Norton's methodology. The index of similarity was used to compare nematode communities across locations. Eight nematode species from eight genera were recorded. *Meloidogyne incognita* was the most dominant species, exhibiting the highest mean absolute density (5356.01) and relative density (44.51%). It also had the highest prominence value (247.25). Alengmora, Teok, and Jorhat locations harbored all eight nematode species, while Titabar and Mariani had six each. The index of similarity revealed considerable overlap in nematode species among the locations. The study highlights the dominance of *M. incognita* in the Jorhat district, emphasizing the need for targeted nematode management strategies. The findings offer critical insights into nematode ecology and underscore the importance of site-specific interventions to reduce crop losses in vegetable production systems.

Keywords: Plant-parasitic nematodes; community analysis; vegetable crops; root-knot nematode.

1. INTRODUCTION

India’s warm and humid climate is perfect for growing vegetables. One of the main obstacles to the productive development of crops, particularly vegetable crops, is the presence of plant parasitic nematodes (PPNs). Nematodes that parasitize plants seriously threaten the successful cultivation of many commercial crops by reducing their output, productivity, and quality (Jones *et al*., 2013). Therefore, it is crucial to understand what nematode species are present and at what population level (Agrios, 2005).

Since most developing nations are located in the tropical and sub-tropical regions, where the climatic conditions are best suited for plant growth, development, and reproduction, crops grown there suffer more from the attack of PPNs. As a result, the problem is more serious in developing nations than in developed ones. The sandy, warm soil in many underdeveloped nations is better suited for nematode invasion.

The amount of PPNs in the soil and crop loss is directly correlated, with more nematodes causing higher yield loss (Trudgill and Blok, 2001). The density of nematodes can be used to determine whether treating soil with fumigants or other nematicides is cost-effective before planting or after that. The kind of cultivation, season, prior crop, soil type, environmental factors, and worm control strategies can all impact the population density and distribution of nematodes in fields.

2. MATERIALS AND METHODS

A roving survey was conducted during 2021-22 in five locations in the Jorhat districts of Assam. A soil tube auger was taken for collecting soil and root samples from thirty-nine different vegetable crops from five locations of the Jorhat district.

A total of one hundred and forty-six soil samples along with roots were collected in zig-zag method from the rhizosphere of brinjal, knol-khol, tomato, potato, bean, French bean, squash, pea, cowpea, mustard green, radish, bitter gourd, bottle gourd, cauliflower, onion, garlic, Chinese mellow, broccoli, pumpkin, cabbage, cucumber, chilli, carrot, spinach, beetroot, ivy gourd, sweet potato, ginger, pointed gourd, ash gourd, taro, yam, coriander, lesser yam, sponge gourd, okra, zucchini, amaranthus, tapioca, watermelon, and ridge gourd; grown at different places of Jorhat district. Each composite sample of 250 cc was made up of several sub-samples. Extraction of nematode from soil was done by Cobb’s modified decanting and sieving technique (Christie and Perry, 1951). The extraction of nematodes from the root samples (5 gm) was done by modified Baermann’s funnel technique (Christie and Perry, 1951).

Extracted nematodes in water were observed under Magnus MS24 stereozoom binocular microscope for primary identification of nematodes. The nematodes were picked separately, killed & fixed, processed in Seinhorst’s method (1962) for clearing the nematodes for better observation. The cleared nematodes were placed in anhydrous glycerin on laboratory slides (75 x 26 mm), topped with a clean coverslip (18 mm, No. 1), and sealed with paraffin wax. All measurements were taken with the help of Zeiss Axiostar Plus trinocular research microscope using an ocular micro-meter calibrated properly with a stage micrometer. For denoting the dimensions of nematodes, de Man’s (1880) formula and de Grissie’s (1964) symbols were used. According to Norton's formula (1978), each nematode’s absolute frequency, relative frequency, absolute density, relative density, plant-parasitic index and prominence value were determined.

3. RESULTS AND DISCUSSION

Tylenchorhynchus Annulatus: (Cassidy, 1930) Golden, 1971 (nec *T. annulatus* (Merny, 1964) comb. n. (=*T. triversus* nom. nov.))

Synonyms:

Tylopharynx annulatus (Cassidy; 1930)

Anguillulina annulatus (Cassidy, 1930) Goodey, 1932

Chitinotylenchus annulatus (Cassidy, 1930) Filipjev, 1936

Ditylenchus annulatus (Cassidy, 1930) Sher, 1970

Tylenchorhynchus martini Fielding, 1956

Dimensions:

Females (15**):** L = 0.61-0.73 mm (0.70 mm); a = 30-33 (31.68); b = 4.5-5.3 (4.86); c = 12-15 (13.42); c' = 3-4 (3.48); V = 53-57 (55.68); Stylet length = 18-22 µm (20.5 µm); MB = 45-53 (48.87); O = 13.5-16.6 (14.78)

Males: Not found.

Descriptions:

Females: Body ventrally arcuate upon fixation; cuticle moderately thick, distinctly annulated by deep striae 2 µm apart near midbody; no longitudinal striae. Lateral fields about one-third of the body width; with 4 incisures, outer incisures crenate. Lip region rounded, slightly set off from body with 3 lip annules, 6-7 µm wide and 3-5 µm high; cephalic framework slightly sclerotized with outer margins extending 2 to 3 annules into body. Stylet is 18-22 µm long, anterior conical part solid, needle-like in distal half, almost equal in size with that of posterior shaft part with distinct, rounded basal knobs, about 3 µm across. Orifice of dorsal oesophageal gland 2-3 µm from the stylet base. Median oesophageal bulb oval, 6-7 body annules long, slightly anterior from the middle of the oesophagus in position. Basal oesophageal bulb sac-like, with a distinct cardia, pushing into its base slightly ventrally; dorsal oesophageal gland prominent. Nerve ring at 90-97 µm; middle of isthmus. Excretory pore 95-111 µm from the anterior end. Hemizonid prominent, 2 body annules long, just in front of excretory pore. Vulva a transverse slit; vagina straight, extending half-way into body. Ovaries paired, outstretched, opposed, with a single row of oocytes. Spermatheca absent. Rectum shorter than anal body width, partially overlapped by intestine; anus distinct. Phasmids distinct, pore-like, 13-17 µm or 7-8 annules behind anus, anterior to middle of tail. Tail elongate, sub cylindrical, straight, 45-62 µm long, 20-24 annules ventrally, with broadly rounded unstriated terminus. Phasmids located in the anterior half of tail, 7-8 annules behind anus.

Males: Not found.

Habitat and locality: Soil samples around the rhizosphere of bean, pea and cowpea grown at different places of Titabar, Alengmora, Teok, horticultural farm of Assam Agricultural University, Jorhat and Mariani.

Remarks: The present population confirm well with the dimensions and descriptions of females of *Tylenchorhynchus annulatus* given by Siddiqi, 1976.

Hoplolaimus indicus Sher, 1963

Synonyms:

Basirolaimus indicus (Sher) Shamsi, 1979

Hoplolaimus arachidis Maharaju & Das, 1982

Basirolaimus arachidis (Maharaju & Das) Siddiqi, 1986

Dimensions:

Females (11): L = 1.92-1.58 mm (1.41 mm) a = 25-37 (30.66); b = 7.20-9.82 (8.58); b' = 6.4-7.2 (6.99); c = 66-72 (69.12); c' = 0.60-0.66 (0.63); V = 53-56 (55.83); MB = 54-65 (60.4); Stylet length = 33-39 µm (35.57 µm).

Males (5): L =1.12-1.15mm (1.13 mm); a = 29-33 (30.75); b = 8.0-8.3 (8.1); b′ = 5.5-7.1 (6.4); c = 32.8-42.2 (38.2); Stylet length = 33-35 µm (34 µm); Spicule = 38-42 µm (39.7 µm); Gubernaculum = 17-20 µm (18.3 µm).

Descriptions:

Females: Body elongate-cylindrical, curved ventrally to varying degree upon fixation, tapering anterior to oesophagus. Lateral fields with four incisures, indistinct in most part of the body. Lip

region setoff, hemispheroid, 13-15 µm wide with 3-4 distinct annules. Cephalic framework strongly developed with high sclerotization. Stylet massive, with anteriorly projected anchor shaped or tulip shaped basal knobs, 7.5-8.2 µm across. Dorsal oesophageal gland opens 3-5 µm from the stylet base. Median oesophageal bulb spherical at about the middle of oesophagus, 85-85 µm from the anterior end. Oesophageal glands with six nuclei, overlapping intestine dorsally. Nerve ring encircling the isthmus at 100-110 µm. Excretory pore located at 120-132 µm from the anterior end. Hemizonid 3-4 annules behind excretory pore. Metacorpus spheroid, located at middle of oesophagus, with well-developed valve. Anterior phasmid on right and posterior on left side of body. Cuticle coarsely annulated. Spermatheca present, usually containing sperms. Vulva transverse slit. Vagina almost right angle to the body axis. Ovaries outstretched, but obscured by intestinal globules. Epitygma single on anterior lip of vulva. Intestine slightly overlapping rectum. Tail 18-20 µm long with 10-13 annules ventrally, hemispherical to broadly rounded. Cuticle markedly thicken in tail terminus.

Males: Similar to female in general morphology but, proportionately smaller in dimensions. Testis single, outstretched. Spicules slightly arcuate and cephalated, 1.4-2.0 times the anal body width in length, gubernaculum about half of the spicule length with titillae. Tail 26-28 µm long, completely enveloped by bursa. Bursa 52-55 µm long.

Habitat and locality: Soil samples around the rhizosphere of brinjal, tomato, bean, squash, pea, cowpea, broccoli and watermelon grown at different places of Titabar, Alengmora, Teok, horticultural farm of Assam Agricultural University, Jorhat and Mariani.

Remarks: The present population confirm well with the dimensions and descriptions of males and females of *Hoplolaimus indicus* given by Sher (1963) and Khan & Chawla (1975).

Scutellonema brachyurus (Steiner, 1938) Andrássy, 1958

Synonyms:

Rotylenchus brachyurus Steiner, 1938

Rotylenchus coheni Goodey, 1952

Rotylenchus boocki Lordello, 1957

Scutellonema boocki (Lordello) Andrássy, 1958

Scutellonema coheni (Goodey) Andrássy, 1958

Scutellonema sheri Edward & Rai, 1970

Scutellonema ramai Verma, 1972

Scutellonema orientale Rashid & Khan, 1974

Dimensions:

Females (5): L = 0.70-0.88 mm (0.82 mm); a = 25.3-33.4 (27.6); b = 5.3-7.1 (6.1); c = 49.0-74.2 (62.7); c' = 0.6-0.9 (0.7); V = 56-61 (57); Stylet length = 22-27 µm (26 µm)

Males: Not found

Descriptions:

Females: Body forming a single spiral; annulations distinct, average annule width 1.3 µm near midbody. Lip region hemispherical, slightly set off by a constriction, with 3 to 4 annules of irregular width and a terminal flat labial disc; basal annule marked by 6 longitudinal striae; framework strongly sclerotized, its outer margins inwardly concave, extending posteriorly one body annule. Stylet well developed, 26-30 µm long, in two almost equal parts; basal knobs prominent, rounded with slightly flattened anterior surfaces, 4.5 µm across. Dorsal oesophageal gland opening rather obscure, about 5 µm behind spear knobs. Cephalids, hemizonid, and hemizonion indistinct. Oesophagus typical of the genus, slightly contracted at base of isthmus. Median oesophageal bulb ovoid, extending over 8 body annules. Nerve ring encircling isthmus a little behind median bulb, well anterior to excretory pore which lies at approximately 88 body annules behind the lip region and about one body-width behind the oesophageal glands. Oesophageal glands overlap intestine dorsally. Gonads amphidelphic, symmetrical, on left side of intestine. Ovaries outstretched with oocytes in a row except for 4 or 5 in multiplication zone near tip. Single egg in posterior uterus. No spermatheca or sperms in uterus. Epiptygma double, indistinct, not projecting out through vulva. Intestine extending slightly over rectum. Tail broadly rounded, about half anal body-width long, annulations following tail contour; annules

slightly irregular and coarser than adjacent body annules; 8 annules between anus and tail tip. Phasmids enlarged, 3-4 Âµm in diameter, anterior to anus.

Males: Not found

Habitat and locality: Soil samples around the rhizosphere of tomato, potato, bean, pea, cowpea, chilli, beetroot, sweet potato and ginger grown at different places of Alengmora, Teok and horticultural farm of Assam Agricultural University, Jorhat.

Remarks: The present population confirm well with the dimensions and descriptions of females of *Scutellonema brachyurus* given by (Steiner, 1938) Andrássy, 1958.

Helicotylenchus dihystera (Cobbs, 1893) Sher, 1961

Synonyms:

Tylenchus dihystera Cobb, 1893

Tylenchus olaae Cobb, 1906

Tylenchorhynchus olaae (Cobb) Micoletzky, 1922

Helicotylenchus olaae (Cobb) Siddiqi, 1986

Aphelenchus dubius var. *peruensis* Steiner, 1920

Tylenchus spiralis Cassidy, 1930

Helicotylenchus spiralis (Cassidy) Sher, 1961

Helicotylenchus spiralis (Cassidy) Siddiqi, 1986

Helicotylenchus nannus Steiner, 1945

Helicotylenchus crenatus Das, 1960

Helicotylenchus flatus Román, 1965

Helicotylenchus punicae Swarup & Sethi, 1968

Helicotylenchus paraconcavus Rashid & Khan, 1974

Helicotylenchus reversus Sultan, 1985

Helicotylenchus membranatus Xie & Feng, 1993

Dimensions:

Females (15): L = 0.53-0.71 mm (0.64 mm); a = 22-33 (28.08); b = 5-7 (6.09); b' = 4.2-6.0 (4.85); c = 40-49 (47); c' = 0.9-1.2 (1.01); V = 63-67 (65.33); Stylet length = 21-27 µm (23.4 µm); O = 38-50 (42); MB = 65-78 (71.8)

Males: Not found

Descriptions:

Females: Body spiral upon fixation, tapering slightly towards anterior end; striae distinct. Lip region semi-hemispherical, with 4 or 5 annules, continuous with body contour; outer margins of labial framework conspicuous, extending 2-3 annules into body. Lateral fields one-fourth body width wide, with 4 incisures, not areolated. Stylet well developed; anterior tapering part 9.0-10.5 µm long; basal knobs about 4.5 µm across with indented anterior surfaces. Stylet guide prominent, apparently providing attachment surfaces for the protracter muscles of the stylet. Orifice of dorsal oesophageal gland below 9-11 µm from the stylet base. Median oesophageal bulb oval, 6-8 body annules long. Nerve ring located at 95-105 µm from anterior end. Excretory pore anterior to oesophageal glands. Hemizonid 2-3 annules long, just anterior to excretory pore. Oesophageal glands overlapping intestine on all sides at the anterior portion, extended more on the ventral side than the dorsal.

Vulva a transversal slit, at around 65% of the body, vagina extended half way across body. Ovaries paired, outstretched, with oocytes arranged in single row. Both anterior and posterior reproductive tract equally developed. Epiptygma not seen. Spermatheca slightly offset, without sperm. Tail dorsally convex -conoid to a narrow terminus with slight ventrical

Males: Not found

Habitat and locality: Soil samples around the rhizosphere of brinjal, tomato, potato, bean, squash, pea, cowpea, mustard green, onion, pumpkin, cabbage, cucumber, chilli, carrot, spinach, beetroot, sweet potato, taro, yum, lesser yam, sponge gourd, okra, zucchini and amaranthus grown at different places of Titabar,

Alengmora, Teok, horticultural farm of Assam Agricultural University, Jorhat and Mariani.

Remarks: The present population confirm well with the dimensions and descriptions of females of *Helicotylenchus dihystera* given by Sher (1961) and Baqri & Ahmed (1984).

Rotylenchulus reniformis Linford and Oliveira, 1940

Synonyms

Tetylenchus nicotiana Yokoo and Tanaka in Tanaka & Tsumagori, 1954

Rotylenchus elisensis Carvalho, 1957

Spyrotylenchus queirozi Lordello and Cesnik, 1958

Helicotylenchus elisensis (Carvalho) Carvalho, 1959

Leiperotylenchus leiperi Das, 1960

Rotylenchulus leiperi (Das) Loof & Oostenbrunk, 1961

Rotylenchulus queirozi (Lordello & Cesnik) Sher, 1961

Rotylenchulus nicotiana (Yokoo and Tanaka in Tanaka & Tsumagori) Baker, 1962

Rotylenchulus stakmani Husain & Khan, 1965

Rotylenchulus elisensis (Carvalho) Siddiqi, 1986

Dimensions:

Immature Females (15): L = 0.31-0.35 mm (0.33 mm); a = 20-26 (23); b = 3-4 (3.5); b' = 3-4 (3.3); c = 14-17 (15.5); c' = 2-4 (3); V = 70-73 (72); Stylet length = 16-19 µm (17.5 µm); O = 64-80 (74.4).

Males (10): L = 0.35-0.39 mm (0.37 mm); a = 24-27 (25.5); b = 4-5 (4.5); b' = 3.3-3.9 (4.5); c = 15.8-17 (16.4); c' = 2-3 (2.5); Stylet length = 14-15 µm (14.6 µm); Spicule = 18-20 µm (19 µm); Gubernaculum = 8 µm

Descriptions:

Immature female: Body vermiform, assume open C-shaped when killed by gentle heat. Length 0.31-0.35 mm. Cuticular annulation coarse, about 1.5-2.0 µm apart at mid body. Lateral fields about one-third of body width. Lip region conical, continuous with body contour, 4-5 annules. Cephalic framework moderately developed. Stylet attenuated, well developed, about two and half lip width long, with slightly slanted rounded basal knobs. Dorsal Oesophageal Gland opens about one stylet behind the stylet base. The median oesophageal bulb oval to round with distinct valves and the basal glands of oesophagus overlap the intestine laterally and sub ventrally. Nerve ring at 70-75 Length less than 0.4 mm. from the anterior end and excretory pore slightly behind the nerve ring, hemizonid anterior to excretory pore. Oesophageal lumen very much prominent.

Vulva posterior, at 70-73% of body, well differentiated transverse slit. Vulva lips not protuberant. Gonads amphidelphic. Vulva-anus distance 60-65 µm. Tail conoid, 20-25 µm, crenate, tapers to a narrow rounded terminus.

Males: Vermiform. Anterior end reduced; stylet reduced. The oesophagus is degenerate with reduced median bulb and valve. Sexual dimorphism present. Spicules elongate-slender, 18-20 µm long, slightly arcuate, ventrally curved, about the twice the anal body diameter long. Gubernaculum 8 µm long. Bursa sub-terminal, not enveloping the tail, about 25 µm long. Caudal alae present, difficult to see, not quite reaching tail end.

Habitat and locality: Soil samples around the rhizosphere of brinjal, tomato, potato, bean, squash, pea, cowpea, radish, bitter gourd, bottle gourd, onion, garlic, broccoli, cucumber, carrot, spinach, beetroot, sweet potato, ginger, pointed gourd, ash gourd, taro, yum, lesser yam, sponge gourd, okra and watermelon grown at different places of Titabar, Alengmora, Teok, horticultural farm of Assam Agricultural University, Jorhat and Mariani.

Remarks: The present population confirm well with the dimensions and descriptions of juveniles and males of the type species of *Rotylenchulus reniformis* given by Linford and Oliviera (1940).

Meloidogyne incognita (Kofoid & White, 1919) Chitwood, 1949

Synonyms:

Oxyuris incognita Kofoid & White, 1919

Heterodera incognita (Kofoid & White) Sandground, 1923

Meloidogyne incognita incognita (Kofoid & White) Chitwood, 1949

Meloidogyne acrita Chitwood, 1949

Meloidogyne incognita acrita Chitwood, 1949

Meloidogyne elegans da Ponte, 1977 (syn. of *M. incognita incognita* for Jepson, 1987)

Meloidogyne grahami Golden & Slana, 1978

Meloidogyne incognita grahami Golden & Salana, 1978 (Jepson, 1987)

Meloidogyne incognita inornata Lordello, 1956

Meloidogyne inornata Lordello, 1956

Meloidogyne kirjanovae Terenteva, 1965 (syn. by Karssen & Hoenselaar, 1998)

Meloidogyne wartellei Golden & Birchfield, 1978

Meloidogyne incognita wartellei Golden & Birchfield, 1978

Dimensions:

Mature females (5): L = 0.50-0.57 mm (0.55 mm); width = 0.42-0.45 µm (0.43 µm); stylet length = 13-15 µm (14 µm); neck length = 12.5-15.0 µm (13.5 µm); stylet base width = 3.2-4.9 µm (4.5 µm); dorsal oesophageal gland orifice = 2.3-3.8 µm (3.3 µm) behind stylet base; median bulb length = 37.5-42.2 µm (38.7 µm); median bulb width = 31.4-39.8 µm (33.3 µm)

Males (3): L = 1.20-1.85 mm (1.48 mm); a = 32.1-54.9 (44.2); b' = 13.8-20.5 (17.4); c = 97-255 (146); stylet length = 25.0-31.9 µm (27.5 µm); stylet base width = 4.9-6.5 (5.7) µm; dorsal oesophageal gland orifice = 1.7-2.3µm (1.9 µm) behind stylet base; median bulb length = 14.9-24.8µm (19.0 µm); median bulb width = 9.0-15.3µm (12.4 µm); spicules = 31.2-40.1µm (36.8 µm); gubernaculum = 9.9-13.4µm (11.5 µm).

Second-stage juveniles (15): L = 0.40-0.43 mm (0.41 mm); a = 24-29 (25.5); b = 2.5-3.0 (2.7); b' = 6.7-8.2 (7.1); c = 8.12-9.2 (8.52); tail length = 40-54 µm (47 µm); stylet length = 10-12 µm (11 µm); median bulb length = 10.5-12.4 µm (11.9 µm); median bulb width = 6.0-8.0 µm (7.0 µm).

Descriptions:

Mature females: Endoparasitic, body pear-shaped, pearly white, with projected neck. Cuticle translucent and glistening. Annulations visible in neck and vulva-anus region. Lip region setoff, 4-5 µm across, consists of a cup and having 2-3 annules. Stylet slender with distinct rounded knobs. Oesophagus well developed with large cylindrical procorpus and rounded metacorpus. Orifice of dorsal oesophageal gland 4-5 µm from the base of the stylet. Excretory pore just behind the level of stylet knobs. Perineal pattern wavy or zig-zag dorsally or laterally, striae closely spaced. Dorsal arch high and squarish or round, ventral arch round and striae plain. Lateral fields not clean, pattern merging into body striae.

Males: Body vermiform, 1.20-1.85 mm in length. Head continuous. Shaft of stylet shorter than conus, stylet knobs prominent. Excretory pore at level of posterior end of isthmus with hemizonid 5 annules anterior. Tail bluntly rounded, terminus unstriated. Phasmids at cloaca level or just posterior. Spicules slightly curved, gubernaculum crescentic.

Second-Stage Juveniles (J2): Body vermiform, 0.41 mm in length. Head region continuous with the body contour. Cephalic framework not fully developed. Lip region bearing faint post labial annules. Stylet knobs prominent, rounded. Hemizonid 2-3 annules long, just anterior to excretory pore. Lateral field with 4 incisures, outer bands areolated. Rectum inflated. Tail long, conoid 40-45 µm long.

Habitat and locality: Soil samples around the rhizosphere of brinjal, knol-khol, tomato, potato, bean, squash, pea, cowpea, mustard green, radish, bitter gourd, bottle gourd, onion, garlic, broccoli, pumpkin, cucumber, chilli, carrot, spinach, beetroot, ivy gourd, sweet potato, ginger, colocasia, taro, yum, coriander, lesser yam, sponge gourd, okra, zucchini, watermelon and ridge gourd grown at different places of Titabar, Alengmora, Teok, horticultural farm of Assam Agricultural University, Jorhat and Mariani.

Remarks: The present population confirm well with the dimensions and descriptions of juveniles, males and females of *Meloidogyne incognita* given by Orton Willams (1973).

Macroposthonia onostris Phukan & Sanwal, 1980

Synonyms: *Mesocriconema onostris* (Phukan & Sanwal) Loof & De Grisse, 1989

Dimensions:

Females (15): L = 0.39-0.51 mm (0.48 mm); a = 10-15 (14.16); b = 3.3-3.9 (3.65); c = 16.0-25.8 (17.10); c' = 1.1-1.2 (0.90); V = 89-94 (91.30); R_{st} = 13-18 (15.70) R_{oes} = 24-32 (27.5); R_{ex} = 26-32 (29.66); RV = 6-8 (7); R_{an} = 4-6 (5); R_{van} = 2-3 (2.5); R = 98-128 (123.33) VL/VB= 1.0-1.2 (1.1); Stylet length = 50-55 µm (54 µm).

Males: Not found

Descriptions:

Females: Body stout, ventrally arcuate upon fixation, tapering slightly towards both extremities. Annules coarse, posterior margin rounded, smooth, 5-6 µm apart at mid body, 30-33 annules up to oesophago-intestinal junction, 73-89 annules from oesophago-intestinal junction to vulva, 2-3 annules from vulva to anus and 3-6 annules from anus to tail terminus. Margins of body annules are rounded and margins of posterior annules are retorse. Lip annules distinct, continuous, 2 in number, 1st lip annule with little anteriorly directed margins, 12-13 µm wide, 2nd lip annule with laterally directed margins, 15-17 µm wide. Metenchium 38-42 µm long or 72-76 percent of total stylet length. Basal knobs anchor shaped, 9-10 µm across located on 15-18 body annules from anterior end. Orifice of dorsal oesophageal gland 3-4 µm from stylet base. Nerve ring at 96-99 µm from the anterior end. Oesophago-intestinal junction 104-124 µm from the anterior end. Excretory pore behind the oesophago-intestinal junction and hemizonid anterior to excretory pore. Vulva to tail terminus 28-35 µm, tail slightly tapering from both the sides to a blunt terminus.

Males: Not found

Habitat and locality: Soil samples around the rhizosphere of brinjal, tomato, bean, squash, mustard green, radish, cauliflower, chinese mellow, broccoli, pumpkin, cabbage, carrot, spinach, beetroot, taro, yum, sponge gourd, okra, tapioca, watermelon and ridge gourd grown at different places of Titabar, Alengmora, Teok, horticultural farm of Assam Agricultural University, Jorhat and Mariani.

Remarks: The present population confirm well with the dimensions and descriptions of females of *Macroposthonia onostris* given by Phukan and Sanwal (1980).

Xiphinema radicicola Goodey, 1936

Synonyms: *Xiphinema hunaniense* Wand & Wu, 1992

Dimensions:

Females (5): L = 1.80-2.00 mm (1.90 mm); a = 47-51 (49.25); b = 5-7 (6); c = 24-40 (30.25); c' = 2-3(2.5); V = 25-28 (26.5); Odontostyle = 92-105 µm (98.5 µm); Odontophore = 52-63 µm (57.75 µm); total stylet length = 154-158 µm (156.25 µm); anterior end to guiding ring = 80-91 µm (85 µm)

Males: Not found

Descriptions:

Females: Body slightly arcuate upon fixation. Body tapering gradually towards extremities. Cuticle 2-3 µm thick at mid body and 4-5 µm on tail. Lateral chord about ¼ of the body width near middle. Lip region continuous, flat, about 12-13 µm wide. Amphideal aperture 7 µm wide, about half of the lip region width. Odontostyle about 8 lip width long, odontophore $^{1}/_{1.7}$ th or $^{1}/_{1.9}$ th of odontostyle length. Fixed guiding ring is about 7 labial width from the anterior end. Expanded oesophagus about 74 µm or about 23 per cent of the total oesophageal length. Cardia short and conoid. Nerve ring 24-26 µm or 2 labial width behind odontophore base. Prerectum about 357-368 µm. Rectum less than anal body width. Reproductive system mono-opisthodelphic. Ovary well developed and reflexed, oviduct narrow distally and expanded at proximal end. Uterus wide and a sphincter present in between oviduct and uterus. Vagina thick walled, slightly inclined posteriorly. Tail dorsally convex-conoid, ventral surface is almost straight, terminus digited. Two lateral pores present in the tail.

Males: Not found.

Habitat and locality: Soil samples around the rhizosphere of potato and carrot grown at different places of Alengmora, Teok and horticultural farm of Assam Agricultural University, Jorhat.

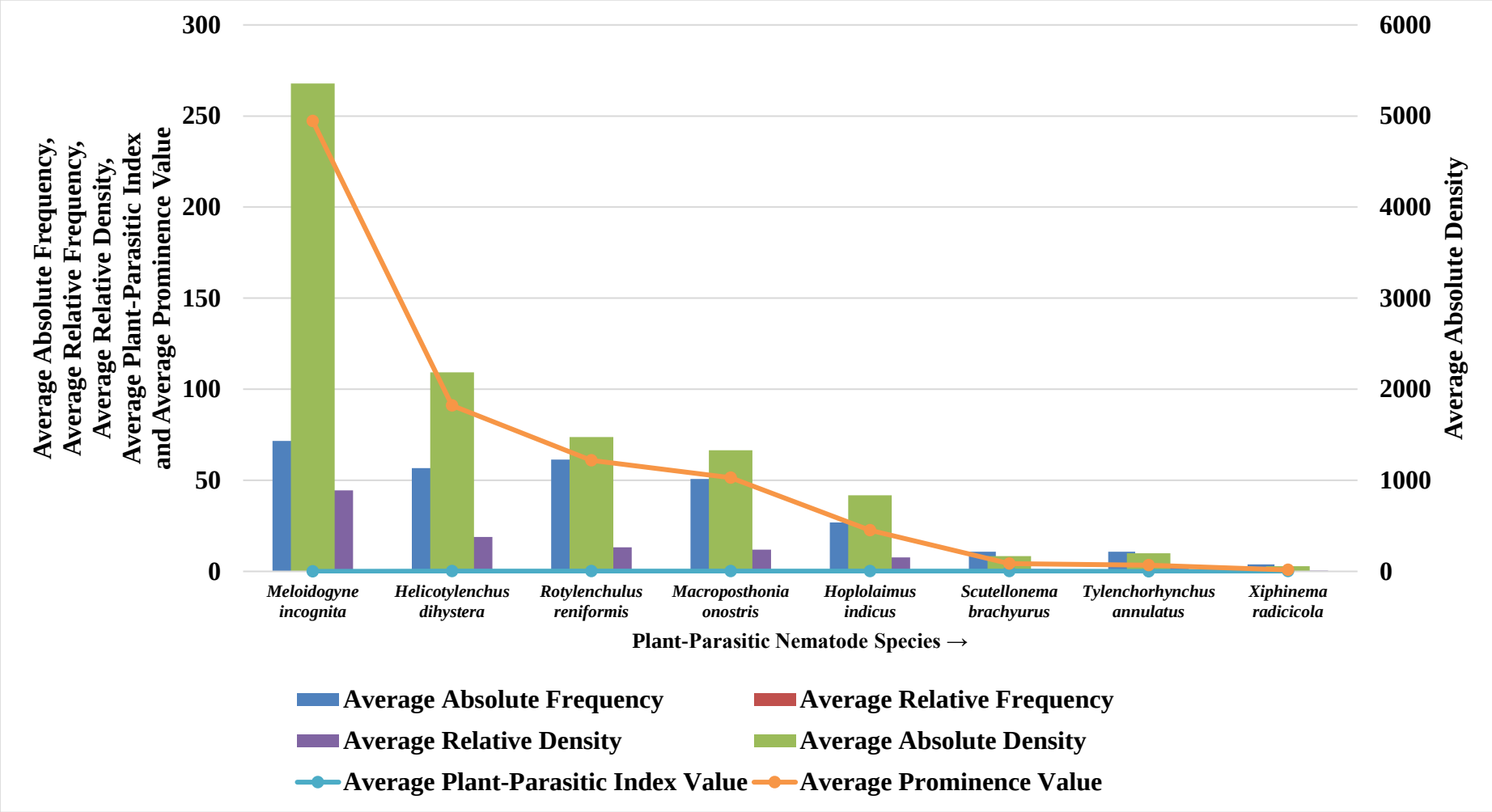

Fig. 1. Graphical representation of community analysis among various plant-parasitic nematodes associated with different vegetable crops in Jorhat district of assam during 2021-2022

Remarks: The present population confirm well with the dimensions and descriptions of females of *Xiphinema radicicola* given by Loss (1949); Bajaj and Jairajpuri (1979); Luc et al. (1986) and Rahman *et al*. (1986).

In the present investigation, eight species of PPNs belonging to eight genera, *viz*., *Meloidogyne*, *Helicotylenchus*, *Rotylenchulus*, *Macroposthonia*, *Hoplolaimus*, *Tylenchorhynchus*, *Scutellonema*, *Xiphinema* were recorded from the rhizosphere of different vegetable plants of Jorhat district.

Of these eight species *Meloidogyne incognita* (71.58%), *Rotylenchulus reniformis* (61.36%), *Helicotylenchus dihystera* (56.71%) and *Macroposthonia onostris* (50.76%) were predominant in respect of mean absolute frequency. Other nematode species recorded were *Hoplolaimus indicus* (26.81%), *Tylenchorhynchus annulatus* (10.83%), *Scutellonema brachyurus* (10.78%) and *Xiphinema radicicola* (3.83%). *Meloidogyne incognita* (24.18%) ranked first in mean relative frequency followed by *Rotylenchulus reniformis* (20.84%), *Helicotylenchus dihystera* (19.84%), *Macroposthonia onostris* (17.42%), *Hoplolaimus indicus* (9.16%), *Tylenchorhynchus annulatus* (3.69%), *Scutellonema brachyurus* (3.53%) and *Xiphinema radicicola* (1.30%). (Fig. 1.).

Meloidogyne incognita ranked first in mean absolute density and mean relative density (5356.01% and 44.51% respectively) and was followed by *Helicotylenchus dihystera* (1882.70% and 18.93%), *Rotylenchulus reniformis* (1433.71% and 13.28%), *Macroposthonia onostris* (1331.57% and 11.92%), *Hoplolaimus indicus* (836.09% and 7.64%), *Tylenchorhynchus annulatus* (199.84% and 2.02%), *Scutellonema brachyurus* (168.899% and 1.22%) and *Xiphinema radicicola* (56.81% and 0.43%). (Fig. 1.)

Xiphinema radicicola was the most predominant species having highest plant-parasitic value of 0.204 and followed by *Rotylenchulus reniformis* (0.126), *Macroposthonia onostris* (0.119), *Scutellonema brachyurus* (0.115), *Helicotylenchus dihystera* (0.095), *Hoplolaimus indicus* (0.094), *Meloidogyne incognita* (0.045) and *Tylenchorhynchus annulatus* (0). (Fig. 1).

A perusal of results revealed that *Meloidogyne incognita* recorded the highest prominence value of 247.25 followed by *Helicotylenchus dihystera* (77.62), *Rotylenchulus reniformis* (59.37), *Macroposthonia onostris* (51.51), *Hoplolaimus indicus* (22.47), *Scutellonema brachyurus* (4.26), *Tylenchorhynchus annulatus* (3.45) and *Xiphinema radicicola* (0.80). (Fig. 1).

Out of the five locations surveyed in the Jorhat district of Assam, all eight nematode species belonging to eight genera has been recorded from Alengmora, Teok and Jorhat. Soil and root samples collected from Titabar and Mariani revealed the presence of six nematode species belonging to six genera.

So, based on the finding, the index of similarity between Titabar & Alengmora, Titabar & Teok, Titabar & Jorhat, Alengmora & Mariani, Teok & Mariani, and Jorhat & Mariani is 0.75. The index of similarity value is 1 in the case between Titabar & Mariani, Alengmora & Teok, Alengmora & Jorhat, and Teok & Jorhat.

The populations of soil nematodes may offer fresh perspectives on various soil processes. Because most nematodes are active year-round in soil, they may be able to offer a comprehensive assessment of the biotic and functional state of soils and other organisms living there. Representative samples of soil nematode communities are more readily available than samples from other soil microbial communities.

Nevertheless, the majority of recent research on nematode ecology has been survey-based or solely observational in nature, with an ongoing emphasis on in-depth taxonomic analysis of nematode communities. Das and Rahman (1996) reported that *Helicotylenchus dihystera*, *Tylenchorhynchus annulatus* and *Meloidogyne incognita* were the most predominant plant-parasitic nematode species in and around the field and horticultural crops. A study conducted in Jorhat, Deuri and Das (2012) and Deori *et al*. (2014) also reported that *Helicotylenchus dihystera* and *Tylenchorhynchus leviterminalis* and *Meloidogyne incognita* were the most prominent nematodes around the rhizosphere of medicinal and aromatic plants and banana. Kavitha and Das (2016) recorded the association of eight species of PPNs *viz*., *Meloidogyne* sp. *Rotylenchulus* sp. *Pratylenchus* sp. *Helicotylenchus* sp. *Hoplolaimus* sp. *Heterodera* sp. *Trichodorus* sp. and *Xiphinema* sp. with brinjal from Rangareddy

village of Hyderabad. Archidona-Yustu *et al*. (2018) reported that *Meloidogyne* spp. can be found in all horticultural areas of Spain. El-Nudy *et al*. (2019) identified *Belonolaimus*, *Criconema*, *Criconemoides*, *Helicotylenchus*, *Hoplolaimus*, *Meloidogyne*, *Pratylenchus*, *Rotylenchulus*, *Tetylenchus*, *Trichodorus*, *Tylenchorhynchus*, *Tylenchus* and *Xiphinema* from the soil samples collected from the vegetable growing areas of Sania Penninsula of Egypt. Tileubayeva *et al*. (2021) recorded eleven PPNs *viz*., *Scutellonema*, *Helicotylenchus*, *Aphelenchoides*, *Hemicriconemoides*, *Ditylenchus*, *Meloidogyne*, *Rotylenchulus*, *Xiphinema*, *Quinisulcius*, *Pratylenchus*, and *Tylenchulus* from around the rhizosphere of greenhouse vegetable crops. All these reports are in line with the findings of the present investigation.

4. CONCLUSION

This study provides key insights into the community structure and distribution of plant-parasitic nematodes in the rhizosphere of vegetable crops in Jorhat district, Assam. Eight nematode species from eight genera were identified, with *Meloidogyne incognita* emerging as the most dominant species, exhibiting the highest absolute density, relative density, and prominence value. Significant variability in nematode diversity was observed across the five locations, with Alengmora, Teok, and Jorhat harboring all eight species, while Titabar and Mariani reported six species each.

The identification of economically significant species such as *Rotylenchulus reniformis*, *Helicotylenchus dihystera*, and *Macroposthonia onostris* highlights the potential threat to vegetable production in the region. The study emphasizes the importance of adopting region-specific nematode management strategies to mitigate crop damage and improve productivity. These findings contribute to the broader understanding of nematode ecology and offer critical insights for developing site-specific integrated pest management (IPM) strategies aimed at sustaining vegetable production systems in tropical and subtropical regions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

ACKNOWLEDGEMENTS

The authors are thankful to Directorate of Post Graduate Studies, Assam Agricultural University, Jorhat – 13, for providing necessary help during the investigation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Agrios, G. N. (2005). *Plant pathology*. Elsevier Academic Press.

Andrássy, I. (1958). *Hoplolaimus tylenchiformis* Daday, 1905 (Syn. *H. coronatus* Cobb, 1923) und die Gattungen der Unterfamilie Hoplolaiminae Filipjev, 1936. *Nematologica, 3*, 44–56.

Archidona-Yuste, A., Cantalapiedra-Navarrete, C., Liebanas, G., Rapoport, H. F., Castillo, P., & Palomares-Rius, J. E. (2018). Diversity of root-knot nematodes of the genus *Meloidogyne* Göeldi, 1892 (Nematoda: Meloidogynidae) associated with olive plants and environmental cues regarding their distribution in southern Spain. *PLoS ONE, 13*(6). https://doi.org/10.1371/journal.pone.0198236

Baker, A. D. (1962). *Check lists of the nematode superfamilies Dorylaimoidea, Rhabditoidea, Tylenchoidea, and Aphelenchoidea*. E.J. Brill.

Cassidy, G. (1930). Nematodes associated with sugar-cane in Hawaii. *Hawaii. Plant. Rec., 34*(4), 379–387.

Chitwood, B. G. (1949). “Root-knot nematodes” – Part I. A revision of the genus *Meloidogyne* Goeldi, 1887. *Proc. Helminth. Soc. Wash., 16*, 90–104.

Christie, J. R., & Perry, V. G. (1951). Removing nematodes from soil. *Proc. Helminthol. Soc. Wash., 18*(2), 106-108.

Cobb, N. A. (1893). Nematodes, mostly Australian and Fijian. *Macleay Mem. Vol., Linn. Soc. NSW*, 252–308.

Das, D., & Rahman, M. F. (1996). Community analysis of plant parasitic nematodes of

Assam Agricultural University, Jorhat campus. *J. Agric. Sci. Soc. NE India, 9*(1), 69-71.

Das, V. M. (1960). Studies on the nematode parasites of plants in Hyderabad (Andhra Pradesh, India). *Z. ParasitKde, 19*, 553–605.

de Grisse, A. (1964). Morphological observations on *Criconemoides*, with a description of four new species found in Belgium (Nematoda). *Meded. Landb. Opzoek. Staat Gent, 29*, 734–761.

de Man, J. G. (1880). *Die einheimischen, frei in der reinen Erde und im süssen Wasser lebende Nematoden* (Vol. 1). Brill.

Deori, A., Das, D., & Sumita, K. (2014). Nematode community around banana rhizosphere in Jorhat district of Assam. *Indian J. Nematol., 44*(2), 252-254.

Deuri, B. B., & Das, D. (2012). Community analysis of plant parasitic nematodes associated with medicinal and aromatic plants. *Indian J. Nematol., 42*(2), 100 -101.

El-Nuby, A., Montasser, S., & Khadrawy, I. A. (2019). Diversity of plant parasitic nematodes associated with some vegetables in Sinai Peninsula, Egypt. *Egyptian J. Desert Res., 69*(3), 77 -100.

Filipjev, I. N. (1936). On the classification of the *Tylenchinae*. *Proc. Helminth. Soc. Wash., 3*, 80–82.

Golden, A. M. (1971). Classification of the genera and higher categories of the order *Tylenchida* (Nematoda). In B. M. Zuckerman, W. F. Mai, & R. A. Rohde (Eds.), *Plant parasitic nematodes* (Vol. 1, pp. 191–232). Academic Press.

Goodey, T. (1932). The genus *Anguillulina* Gerv. and v. Ben., 1859, vel *Tylenchus* Bastian, 1865. *J. Helminth., 10*, 75–180.

Husain, S. I., & Khan, A. M. (1965). A new genus and six new species of nematodes from India belonging in the family *Neotylenchidae* with an amendation of the subfamily *Ecphyadophorinae*. *Proc. Helminth. Soc. Wash., 32*, 7–15.

Jepson, S. B. (1987). *Identification of root-knot nematodes* (*Meloidogyne* species). Commonwealth Agricultural Bureaux.

Kavitha, B., & Das, V. V. (2016). Characterization of plant-parasitic nematode communities associated with brinjal crops in the Nagole area of Rangareddy district, Hyderabad, Telangana, India. *Int. J. Sci. Res, 5*(5), 2293–2297.

Linford, M. B., & Oliveira, J. M. (1940). *Rotylenchulus reniformis*, nov. gen., n. sp., a nematode parasite of roots. *Proc. Helminth. Soc. Wash., 7*, 35–42.

Loof, P. A. A., & De Grisse, A. (1989). Taxonomic and nomenclatorial observations on the genus *Criconemella* De Grisse and Loof, 1965 sensu Luc and Raski, 1981 (Criconematidae). *Meded. Fac. LandbouWeten. Rijksuniv. Gent, 54*, 53–74.

Lordello, L. G. E., & Cesnik, R. (1958). Alguns nematodeos do tomateiro. *Revta Bras. Biol., 18*, 159–165.

Micoletzky, H. (1922). Die freilebenden Erd-Nematoden. *Arch. Naturg. Berlin Abt. A, 87*(1921), 1–650.

Norton, D. C. (1978). *Ecology of plant parasitic nematodes*. John Wiley & Sons.

Phukan, P. N., & Sanwal, K. C. (1980). Two new species of *Macroposthonia* De Man, 1880 (*Criconematidae*: Nematoda) from Assam. *Indian J. Nematol., 10*(2), 135–140.

Rashid, A., Khan, F. A., & Khan, A. M. (1974). Plant parasitic nematodes associated with vegetables, fruits, cereals, and other crops in North India. I. Uttar Pradesh. *Indian J. Nematol.*

Seinhorst, J. W. (1962). On the killing, fixation, and transferring to glycerin of nematodes. *Nematologica, 8*(1), 29–32.

Shamsi, M. A. (1979). *Basirolaimus* gen. n. (Nematoda: Hoplolaimidae) with the description of *Basirolaimus sacchari* n. sp. from India. *Nematol. Medit., 7*, 15–19.

Sher, S. A. (1961). Revision of the *Hoplolaiminae* (Nematoda). I. Classification of nominal genera and nominal species. *Nematologica, 6*, 155–169.

Sher, S. A. (1970). Reclassification of the genus *Chitinotylenchus* (Micoletzky, 1922) and a redescription of *C. paragracilis* (Micoletzky, 1922) (Nematoda: Tylenchoidea). *J. Nematol., 2*, 236–238.

Siddiqi, M. R. (1986). *Tylenchida: Parasites of plants and insects*. Commonwealth Agricultural Bureaux.

Tileubayeva, Z., Avdeenko, A., Avdeenko, S., Stroiteleva, N., & Kondrashev, S. (2021). Plant-parasitic nematodes affecting vegetable crops in greenhouses. *Saudi J. Biol. Sci., 28*(9), 5428–5433.

Trudgill, D. L., & Blok, V. C. (2001). Apomictic species of root-knot nematodes: Biology, distribution, and control. *Annual Review of Phytopathology, 39*(1), 177–205.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/128637