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Dominant Plant-Parasitic Nematodes in Sugarcane crop: A Affliction to Sugar Production.

Dr. Resha
Department of Science, SDPG College Dankaur, GauttamBuddha Nagar
***Email*: reshareshu@gmail.com**

Abstract: Sugarcane is a significant crop globally, but its production is threatened by plant-parasitic nematodes, particularly *Meloidogyne* and *Pratylenchus* species. Estimated annual losses: $100 billion globally. These nematodes attack sugarcane roots, causing stunted growth, reduced yields, and lower sugar content. The two most common types or class of plant-parasitic nematodes, these are ecto-parasitic &endo-parasitic include *Meloidogyne* (root-knot), *Heterodera* (cyst), and *Pratylenchus* (lesion) species. These nematodes use complex mechanisms to invade and manipulate plant cells, suppressing plant defenses and creating a nutrient-rich environment for themselves. Plant-parasitic nematodes are challenging to manage due to their underground habitat, high reproductive rates, and ability to survive in soil for extended periods.

Keywords:*sugarcane, plant parasitic nematodes, soil sample, root sample.*

INTRODUCTION:

In India, Phyto-nematodes are reported to cause about 10-40 %yield loss in sugarcane and could as well go as high as 50-80% in some crops such as sugarcane, okra, brinjal, and potatoes etc; however, losses may become still higher if phytonematodes are associated with other biotic and abiotic stresses in the field.In Meerut, nematodes have the potential to cause substantial yield losses, yet it is not known whether farmers have knowledge of the damage these pests cause. Plant parasitic nematodes cause about 87 billion dollars annual loss to the crops throughout the world. Nematodes have been known to cause crop losses in vegetables and many cash crop like sugarcane for many years. Whereas they were once considered only a pest in coarse textured sandy soil, it was studied that nematodes are responsible for significant yield loss in sugarcane crop in district Meerut. Soil samples were collected from sugarcane fields in all the seasons from various fields. After processing of samples different genera of plant parasitic nematodes were identified from soil samples. The identification of

plant parasitic nematodes was done on the basis of taxonomic keys as stylet, esophageal, median bulb, vulva or spicules. The identified genera of nematodesof sugarcane from district Meerut were *Hoplolaimus, Tylenchus, Rotylenchus, Helicotylenchus, Pratylenchus, Hoplolaimus*and *Helicotylenchus*.

Plant parasitic nematodes are reported to cause about 10-40 %yield loss in sugarcane crop in India and could as well go as high as 50-80% in some crops such as okra, brinjal, and potatoes etc; however, losses may become still higher if phytonematodes are associated with other biotic and abiotic stresses in the field. Plant parasitic nematodes cause considerable loss to worldwide agriculture (Chitwood, 2003; Abad *et al.,* 2008; Fuller *et al.,* 2008).

About 75% of the sugar harvested from sugarcane crop for human consumption (FAO 2004), it is theWorld's major cash crops. FAO estimates it was cultivated on about 23.8 million hectares, with a worldwide harvest of 1.69 billion tones. India was the second largest producers with 277,750,000 tones than Brazil. The yield gap of sugarcane in India with respect to 10 major sugarcane producing countries during the last 5 years is ranges 1.33 – 31.22t/ha.

The problems caused by phyto-nematodes are common, which was a highlighted by Severino*et al*; (2010). At present 48 genera and 310 species of endoparasitic and ecto parasitic nematodes species have been reported to be associated with rhizosphere soil and roots of various crops including sugarcane (Cadet and Spaull, 2005). Species of five genera namely *Hoplolaimus, Helicotylenchus,Pratylenchus,Tylenchorhynchus* and *Meloidogyne* is listed as major plant parasitic nematodes with wide distribution and common occurrence in soil of India (Mehta *et al*., 1992). A disease complex, known as stubble decline, is responsible for reductions in the ratooning ability of sugarcane crop (Edgerton *et al*., 1934; Edgerton, 1939).

The annual yield loss of World's major crops due to plant parasitic nematodes has been reported to the extent of 12.3% (Sasser and Freckman, 1987) and the latest estimated annual yield loss of national major crops due to plant parasitic nematodes has been reported to the extent of Rs 21,068.73 million. In economic terms, nematodes cause an estimated loss of about $ 157 billion annually to world agriculture (Abad *et al.,* 2011). Plant parasitic nematodes cause considerable loss to worldwide agriculture (Chitwood, 2003; Abad *et al.,* 2008; Fuller *et al.,* 2008). However, extensive information on accurate economic loss is often lacking.

METHODS:

The experimental work was conducted in sugarcane field of districtMeerut of Uttar Pradesh. The Meerut region is located between 23^0 11^1 E and $77^0$11N altitudes and also located in the between two river Ganga and Yamuna. Soil samples were collected at tahseel level from different villages/locations such as, Sardhana, (Daurala, Sarswaand Mavi, Lawar), Mawana (Parikshatgarh, Ulkhpur, Hastinapur,Incholi, and Kila), and Meerut (Fafunda,Kharkhoda, Rithani, Partapur and Gaggol). The sugarcane field in Meerut is characterized by cool, wet sandy soil, loam soil which is often irrigated. Sugarcane field were randomly selected for sampling. 14, 24, and 32 soil samples were collected from the rhizosphereof each site using a soil auger. Soil samples collected depth on 12-15 cm in field site. A total of 320 samples collected by adopting the method of Wallace (1971). The soil samples sealed in polythene bags and kept away from sun. The samples were properly labeled and taken to Nematology Research Laboratory, in Zoology Department in C.C.S. University, and Meerut for analysis and identification of plant-parasitic nematodes.

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RESULTS AND DISCUSSION: Identified of some dominant pant parasitic nematodes with their systematic position and identified the nematode. Nematodes were identified which were belong to the *Tylenchidae* and they were under two families such as,*Hoplolaimidae and Helicotylendae*. The distribution revealed a general trend of high population during the winters at relatively lower temperature. On the basis of taxonomic key we diagnosed four species of *Hoplolaimus*and two species of*Helicotylenchus*. Present investigation have clearly indicated that the association of plant parasitic nematodesespecially the most an important nematodes species like *Hoplolaimus spp. Rotylenchusreniformis, Helicotylenchusdihystera, Pratylenchuszeae, Tylenchorhynchusnudus,Longidorus elongates,Meloidogyne incognita, Xiphinema, attenuatus,Scutellonemabrachyurus* and *Tylenchusarcuatus* would cause severe economic yield loss (about 40- 42%) to sugarcane crop in Meerut region.

1. Systematic (genus- *Hoplolaimus*Daday, 1905)

Diagnosis: Specimen- *Female:* large sized (1-6mm), lip region high, offset, with prominent transverse and longitudinal striae (except H. cephalus. Stylet massive (30-61µm). Basal knobs tulip-shaped. Esophageal gland with six nuclei. Excretory pore anterior to oesophago-intestinal junction. Intestine overlapping rectum. Vulva median. Tail short terminus hemispherical to bluntly rounded, annulated. *Male:* slightly smaller in size, tail short, spicules well developed, Arcuate with distal flanges (variable in size). Spermateca

filled with sperms. Bursa extending to tail tip, gubernaculum large protrusible with titillate and telamon. The observed specimens are in the range and have similarities with indigenous *Hoplolaimusindicus*.(Morphology show in fig: 1).

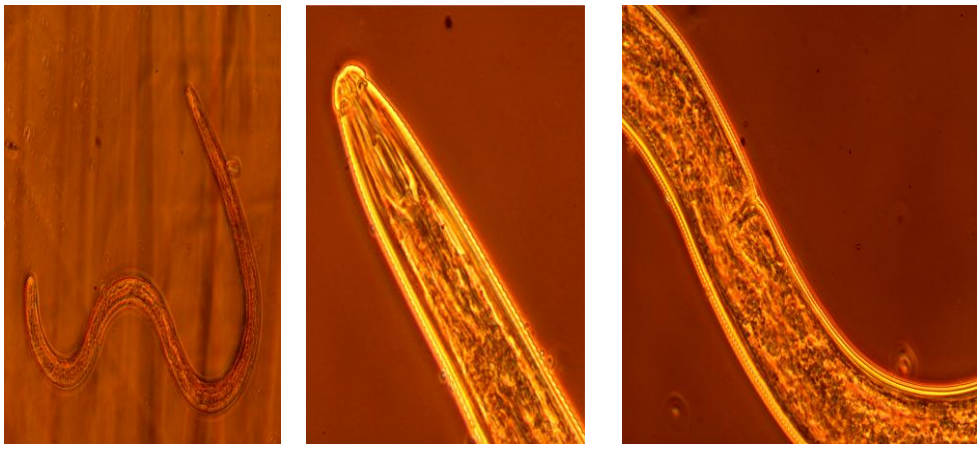

Fig -1

A. Microphotographs of Holotype entire body of*Hoplolaimusindicus* (10X4)
B. Microphotographs ofanterior region of*Hoplolaimusindicus*(10X40)
C. Microphotographs of vulva region of*Hoplolaimusindicus*(10X40)
D. Microphotographs oftail region of*Hoplolaimusindicus*(10X40)

2. Genus*Rotylenchusreniformis*

Anguillulina (Rotylenchus) Filipjev, 1936

OrientylusJairajpuri& Siddiqi, 1877

Varotylus Siddiqi, 1986

Morphometric Characters:

*Rotylenchulusreniformis*are plant parasitic nematodes collected from the soil of sugarcane fields. The common name of this nematode is reniform nematodes and this isecto parasite. Body spiral to C – shaped or kidney shaped. Labial region offset, anteriorly rounded or flattened, generally annulated, with longitudinal striae on basal lip annules. Oesophageal glands overlap intestine dorsally and laterally. Tail short, hemispherical, spicules robust, distally flanged, bursa enveloping tail. Sometimes anterior part of male body slightly smaller than female. The dead nematode generally show spirally coiled position. (fig:2).

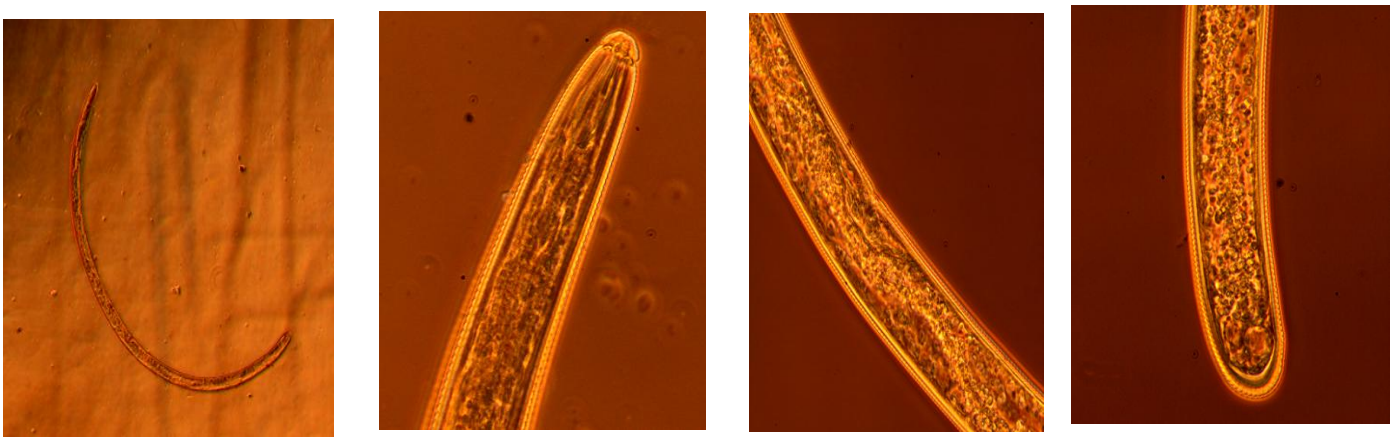

Fig. 2

A. Microphotographs of Holotype entire body of*Rotylenchusreniformis* (10X10)

B. B-Microphotographs ofanterior region of*Rotylenchusreniformis* (10X40)

C. Microphotographs of vulva region of*Rotylenchusreniformis* (10X40)

D. Microphotographs oftail region of*Rotylenchusreniformis* (10X40)

3. Systematic Position: (genus- *Helicotylenchus)*

Diagnosis: Female: large sized (.69mm**),** Body spiral. Cuticle with distinct transverse striae. Lip region continuous with body, hemispherical bearing 4-5 annules. Oesophagus with overlapping glands, longest overlap ventral. Both genital branches equally developed. Tail dorsally convex-conoid, usually with slight ventral projection. Male extremely rare. *H.dihystera* is a cosmopolitan and most widely distributed species of the genus associated with various host plants.

4. **Genus *Pratylenchuszeae***

Filipjev, 1936

Morphometric Characters:

Body length (0.4-0.8mm). Cephalic region low, flattened anteriorly or rarely rounded. Stylet (18-23um) with round, flat labial disc, or indented basal knobs. Median bulb oval to round. Oesophageal glands extending over intestine ventrally. Vulva in posterior region. Femaile tail subcylindrical to conoid, terminus smooth or annulated. Bursa enclosing tail terminus. There are over 60 named species of root lesion nematode which are distributed worldwide.*Pratylenchus* species rank third only to root-knot and cyst nematodes as having the greatest impact on crops worldwide.

Plant parasitic nematodes have been reported to constitute serious impediments to sugarcane production in various parts of the world (Anwar *et al*, 1986). In the present investigation, *Hoplolaimusspp* (lance nematode)and*Helicotylenchus*spp. (spiral nematode) were the most frequently occurring species in the soil and root sample. Of these, lesion nematode *Hoplolaimus*spp. is the most predominant and economically important genus. This nematode is widely prevalent in both subtropical and tropical regions and reduces yield and quality of cane in both light and heavy soil types. The lance nematode, *Hoplolaimus*spp., nematode causes root rotting and reduced uptake of water and soil nutrients. The symptoms are general lack of vigor, discoloration of foliage, and stunted plants (Hall and Irey, 1992). Srivastava *et al.,* (2000) studied seasonal population dynamics of plant parasitic nematodes associated with litchi in Doon Valley while Rama and Dasgupta (2000) investigated population ecology and community structure of plant parasitic nematodes associated with coconut and areca nut in northern West Bengal. Sivakumar*et al.,* (2002) studied biodiversity of nematode fauna in Tamil Nadu range of Nilgiris biosphere. Kumar *et al.,* (2003, 2004) investigated the occurrence of plant parasitic and free living nematodes on temperate fruits and aromatic plants at Chaubattia respectively.Accordingly to some Nematologistsprovide insights into the relationship between plant-parasitic nematodes and sugarcane, including nematode identification, resistance assessment, biological control, and genetic diversity studies, these are following: R. A. S. Silva, et al (2018),S. K. Singh, et al (2019);J. L. C. Santos, et al. (2020) and A. K. Singh, et al. (2020); These references provide insights into the relationship between plant-parasitic nematodes and sugarcane, including nematode identification, resistance assessment, biological control, and genetic diversity studies

5. Genus *Tylenchorynchusnudus*

Cobb, 1913

Allen, 1955

Morphometric Characters:

*Tylenchorhynchusnudus*is plant parasitic nematodes, collected from soil of sugarcane field of studying area. The common name of this nematode is stunt nematode and they are ecto parasite. The body size about 0.9-1.0mm. Styletwell-developed 14-26mm long, median bulb round to oval with prominent valve plates. Vulva equatorial; spermatheca round, axial; ovaries paired. Female tail variable from conoid with bluntly rounded terminus to cylindrical or clavate with rounded terminus. Mail tail completely enveloped with bursa. Spicules distally flanged, terminus narrow, indented or pointed. Gubernaculum well developed and spicules rode like, protrusible.

Fig. 4

A. Microphotographs of Holotype entire body of*Tylenchorhynchusnudus*(10X10)

B. B-Microphotographs ofanterior region of*Tylenchorhynchusnudus* (10X40)

C. Microphotographs of tail region of*Tylenchorhynchusnudus* (10X40)

D. Microphotographs oftail region of*Tylenchorhynchusnudus* (10X40)

These results indicated that significant population of plant parasitic nematodes was found with different soil textures. The highest population of nematodes was found in areas having sandy soil and lowest population was found in the sugarcane field having clay soil. Present study showed a significant distribution pattern of nematodes population, highest was reported from Mawanatahseel of Meerut district. Total ten genera of plant parasitic nematodes were found associated with soil and roots of sugarcane in Meerut. The reported ten genera are *HoplolaimussppHelicotylenchudyshetra, Rotylenchusreniformis, Pratylenchuszea, Tylenchorhynchusnudus, Scutellonemabrachyurus, Meloidogyne incognita, Xiphinemaspp, Longidorusspp, and Tylenchusarcuatus*

Screening of seed plants and regular plant quarantineservices should be employed prior to the introduction of new varieties to sugarcane farmers and also more effective nematode management strategies should be considered in order to improve yield in sugarcane crop.Observation of aberrant Ecological and Morphological characteristics in plant and soil nematodes trigger questions regarding their fitness costs and the underlying control mechanisms that allow or facilitate them.In view of above aspect the present study was taken to evaluate the distribution and prevalence of different species of plant parasitic nematodes associated with sugarcane crop in district Meerut. It was helpful to the farmers, agricultural scientists and policy makers for proper extension of nematode control programmers.

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