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Awareness Of Plant Parasitic Nematodes, And Preferred Sugarcane Varieties, Among Smallholder Farmers In Meerut Region.

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Abstract: the first comprehensive compendium of plant parasitic nematodes problem across western Uttar Pradesh, with special crop hosts impact on crop production, management practices conducted in each agricultural region within the continent of western Uttar Pradesh.

In India, phytonematodes 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 77 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 nematodes of sugarcane from district Meerut were *Hoplolaimus*, *Tylenchus*, *Rotylenchus*, *Helicotylenchus*, *Pratylenchus*, *Hoplolaimus* and *Helicotylenchus*.

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

INTRODUCTION:

Plant parasitic nematodes are present in a habitat and in proximity of hosts conducive to their development, they may rapidly multiply. A major global challenge in the coming years will be to ensure food security and to feed the increasing human population. Nowhere will the need to sustainably increase agricultural productivity in line with increasing demand be more pertinent than in resource poor areas of the world, especially India, where populations are most rapidly expanding. It is essential that the full spectrums of crop production limitations are considered appropriately, including the often overlooked nematode constraints. Plant parasitic nematodes species obtain food directly or indirectly from plants either feeding on roots or stem portions.

Plant parasitic nematodes not only cause damage individually but form disease complexes with other microorganism and increased the crop loss. Nematodes that feed on plant parts are called plant parasitic nematodes and are ubiquitous in agricultural soils. A participatory rural appraisal was therefore conducted to assess farmers' awareness of nematodes, and to determine the preferred traits in new sugarcane germplasm. These traits need to be integrated into a breeding programme for nematode resistance in maize.

Sugarcane is the World's major cash crops providing about 75% of the sugar harvested for human consumption (FAO 2004). 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.Nematodes are present in a habitat and in proximity of hosts conducive to their development, they may rapidly multiply. A major global challenge in the coming years will be to ensure food security and to feed the increasing human population.

In the phylum Nematoda members of the family Hoplolaimidae, commonly called the hoplolaimids are large and closely related group of soil inhabiting organism. Nematodes are usually vermiform parasites having unsegmented, bilateral symmetrical body possessing a pseudocoel, belonging to the phylum nematode. All plant parasitic nematodes share one distinguishing feature- a stylet. The stylet is essentially a hollow spear, like a hypodermic needle, that the nematode uses to puncture cells and feed. The aperture of the stylet is too small to allow passage of microorganism. The soil or plant nematodes are petite, un-segmented round worms that are different from the flatworms. In India nematodes are reported to cause about 10-40 %yield loss in sugarcane. However, losses may become still higher if nematodes are associated with other biotic and abiotic stresses in the field.

Nowhere will the need to sustainably increase agricultural productivity in line with increasing demand be more pertinent than in resource poor areas of the world, especially India, where populations are most rapidly expanding. It is essential that the full spectrums of crop production limitations are considered appropriately, including the often overlooked nematode constraints. Plant parasitic nematodes species obtain food directly or indirectly from plants either feeding on roots or stem portions. The problems caused by phytonematodes 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).

Plant parasitic nematodes are pathogens of all cultivated crops including sugarcane. Which is a major agricultural crop produced in many countries with tropical and subtropical climates. The problems caused by phytonematodes are common, which was and subtropical climates. Nematodes undoubtedly are a group of the most abundant multi-cellular organism in the world. They are regarded as one of the most successful group of animals and are found in free living to parasitic forms (infesting animals and plants both).

The estimated 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). It is estimated that annual crop loss due to parasitic nematodes in India accounts for about 21 million. However, in India it was estimated as 21068.73 million rupees from the 24 major crops growing in the Country. In India, phytonematodes 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 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). However, extensive information on accurate economic loss is often lacking.

Showing, the most common symptoms are: root lesions, root pruning, root galling, and cessation of plant roots. Roots damaged by nematodes cannot efficiently use the water moisture and nutrients available in the soil. Among different plant parasitic nematodes, root knot nematodes are by far the most important. Their easily recognized galls on the roots make their presence obvious. Galls result from growth of plant tissues around juvenile nematode, which feed near the center of the root. Root-knot gall tissue is firm without a hollow center, and is an integral part of the root; removing a root-knot gall from a root tears root tissue.

Plant Parasitic Nematodes (PPN) attacks the roots of living plants including sugarcane. There are many species of PPN, with the two most important pests of sugarcane being **root knot nematode** *(Meloidogyne spp.)* and **lesion nematode** *(Pratylenchus zeae)*. **Stunt nematode** *(Tylenchorhynchus annulatus)*, **dagger nematode** *(Xiphinema spp.)* and **stubby root nematode** *(Paratrichodorus minor)* also cause economic damage. **Lance nematode (***Hoplolaimus spp.)* and **spiral nematode** *(Helicotylenchus dihystera)* only cause economic damage when populations are sufficiently high.

A common feature of plant parasitic nematodes on annual crops is that they have an uneven distribution within a field and the symptoms of damage, normally associated with high population densities, occur in patches (McSorley, 1998). Where a susceptible annual crop is replanted year after year the nematodes spread and the patches increase in size and eventually coalesce. Sugarcane is one of the major cash crop of Meerut region, Uttar Pradesh state of India. In India Uttar Pradesh is the major sugarcane growing state, contributing about 48% of the area and 40% of the production. Maharashtra is the second largest producer of sugarcane after Uttar Pradesh in area and after Tamilnadu in productivity. In India sugarcane is mainly used for the production of white sugar (50%), Gur and Khandsari (40%). Molasses, an important by-product of sugar industry is used for alcohol production. The objective of this work was to identify most important plant parasitic nematodes associated with sugarcane crop of district Meerut. The distribution and taxonomic study has great significance to overcome the problem of these nematodes. It will provide the appropriate management tools and practices to control the population of the plant parasitic nematodes according to the cropping patterns of the particular agriculture areas.

MATERIALS AND METHODS:

EXPERIMENTAL SITE: The experimental work was conducted in sugarcane field of district Meerut 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, Sarswa and 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.

SOIL SAMPLING: sugarcane field were randomly selected for sampling. 15, 25, and 30 soil samples were collected from the rhizosphere of each site using a soil auger. Soil samples collected depth on 10-15 cm in field site. A total of 230 samples collected periodically from March 2013 to August 2014, 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.

NEMATODE EXTRACTION FROM ROOTS AND SOIL:

Nematodes was extracted and mounted within a week from collected soil samples. For endoparasitic nematodes, the roots were held and place in petridishes washed with clean water. A sub-sample of 250g roots was taken for nematode extraction using a modified **Baermann funnel technique** (Hooper et al., 2005) after maceration in a blender. The nematodes extracted were killed and fixed by using FAG, heated to 80%, then mounted in pure glycerine to make slides for microscopic observation according to Hooper (1970). Photographs and measurement was taken by Phase contrast microscope. The identification was done with the help of taxonomic keys defined by Mai and Lyon 1975.

IDENTIFICATION OF NEMATODES: Photographs and measurement was taken by Phase contrast microscope. The identification was done with the help of taxonomic keys defined by Mai and Lyon 1975. We select two dominant genera i.e. *Hoplolaimus* & *Helicotylenchus.*

RESULTS AND DISCUSSION: Identified of 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 nematodes especially the most an important nematodes species like *Hoplolaimus spp. Rotylenchus reniformis, Helicotylenchus dihystera, Pratylenchus zeae, Tylenchorhynchus nudus, Longidorus elongates, Meloidogyne incognita, Xiphinema, attenuatus, Scutellonema brachyurus* and *Tylenchus arcuatus* would cause severe economic yield loss (about 35- 40%) to sugarcane crop in Western of Uttar Pradesh.

1. *Hoplolaimus spp, (*92%) and *Rotylenchus sp*, (85%) were observed the frequently and dominant PPN in Meerut, U.P. infesting sugarcane fields.
2. *Meloidogyne incognita (*87.50%) and *Pratylenchus Zeae* (67.50%) were observed the frequently and dominant PPN in roots of sugarcane fields in Meerut.
3. The highest population of PPN was present in early and late winter season (September & March), during 2013-2015.
4. The highest population of phytonematodes was observed at harvesting time comparison to planting of sugarcane crop in Meerut districts.
5. The highest population of PPN was recorded in sandy soils comparison to clay soils.
6. The temperature was detrimental to that of the total nematodes population of the plant parasitic nematodes.
7. Temperature was observed important to minimize the population of phytonematodes.
8. Moisture indicated the insignificant positive correlations with dominant plant parasitic nematodes.
9. Organic carbon was found to have substantial effect on the population of Plant Parasitic Nematodes.

10. High degree negative correlations were observed in between iron and the population of Plant Parasitic Nematodes.
11. Zinc, Copper and Iron was observed to decrease the population of PPN, because the nutrients cause toxicity against PPN.

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 *Hoplolaimus indicus*. Measurements see table-1.

Systematic (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. Measurements see in table-1.

The results indicated a significant population of plant parasitic nematodes on the different soil textures. The highest population of nematodes was found in areas having sandy soil and lowest population was found in the cane field having clay soils. 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, *Hoplolaimus spp* (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). Plant-parasitic nematodes damage is an important factor in tuber quality reduction and yield loss in sugarcanes both in the field and in storage. Sugarcanes are vulnerable to nematode damage as they reduce the yield and quality of the tubers as a result of root gallings, root lesions, dry and soft rots depending on the type of plant parasitic nematodes. Nandwan et al., (2005) reported the community analysis of phytonematodes in the sugarcane ecosystem in Bundi district of Rajasthan. Prakash et al; (2009) reported on collection and distribution frequency of plant-parasitic nematodes associated with sugarcane in Uttar

Pradesh. In Meerut region Chaubey and Satyandra (2010) have studied the prevalence and management of different species of Meloidogyne spp. Padma Bohra (2012) has studied on twelve species of nematodes: new records for India. The presence of plant parasitic nematodes could constitute serious impediments to the growth and yield of sugarcanes in Meerut regions of U.P. States.

The plant parasitic nematodes species associated with the soil and roots of sugarcane in Meerut district. *Hoplolaimus* and *Helicotylenchus* species during growing season were above damage threshold level at many locations although population levels of other plant parasitic nematodes were below economic or damaging levels. There need to educate local farmers on the large diversity of plant parasitic nematodes associated with sugarcane their damage potentials by creative awareness programmes. In view of above aspect the present study was taken to evaluate the distribution and prevalence of different species of plant parasitic nematodes in Meerut.

References:

Anwar, S.A., Kallu, M.A., Javid, M.A. and Khan, S.H. 1986. Nematode parasites of sugarcane. Journal of Agriculture Research, Pakistan, 24:123-127.

Bell M. 2004. Plant Parasitic Nematodes: Lucid key to 30 Genera of Plant Parasitic Nematodes. http://www.lucidcentral.com/keys/nematodes.

Bohra.P. 2012. Twelve species of nematodes: new records for India. *Journal of Threatened Taxa* 4(9): 2889-2899.

Cadet, P., and Spaull, V.W. 2005. Distribution of nematodes, soil factors and within variation in sugarcane growth. Proc. S. Afr. Sug Technol. Ass.76.

Chaubey, A.K. and Satyandra, K. 2010. Bio-management of root-knot nematodes and root-rot disease by antagonistic fungi and rhizobacteria. *J. Plant Protection Science*. 2(2): 35-45.

Cobb, N.A. 1918. Estimating the Nema population of soil. U.S.Department of Agriculture, Bur. Plant. Industry, *Agr.Tech.Cir*. **1**:1-48.

Edgerton, C. W. 1939. Stubble deterioration. Proceedings of the International Society of Sugar Cane Technologists 6:334–341.

Edgerton, C. W., E. C. Tims, and P. J. Mills. 1934. Stubble deterioration of sugar cane. Bulletin No. 256. Baton Rouge: Louisiana State University.

Fao.2004 .Saccharumofficinarum.www.Fao.org/AGP/AGPC/doc/GBASE/data/pf000310.

Hall, D.G. and Irey, M.S. 1992. Population levels of plant-parasitic nematodes associated with sugarcane in Florida. *Journal of the American Society of Sugar Cane Technologists*, **12**:38-46.

Hooper, D.J. 1970. Handling, fixing, staining and mounting nematodes. In: Southey, J.F. (eds) , and Food Technical Bulletin 2.

Lambshead, P.J.D. 2004. Marine nematode biodiversity. In Z.X. Chen, S.Y. Chen, and D.W. Dickson (eds.), *Nematology, Advances and Perspectives*. ACSE-TUP Book Series. Pp. 436–467.

Mai, W.F. and Lyon, H.H. 1975. Pictorial key to the genera of the plant parasitic nematodes. 4th Edition Cornell University Press, Ithaca, New York, USA.

Mehta, U.K. (1992). Nematodes pests of sugarcane. In; Bhatti, D.S. and Walia, R.K. (Eds) Nematode pests of crops. Vedams Books Ltd, New Delhi, India, pp. 159-176.

McSorley, R. 1998. Population dynamics. In: plant and Nematode Interactions. (Eds.) Barker KR, Pederson GA and Windham GL. Pp 109-133. Madison Publishers, Wisconsin, USA.

Nandwan, R.P., Varma, M.K. and Arjun Lal. 2005. Community analysis of phytonematodes in the sugarcane ecosystem in Bundi district of Rajasthan. *Ind.J.Nematol*. **35**(2): 222-225.

Prakash, R., Singh, D.K. and Kumar, M. 2009. Collection and distribution frequency of plant-parasitic nematodes associated with sugarcane in Uttar Pradesh—a field study, *An International Journal*, **1**(1): 85-88.

Rahman, M.M. and Mian, I.H. 2010. Pictorial key to genera of plant patarasitic nematodes, Cornell University Ithaca, NY, 219pp.

Severino, J. J., Dias – Arieira, C. R. and Tessmann, D. J. 2010. Nematodes associated with sugarcane (Saccharum. spp) in sandy soils in Parana, Brazil, Nematropica 40:111-119.

Wallace, H.R. 1971. Abiotic influences in the soil environment. In, "Plant parasitic nematode" Vol.1, pp. 25-80.

TABLE-1 Morphometric of *Hoplolaimus spp.* female and *Helicotylenchus spp.* female

POPULATION NO n	*HOPLOLAIMUS spp.* (FEMALE-10)	*HELICOTYLENCHUS spp.* (FEMALE-09)
L (mm)	1.23±.16 (.91-1.5)	0.59±0.05 (0.53-0.69)
a	35.73±12.45 (27.35-66.24)	29.41±0.63 (27.76-31.95)
b	12.84±3.06 (8.21-18.26)	5.22±0.5 (5.03-5.66)
C	47.61±14.52 (32.49-72.15)	43.96±3.72 (40.72-49.57)
c'	1.02±.52 (.35-1.86)	0.99±0.04 (0.82-1.10)
V	47.57±11.05 (30.29-67.35)	65.39±67.31 (63.28-67.31)
Stylet	39.21±4.15 (33.89-46.01)	22.01±0.43 (21.06-22.04)
Body width	38.74±5.59 (33.12-45.46)	26.35±2.88 (23.56-30.13)
Tail length	25.09±8.49 (10.01-36.94)	12.04±1.86 (9.05-14.56)
ABW	24.52±5.32 (18.59±33.01)	13.27±2.25 (10.89-16.98)
Esophagus length	102.84±13.49 (84.47-124.34)	106.79±8.24 (89.90-115.97)

All measurements except length in micrometers.

Table-3: Morphometric characters of nematode population (specimen) collected from different Sugarcane fields of district Meerut and their comparison with the species of *Helicotylenchus dihystera*, *Rotylenchus reniformis and Pratylenchus zeae.*

Characters	***H. dihystera***	***H. dihystera***	***P. Zeae***	***P. zeae***	***R. reniformis***	***R. reniformis***
	Nematode specimen	Steiner, 1945	Nematode specimen	Sher, 1567	Nematode specimen	Filipjev, 1936
L	0.82±.36 (0.56-1.4)	0.50-0.90	0.48±.34 (39-56)	0.38-0.57	1.25±.21 (0.92-1.5)	1.5-1.6
a	28.24±9.4 (19-41)		26.57±.1.26 (17-27)	19-29	33.06±4.06 (27-40)	30-37
B	6.4±1 (5-7)		5.36±2.3 (2-8)		10.29±2.81 (7-14)	6-8
c	42.54±17 (25-62)	27-67	15.45±.57 (13-18)	13-19	53.41±19.59 (51-56)	63-67

c’	1.35±.65 (0.63-2.11)		2.1±0.49 (1-3)		1.08±0.46 (.67-1.9)	
Stylet	22.17±3.76 (19-28)	20-30	18.22±2.02 (14-19)	15-17	27.76±7.91 (16-38)	43-52
Oesophagus Length	122.14±40 (76-186)		147±31 (105-176)		132.73±23.72 (94-165)	
GBW	33.88±4.7 (28-41)		29.74±4.4 (22-33)		39.28±4.02 (33-42	
Tail length	20.70±7.6 (9-30)		22.55±11 (15-27)	21-26	22.73±7.36 (14-32)	
ABW	16.30±4.79 (10-23)		10.36±3.68 (6-16)		25.38±4.25 (21-32)	
V	65±9.86 (55-74)	56-71	71.09±3.48 (67-73)	69-75	51.37±5.72 (44-57)	55-57
SL	42.36±.22 (42-43)				42.52	32-42
GL	9.9±2.7 (7-11)				7.93	16-20

All measurements in µm.

Table- 4: Morphometric characters of nematode population (specimen) collected from different Sugarcane fields of district Meerut and their comparison with the species of *Tylenchorhynchus nudus*, *Longidorus elongatus* and *Meloidogyne incognita.*

Characters	***T. Nudus***	***T. Nudus***	***L. elongatus***	***L. elongatus***	***M. incognita***	***M. incognita***
	Nematode specimen	Allen. 1955	Nematode specimen	Filipjev 1876	Nematode specimen	Chitwood,1 949
	05		05		05	
L	0.65±0.70 (0.54-0.68)	0.95-1.6	3.7±**0.**81 (2.3-4.4)	2.3-5.8	0.37±0.56 (0.31-0.43)	0.34-0.40
a	22.44±2.01 (19-24)	25-37	98.2±13 (80-108)	78-145	26.45±2.8 (24-31)	25-32
b	6.17±.94 (4.6-6.9)	9.2-11	11.19±1.9 (8-13)		2.54±0.23 (2-2.6)	2.0-2.1
c	16.17±1.41 (15-18)	45-72	91.7±18 (64-116)	98-156	69.18±3.99 (64-73)	
c’	5.06±6.67 (1.84-17)		1.45±0.18 (1.3-1.7)		0.57±0.51 (0.50-0.63)	
Stylet	16±1.98 (14-18)	33-47	127±8.2 (118-138)	124-136	10.20±1.33 (8-11)	9.6-11.7
Oesophagus length	101.60±15.20 (78-119)		332±38 (287-381)		156.80±20 (128-178)	

GBW	27±2.02 (24-29)		37.8±5.8 (29-44)		14.40±2.88 (12-18)	
Tail length	38.6±3.8 (34-43)	29-34	28.68±2.1 (25-31)	35-46	37.60±1.14 (36-38)	38-55
ABW	19±1.58 (17-21)		25.38±2.1 (21-28)		41.20±2.38 (39-44)	
V	50.5±7.0 (40-52)	49-57	54.64±.71 (54-55)	46-54	55-57	
SL	46±5.9 (41-50)	34-42				
GL	9.4±0.88 (8-10)	16-20				

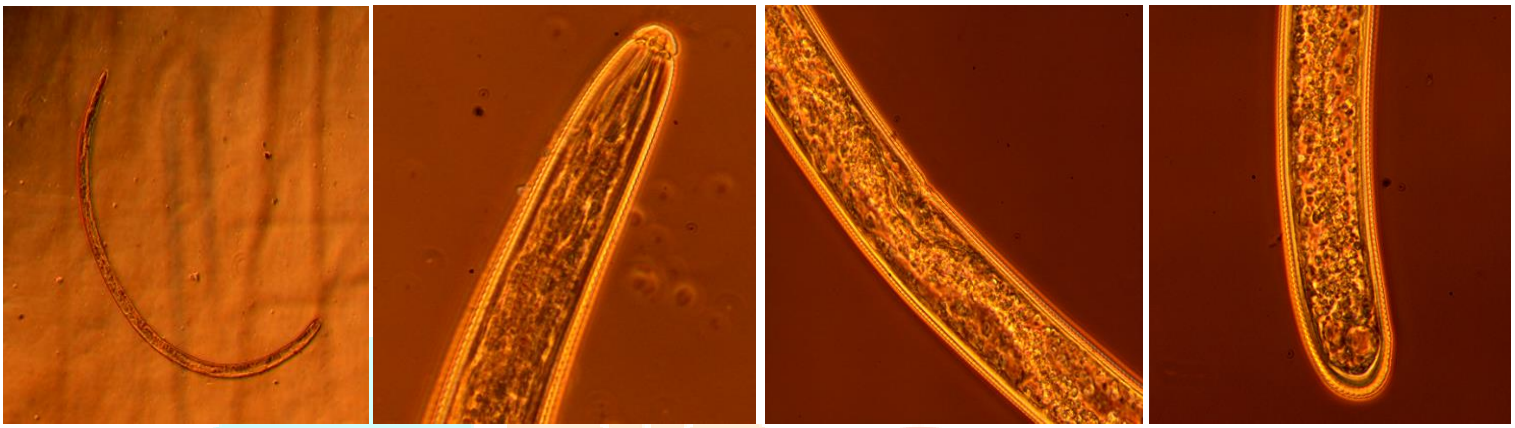
All measurements are in µm.

Table- 5: Morphometric characters of nematode population (specimen) collected from different Sugarcane fields of district Meerut and their comparison with the species of *Xiphinema attenuatus*, *Scutellonema brachyurus* and *Tylenchus arcuatus.*

Characters	***X. attenuatus***	***X. attenuatus***	***S. brachyurus***	***S. brachyurus***	***T. arcuatus***	***T. arcuatus***
	Nematode specimen	Cobb, 1913	Nematode specimen	Andrassy, 1958	Nematode specimen	Sher,1876
L	1.8±.24 (1.5-2.1)	2.5-2.9	0.74±.149 (0.56-0.91)	0.5-1.0	.78±.52 (.72-.84)	0.84-1.3
a	53.39±2.2 (50-55)	53-56	28.54±8.23 (19--38)	16-36	28.45±2.7 (25-32)	
b	5.3±0.38 (4.8-5.8)	5.0-5.4	4.97±1.02 (03-06)	4.9-10.3	5.85±.43 (5.5-6.4)	
c	45.86±1.6 (43-48)	40-46	69±4 (64-69)	37-108	7.68±1.2 (6.1-8.7)	
c’	1.97±0.35 (1.6-2.3)		0.57±0.51 (0.50-0.63)		5.97±.48 (5.2-6.3)	
Stylet	106.29±9.57 (96-117)	33-47	25±3.39 (21-29)	22-31	16.93±1.4 (15-18)	35-37
Oesophagus Length	341.2±33.79 (315-398)		150±12.07 (134-165)		135.2±14.3 5 (115-152)	
GBW	34.2±5.4 (28-42)		26.80±2.58 (24-30)		27.80±3.9 (22-33)	
Tail length	38.8±4.14 (34-44)		10.80±1.92 (08-13)		98.80±7.4 (89-110)	
ABW	21±3.08 (18-26)		18±1.58 (16-20)		16.60±1.1 (15-18)	
V	44±2.34 (41-47)	43-44	53.20±3.27 (50-58)	53-67	65.79±2.6 (62-68)	

SL	Nil				21.44±1.5 (19-23)	38-47
GL	Nil			11-14	4.48±0.31 (4.1-4.8)	

All measurements are in µm.



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

B. B-Microphotographs of anterior region of *Rotylenchus reniformis* (10X40)

C. Microphotographs of vulva region of *Rotylenchus reniformis* (10X40)

D. Microphotographs of tail region of *Rotylenchus reniformis* (10X40)

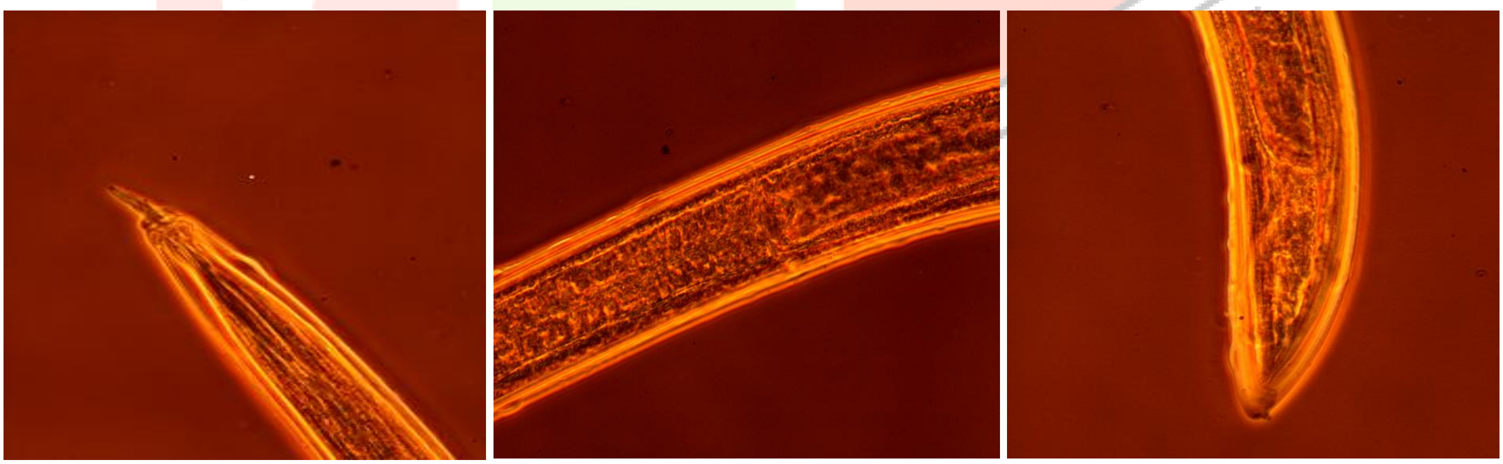


Plate-2

A. Microphotographs of anterior region of *Longidorus elongatus* (10X4)

B. Microphotographs of vulva region of *Longidorus elongatus* (10X40)

C. Microphotographs of tail region of *Longidorus elongatus* (10X40)

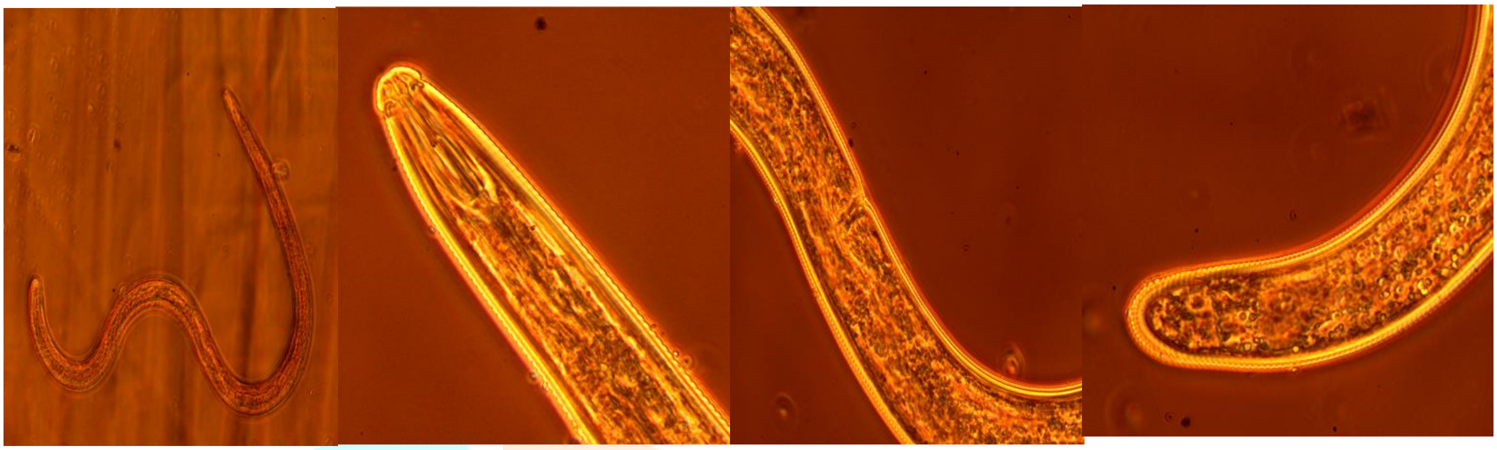


Plate -3

A. Microphotographs of Holotype entire body of *Hoplolaimus indicus* (10X4)

B. Microphotographs of anterior region of *Hoplolaimus indicus* (10X40)

C. Microphotographs of vulva region of *Hoplolaimus indicus* (10X40)

D. Microphotographs of tail region of *Hoplolaimus indicus* (10X40)

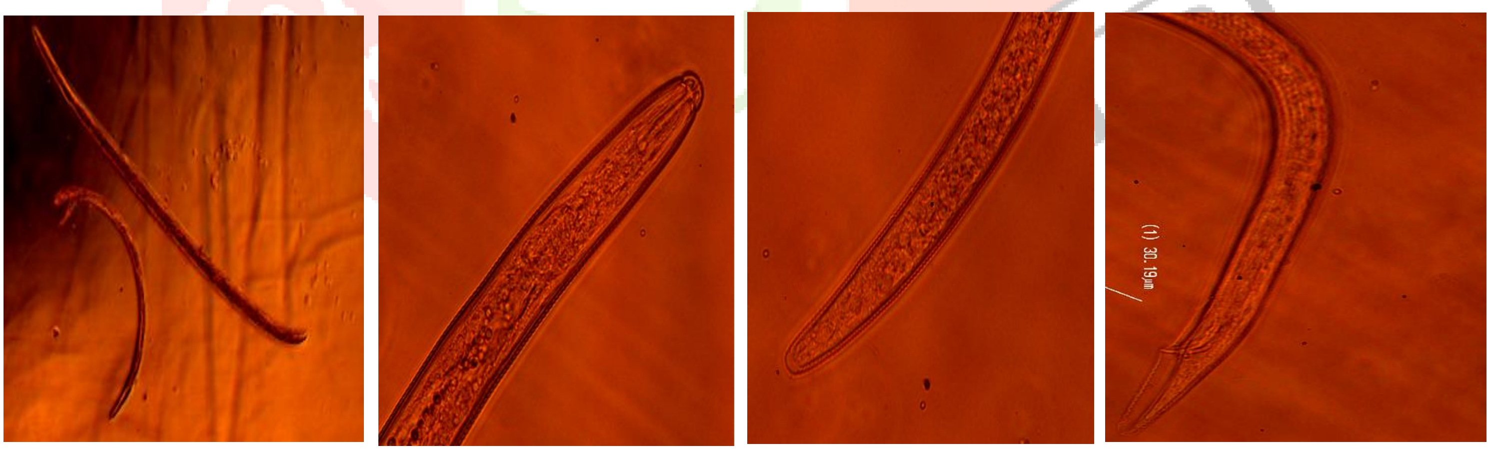


Plate -4

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

B. B-Microphotographs of anterior region of *Tylenchorhynchus nudus* (10X40)

C. Microphotographs of tail region of *Tylenchorhynchus nudus* (10X40)

D. Microphotographs of tail region of *Tylenchorhynchus nudus* (10X40)