A STUDY OF NEMATODE DIVERSITY FROM DIFFERENT HABITATS IN ALIGARH

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Abstract: Nematology is an important branch of biological science, which deals with a complex, diverse group of roundworms known as nematodes. They have successfully adapted to nearly every ecosystem from marine to fresh water, to soils, and from the polar regions to the tropics, as well as the highest to the lowest of elevations. The present work deals with the study of biodiversity of nematodes of different habitats belonging to the order Rhabditida, Tylenchida and Dorylaimida. During this study, samples were collected from farmyard manure, flower beds, grasslands, duck pond, rotting banana rhizome, rotting barks and cavities in the tree trunk. Several nematodes i.e., *Hoplolaimus*, *Helicotylenchus*, *Tylenchorhynchus*, *Neodolichorhynchus*, *Hemicriconemoides*, *Mononchoides, Diplogastrellus, Pseudoacrostichus, Fictor*, *Butlerius*, *Oigolaimella*, *Metarhabditis*, *Curviditis*, *Acrostichus*, *Koerneria*, *Brevibucca*, *Teratorhabditis*, *Cheilorhabditis*, *Oscheius*, *Prodontorhabditis*, *Longidorus*, *Discolaimus*, *Aporcelaimellus* and *Oriverutus* were identified. The aim of present study is to investigate nematode diversity of different habitats which provides a good tool for diagnosis of the complexity and status of soil food webs.

Keywords: Diversity, Habitat, Nematodes, SEM.

Introduction: The phylum nematode is characterized by high species diversity. It has been estimated that the total number of described and undescribed species might be ranged from 0.1 to 100 million (May, 1988; Hammond, 1992; Lambshead, 1993; Coomans, 2000). From an environmental point of view, nematodes are part of nearly all ecosystems in their roles as bacterivores, herbivores, parasites of animals and plants, and consumers of dissolved as well as particulate organic matter. Of the known nematode species, approximately 50% are free-living species found in soil or fresh water, 25% are marine, 15% animal parasites, and 10% are known plant parasitic nematodes (Pokharel & Larsen, 2007). The ecological classification of terrestrial nematodes has usually been based on feeding biology (trophic function) and on the life strategies *viz* colonizers *vs* persisters (Bongers, 1990). The nematode ecologists generally recognize following major trophic groups among soil inhabiting forms on the basis of their feeding apparatus:- i) herbivores, ii) bacterivores, iii) fungivores, iv) predators and v) omnivores (Yeates, Bongers, de Goede, Freckmen & Georgieva, 1993; Yeates, 1998; Yeates & Bongers, 1999). Herbivorous nematodes are plant parasites which include many members of the order Tylenchida, as well as a few genera in the orders Aphelenchida and Dorylaimida. Many kinds of free-living nematodes are bacteriovores, which are extremely abundant in soil. This group includes many members of the order Rhabditida. Fungivorous nematodes feed on fungi and use a stylet to puncture fungal hyphae. Many members of the order Aphelenchida are in this group. Predators feed on other nematodes or small invertebrates such as rotifer, protista and enchytraeids. They may be either ingesters or piercers. Members of order Mononchida are in this group. Some nematodes may feed on more than one type of food material, and therefore, are considered omnivores such as some members of the order Dorylaimida that feed on fungi, algae, and other animals. The aim of the present study was to see the diversity of nematodes from different habitats in Aligarh.

Material and Methods: Samples were collected from farmyard manure, flower beds, grasslands, duck pond, rotting banana rhizome, rotting barks and cavities in the tree trunk.

Sample Processing: Samples were processed by modified Cobb's (1918) sieving and decantation and modified Baermann's funnel technique (Flegg, 1967). Extracted nematodes were fixed in FG (formaldehyde-glycerin) for 24 hrs and then transferred to glycerin-alcohol (5 parts glycerin: 95 parts 30% alcohol, Seinhorst, 1959) for slow dehydration in a desiccator. Dehydrated specimens were mounted in anhydrous glycerin on glass slides using the wax ring method (De Maeseneer & d'Herde, 1963). All observations and photographs were made on an Olympus BX 50 DIC microscope. For scanning electron microscopy, fixed specimens were processed in glycerin: absolute ethanol graded series (% glycerin in absolute ethanol: 70, 50, 30 and 0). The last step was repeated twice to ensure that the glycerin was completely exchanged with ethanol and then specimens were transferred to distilled water. After rehydration, specimens were fixed in 3% glutaraldehyde in 0.05 M phosphate buffer for 48 hrs, washed in 0.05 M sodium phosphate buffer (pH=6.9) several times, dehydrated in a graded ethanol series and critical-point dried in carbondioxide (Eisenback, 1985). Dried specimens were mounted on stubs, coated with gold and observed in a Joel JSM at 15 KV.

Results: Several nematodes were identified from different habitats which belong to different orders i. e., fifteen genera of rhabditid nematodes, five genera of tylenchid nematodes and four genera of dorylaimid nematodes. A list of all genera along with their order and location is presented in table I.

Table I: List of Identified Nematodes with Their Sampling Sites

ORDER	GENERA	LOCATION
Rhabditida	*Oscheius*, *Metarhabditis*, *Curviditis*, *Teratorhabditis*, *Rhabditella*, *Koerneria*, *Fictor*	Farmyard manure
	Prodontorhabditis, *Brevibucca*, *Cheilorhabditis*, *Pseudoacrostichus*, *Acrostichus*, *Diplogastrellus*	Banana rhizome
	Mononchoides, *Oigolaimella*	Cavities in tree trunk
	Butlerius	Rotting bark
Tylenchida	*Hoplolaimus*, *Helicotylenchus*, *Hemicriconemoides*	Grassland
	Tylenchorhynchus, *Neodolichorhynchus*	Flower bed
	Pratylenchus, *Rotylenchulus*	Duck pond
Dorylaimida	*Xiphinema*, *Dorylaimoides*	Grassland
	Oxidirus, *Dorylaimellus*	Flower bed
	Aporcelaimellus, *Oriverutus*, *Discolaimus*, *Discolaimoides*, *Longidorus*	Duck pond

Discussion: Diversity of nematodes in saprobic habitat is more as compared to grassland, flower bed and duck pond. Sixteen genera were recorded in saprobic habitat, 7 in duck pond, 6 in grassland and 4 in flower bed. In saprobic habitat, nematodes belonging to the order Rhabditida were dominant as compared to order Tylenchida and Dorylaimida. Rhabditid nematodes are bacterivorous and have tubular stoma for ingestion of bacteria. They are key microfaunal grazers that regulate ecological processes of decomposition and nutrient cycling thereby indirectly affecting primary production. However, Tylenchid nematodes are root tip feeders, myceliophagous and entomoparasites. They have well developed stomatostyles for feeding on vascular plants and that may be the reason for their prevalence in flower bed and grassland. Dorylaimid nematodes are omnivorous, have low reproductive rates, long life cycle, low colonization ability and non-versatile feeding habits (Bongers, 1990; Bongers & Ferris, 1999). They dominated in terms of number of genera in duck pond due to the high degree of stability of this region, which has been free of human intervention. Dorylaimids are sensitive to disturbance and are used as indicators of environmental disturbances (Thomas, 1978; Sohlenius & Wasilewska, 1984).

In the present study, twenty four genera belonging to eleven families under three orders Rhabditida, Tylenchida and Dorylaimida have been studied in detail. SEM provides high resolution visualization of structure present on the surface of nematode body. It is an indispensable tool in morphological and taxonomical studies of nematodes and useful to identify the minute details of lip region and cuticular structure. The lip structures show many important variations, which may be used either as specific or generic characters. In some nematodes the lip region is completely merged with the body (*Brevibucca*, *Acrostichus*, *Oigolamella*, *Prodontorhabditis*, *Helicotylenchus*, *Longidorus*) and in others it is continuous with distinct cheilorhabdial plates (6 in *Pseudoacrostichus* and *Diplogastrellus*, 8 in *Butlerius*, 13 in *Mononchoides*). In many species, lip region is slightly (*Metarhabditis*, *Oshceius*) to distinctly offset (*Curviditis*, *Cheilorhabditis*, *Hoplolaimus*, *Hemicriconemoides*, *Tylenchorhynchus*, *Neodolichorhynchus*, *Aporcelaimellus*) with elevated labial disc (*Discolaimus*). The shape of oral aperture varies from oval (*Mononchoides*), circular (*Butlerius*, *Diplogastrellus*, *Fictor*, *Pseudoacrostichus*), star-shaped (*Brevibucca*, *Teratorhabditis*), triangular (*Curviditis*, *Metarhabditis*, *Oscheius*, *Acrostichus*) to pore-like (*Hemicriconemoides*, *Tylenchorhynchus*, *Neodolichorhynchus*, *Hoplolaimus*). The cuticle is provided with definite markings and modifications which provide important diagnostic character in identification. The outer layer of cuticle is marked with definite transverse striations which may be fine (*Brevibucca*, *Prodontorhabditis*, *Helicotylenchus*, *Curviditis*) or coarse (*Hoplolaimus*, *Hemicriconemoides*, *Tylenchorhynchus*) and longitudinal striations (*Pseudoacrostichus*, *Fictor*, *Mononchoides*). In *Neodolichorhynchus*, cuticle marked with prominent transverse and longitudinal striae crossing each other to form corncob pattern.

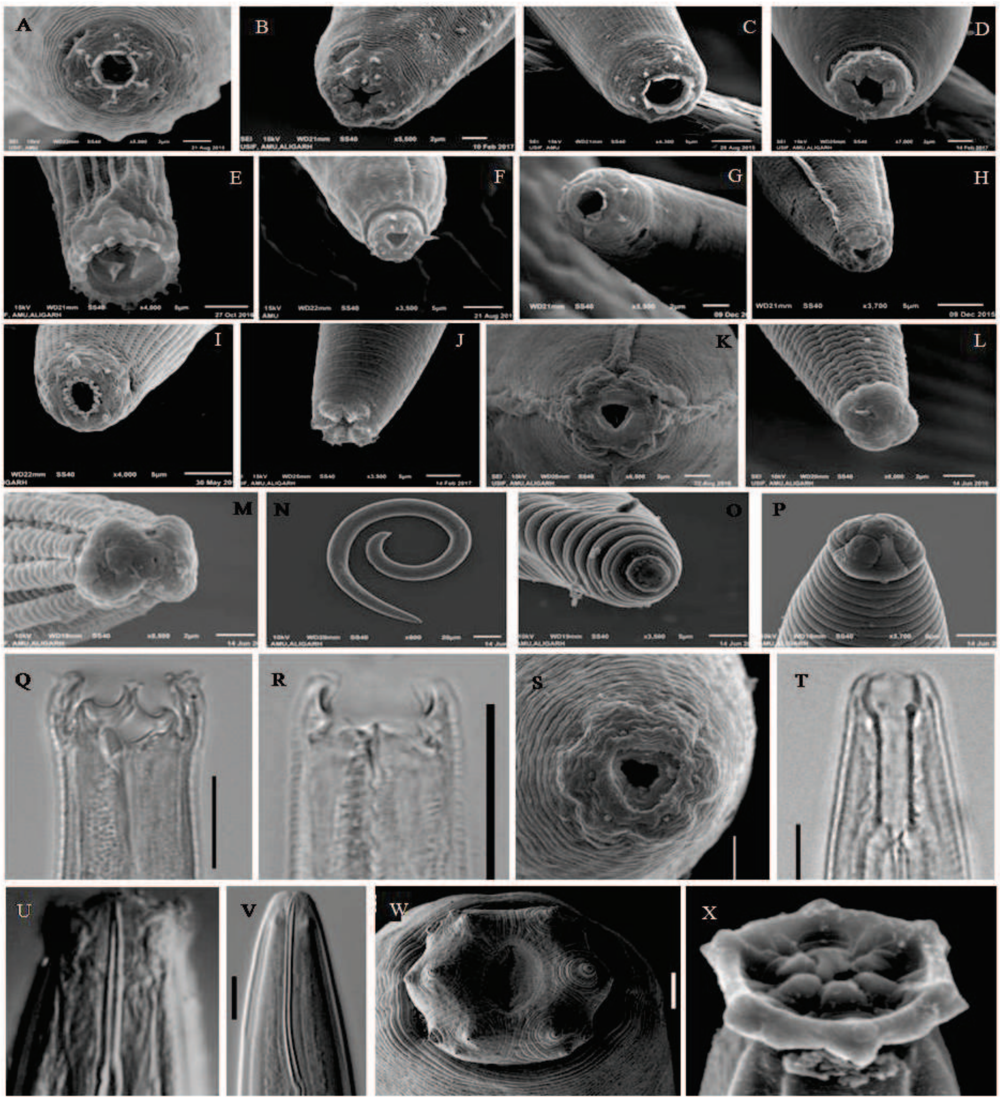

Fig I: A. *Pseudoacrostichus*, B. *Brevibucca*, C. *Butlerius*, D. *Cheilorhabditis*, E. *Fictor*, F *Curviditis*, G. *Diplogastrellus*, H. *Metarhabditis*, I. *Mononchoides*, J. *Teratorhabditis*, K. *Oscheius*, L. *Tylenchorhynchus*, M. *Neodolichorhynchus*, N. *Helicotylenchus*, O. *Hemicriconemoides*, P. *Hoplolaimus*, Q. *Koerneria*, R. *Oigolaimella*, S. *Acrostichus*, T. *Prodontorhabditis*, U. *Oriverutus*, V. *Longidorus*, W. *Aporcelaimellus*, X. *Discolaimus*.

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References:

1. Bongers, T. (1990). The maturity index: An ecological measure of an environmental disturbance based on nematode species composition. *Oecologica* 83: 14-19.
2. Bongers T. & Ferris H., 1999. Nematode Community Structure as a bio-indicator in environmental monitoring. *Elsevier Science Tree*, 14: 224-228.
3. Cobb, N.A. (1918). Estimating the nematode population of soil. *Agricultural Technical Circular – 1 Bureo of Plant Industry. US Department of Agriculture* 48 p.
4. Coomans, A. (2000). Nematode systematics: past, present and future. *Nematology* 2:3-7.
5. De Maeseneer, J., & d'Herde, J. (1963). Me´thodes utilise´es pour l'e´tude des anguillules libres du sol. *Revue d'Agriculture* 16: 441–447.
6. Eisenback, J. D. (1985). Techniques for preparing nematodes for scanning electron microscopy in an advanced treatise on *Meloidogyne* volume II Methodology. Ed K. R. Barker, C. C. Carter and J. N. Sasser, North Carolina, USA, 223 p.
7. Flegg, J. J. M. (1967). Extraction of *Xiphinema* and *Longidorus* species from soil by a modification of Cobb's decanting and sieving technique. *Annals of Applied Biology* 60: 420–437.
8. Hammond, P. M. (1992). Species inventory. In: Groombridge, B. (Ed.). Global diversity, status of the earth's living resources. London, UK, Chapman & Hall, pp. 17-39.
9. Lambshead, P. J. D. (1993). Recent developments in marine benthic biodiversity research. *Oceanis* 6:5-24.
10. May, R.M. (1988). How many species are there on the Earth? *Science* 241, 1441-1449.
11. Pokharel, R. R. & Larsen, H. J. (2007).The importance and management of phytoparasitic nematodes in western Colorado fruit orchard. *Journal of Nematology* 39: 96.
12. Seinhorst, W. (1959). A rapid method for the transfer of nematodes from fixative to anhydrous glycerin. *Nematologica* 4: 67-69.
13. Sohlenius B. & Wasilewska L. (1984). Influence of irrigation and fertilization on the nematode community in a Swedish pine forest soil. *Journal of Applied Ecology*, 21: 327-342.
14. Thomas S.H. (1978). Population densities of nematodes under seven tillage regimes. *Journal of Nematology*, 10: 24-27.
15. Yeates G. W., Bongers, T., de Goede, R. G. M., Freckmen, D. W. & Georgieva, S. S., (1993). Feeding-habits in soil nematode families and genera: an outline for ecologists. *J. Nematol*. 25: 315-331
16. Yeates, G. W. (1998). Feeding in free-living soil nematodes: a functional approach. In: Perry RN, Wright D. J. (eds). *Physiology and biochemistry of free-living and plant parasitic nematodes.* CAB International, Wallingford. pp 245-269.
17. Yeates, G.W. & Bongers, T. (1999). Nematode diversity in agro-ecosystems. *Agriculture, Ecosystems and Environment* 74: 113-135.

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