Biological Forum – An International Journal **8**(2): 65-72(2016)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Community Analysis of Soil and Plant Parasitic Nematodes Associated with Mulberry Plants from Manipur, India

Loukrakpam Bina Chanu and Naorem Mohilal Meitei
Center for Advanced Studies in Life Science,
Manipur University, Canchipur–795003, Manipur, India,

(Corresponding author: Loukrakpam Bina Chanu)
(Received 28 May, 2016, Accepted 10 July, 2016)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Study on ecology of plant parasitic as well as soil nematodes associated with mulberry plants was carried out in Manipur for consecutive period of three years i.e. 2006 – 2008. Sixteen different nematode genera were identified under four orders - Aphelenchida, Dorylaimida, Tylenchida and Mononchida which spread over 12 families. During the present study, *Helicotylenchus* spp. showed as predominant nematode genera in all studied seasons followed by *Scutellonema* spp. from mulberry ecosystem of Government Silkfarm, Wangbal, Thoubal District, Manipur. This may be due to the wide range physiological characteristics of the nematode group. *Helicotylenchus* spp. followed by *Scutellonema* spp., *Ditylenchus* spp., *Caloosia* spp., *Criconemella* spp., *Aphelenchus* sp., *Paratylenchus* spp., *Basiria* spp. and *Tylenchus* spp. are most devastating nematodes of mulberry plantation in Manipur, India.

Key words: Community structure, nematodes, mulberry, Manipur, India.

INTRODUCTION

Mulberry leaf protein is the source for the silkworm (*Bombyx mori* L.) to biosynthesize the silk, which is made up of proteins like fibroin and sericin. Hence good quality leaves are essential for the production of quality silk. Production of quality silk depends both upon fertility of soil and control of disease causing organisms. Plant parasitic nematodes are also a major constraint in the cultivation of healthy mulberry leaves. Mulberry plants are perennial crops, so nematodes can readily perpetuate and spread the entire root system to cause rottening and decaying of roots. They also aggravate the intensity of the disease associating with other plant pathogens (Ramakrishnan & Senthilkumar 2003). About 42 species belonging to 24 genera are associated with mulberry in different mulberry growing regions of the world (Ramakrishnan & Senthilkumar 2003). The severity of attack and damage depends on the soil and climatic conditions of the different areas. The plant parasitic nematodes *Meloidogyne incognita* (Swamy & Govindu 1965), *M. javanica* (Mathur *et al* 1969), *M. arenaria* (Wang & Chen 1989), *Xiphinema index* (Martelli & Raski 1963), *X. meovuittenezi* (Dalmasso 1969); *X. basiri* (Yokoo (1970), *Helicotylenchus digitiformis* (Kiryanova & Shagalina 1976; *Rotylenchus reniformis* (Swarup *et al* 1964), *Hoplolaimus seinhorsti* (Keereewan & Leeprasert 1975); *Longidorus martini* (Ohishima *et al* 1971) and *Pratylenchus* sp. (Edward *et al* 1963) are frequently associated with mulberry. The root knot nematode was reported from almost all countries where mulberry is cultivated. During the work also, some pathogenic nematodes were encountered as *Basiria* sp., *Caloosia* sp., *Criconemoides* sp., *Ditylenchus* sp., *Helicotylenchus* sp., *Hemicriconemoides* sp., *Paratylenchus* sp., *Scutellonema* sp., *Tylencholaimus* sp. and *Tylenchus* sp. No contribution is made on the community analysis of soil and plant parasitic nematodes associated with mulberry plants which is of prime importance for sericulture in Manipur. The present study was carried out in view of investigating the type of nematodes which are mostly affecting the plants.

MATERIALS AND METHODS

A. Collection of soil samples

36 soil samples for consecutive months of three years 2006 – 2008, collected on every 15th or 16th date of each month were examined from around rhizospheric regions of mulberry plants from Government Silk Farm, Wangbal, Thoubal District, Manipur. During the study 40 sub areas were selected where mulberry plants were growing in a zigzag manner. Discarding the top layers of the soils, the sub areas were digged up to a depth of 20 cm.

Soil were collected from around the rhizospheric regions of mulberry plants from the areas in equal quantity, which served as the sub sample of the area and were mixed thoroughly in a bucket. From the mixture, 500 gram of soil was collected in separate polythene bags which served as the samples of the particular area. Data of collection were recorded and the polythene bags were brought to the laboratory and kept undisturbed for at least 2 days before further processing.

B. Processing of soil samples

The collected soil samples were brought to the laboratory and processed for the extraction of nematodes by Cobb's sieving and decanting method followed by Baermann's modified funnel technique. The nematodes were fixed in warm F. A. (Formaldehyde alcohol) (4:1). Commonly encountered nematodes were identified up to generic level.

C. Counting nematode population

The collected nematodes were put in a 100 ml conical flask and the value was made up to 100ml. The nematode suspension was homogenized by blowing with the help of a pipette. 10 ml of the homogenized suspension was taken in a Syracuse counting dish and then the nematode population present on it was recorded. At least three readings were taken to avoid the chances of error and mean taken. This value multiplied by 10 represents the nematode number at the generic level in the soil sample.

D. Calculation of nematode community structure parameters

From the data collected the absolute frequency, relative frequency, relative density, relative biomass, prominence value and importance value of each of the parasitic and soil nematode genera were calculated separately for each year using the formulae given by Norton (1978).

The formulae for calculations are as follows:

$$\textbf{Absolute frequency (AF) or Frequency} = \frac{\text{Number of samples containing a species}}{\text{Number of samples collected}} \times 100$$

$$\textbf{Relative frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Sum of frequency of all species}} \times 100$$

$$\textbf{Relative density (RD)} = \frac{\text{Number of individuals of a species in a sample(500gm soil)}}{\text{Total number of all individuals in a sample}} \times 100$$

$$\textbf{Relative biomass (RB), G} = \frac{a^2 b \times 16}{100{,}00}$$

Where G = biomass in micrograms
a = greatest body width
b = body lengths
16 is a previously determined empirical value (Andrassy 1956).

$$\textbf{Prominence value (PV)} = \text{Density}\sqrt{\text{Absolute frequency}}$$

Importance value (IV) = Relative frequency + Relative density + Relative biomass

RESULTS AND DISCUSSIONS

Sixteen different nematode genera were identified under four orders - Aphelenchida, Dorylaimida, Tylenchida and Mononchida under 12 families namely Aphelenchidae, Dorylaimidae, Tylenchidae, Caloosiidae, Criconematidae, Dorylaimellidae, Hoplolaimidae, Iotonchidae, Mylonchulidae, Tylenchulidae and Tylencholaimidae. The nematodes encountered were *Aphelenchus* spp., *Axonchium* spp., *Basiria* spp., *Caloosia* spp., *Criconemella* spp., *Ditylenchus* spp., *Dorylaimellus* spp., *Dorylaimoides* spp., *Helicotylenchus* spp., *Hemicriconemoides* spp., *Iotonchus* spp., *Mylonchulus* spp., *Paratylenchus* spp., *Scutellonema* spp., *Tylencholaimus* spp. and *Tylenchus* spp.

Table 1, 2, 3 and 4 respectively show the results of absolute frequency, relative frequency, relative density, relative biomass, prominence value and importance values of the nematodes encountered during the three years separately.

The results of the present study revealed that *Helicotylenchus* spp. have the highest potential of infecting mulberry plants with prominence values of 352.4 (2006), 273.3 (2007) and 398.7 (2008) respectively and importance values - 40.38 (2006), 51.06 (2007) and 55.82 (2008) respectively. *Helicotylenchus* spp., is followed by *Scutellonema* spp. with highest relative density in the year 2006 (RD=11.37) and 18.29 importance value. *Scutellonema* spp. had the highest densities next to *Helicotylenchus* during the year 2007 - 2008.

During 2007, its value was 10.49 p.c. with a prominence value of 104.9 and importance value of 17.53. During the year 2008, *Caloosia* spp. had the highest relative density next to *Helicotylenchus* spp., *Axonchium* spp. and *Scutellonema* spp. It had a relative density of 11.78 p.c, relative biomass 0.56, a prominence value of 112.78 and an importance value of 18.25. *Criconemella* spp. had a relative density of 7.15 in the year 2006, but the value is 3.62 in the year 2007 and 1.33 during the year 2008. Its relative biomass value in all three years remains constant with a value of 0.72. Its prominence value remains highest during the year 2006 with a value of 71.5 and lowest in the year 2008 with 11.51 values. Its importance value was highest during the year 2008 with 6.88 values.

Table 1: Community analysis of soil and plant parasitic nematodes associated with *Morus* spp. in Government Silkfarm, Khangabok Wangbal, Thoubal District, Manipur during the year 2006.

Nematode genera	AF	RF	RD	RB	PV	IV
Aphelenchus sp.	100.0	6.55	3.93	6.73	39.3	17.21
Axonchium spp.	100.0	6.55	11.57	1.67	115.7	19.79
Basiria spp.	100.0	6.55	2.11	0.08	21.1	8.74
Caloosia spp.	75.0	4.91	5.81	0.36	50.31	11.08
Criconemella spp.	100.0	6.55	7.15	0.72	71.5	14.42
Ditylenchus spp.	100.0	6.55	3.50	0.34	35.00	10.39
Dorylaimellus spp.	91.66	6.01	3.64	0.09	34.84	9.74
Dorylaimoides spp.	100.0	6.55	3.99	0.65	39.90	11.19
Helicotylenchus spp.	100.0	6.55	27.33	6.50	273.3	40.38
Hemicriconemoides spp.	66.66	4.32	2.14	0.30	17.47	6.76
Iotonchus spp.	100.0	6.55	3.70	10.97	37.00	21.22
Mylonchulus spp.	100.0	6.55	3.32	1.96	33.20	11.83
Paratylenchus spp.	100.0	6.55	1.73	0.62	17.3	8.9
Scutellonema spp.	100.0	6.55	11.37	0.37	113.7	18.29
Tylencholaimus spp.	100.0	6.55	6.31	0.58	63.1	13.44
Tylenchus spp.	91.66	6.01	2.31	0.07	22.11	4.69

Table 2: Community analysis of soil and plant parasitic nematodes associated with *Morus* spp. in Government Silkfarm, Khangabok Wangbal, Thoubal District, Manipur during the year 2007.

Nematode genera	AF	RF	RD	RB	PV	IV
Aphelenchus sp.	100.0	6.41	4.14	6.8	41.4	17.35
Axonchium spp.	100.0	6.41	8.77	2.39	87.7	17.57
Basiria spp	100.0	6.41	2.75	0.14	27.5	9.3
Caloosia spp.	91.66	5.88	5.39	0.58	51.60	11.85
Criconemella spp.	100.0	6.41	3.62	0.72	36.2	10.75
Ditylenchus spp.	100.0	6.41	4.27	0.35	42.7	11.03
Dorylaimellus spp.	100.0	6.41	3.14	0.05	31.4	9.6
Dorylaimoides spp.	100.0	6.41	4.37	0.57	43.7	11.35
Helicotylenchus spp.	100.0	6.41	35.24	9.41	352.4	51.06
Hemicriconemoides spp.	66.66	4.27	1.02	0.41	8.32	5.7
Iotonchus spp.	100.0	6.41	3.15	0.49	31.5	10.05
Mylonchulus spp.	100.0	6.41	2.34	8.80	23.4	17.55
Paratylenchus spp.	100.0	6.41	2.19	1.9	21.9	10.5
Scutellonema spp.	100.0	6.41	10.49	0.63	104.9	17.53
Tylencholaimus spp.	100.0	6.41	6.09	0.29	60.9	12.79
Tylenchus spp.	100.0	6.41	2.96	0.430	29.60	9.80

Only one Aphelenchid under the genera *Aphelenchus* sp. was encountered during the study. It had an absolute frequency of 100 and relative frequency of 6.45 similar to *Helicotylenchus* spp. The genera had 3.86 relative density, relative biomass of 6.73 which was less than that of *Tylenchus* spp., a prominence value of 38.6 which was greater than that of *Criconemella* spp. and an importance value of 17.04 which was lesser than that of *Criconemella* spp. Two nematode genera of the Order Mononchida *i.e. Iotonchus* spp. and *Mylonchulus* spp. were encountered. They have same absolute and relative frequencies in all the years studied.

Table 3: Community analysis of soil and plant parasitic nematodes associated with *Morus* spp. in Government Silkfarm, Khangabok Wangbal, Thoubal District, Manipur during the year 2008.

Nematode genera	AF	RF	RD	RB	PV	IV
Aphelenchus sp.	100.0	6.45	4.83	7.0	48.3	18.28
Axonchium spp.	100.0	6.45	15.65	4.04	156.5	26.14
Basiria spp	100.0	6.45	2.83	0.10	28.3	9.38
Caloosia spp.	91.66	5.91	11.78	0.56	112.78	18.25
Criconemella spp.	75.0	4.83	1.33	0.72	11.51	6.88
Ditylenchus spp.	100.0	6.45	4.69	0.33	46.9	11.47
Dorylaimellus spp.	100.0	6.45	2.44	0.15	24.4	9.04
Dorylaimoides spp.	100.0	6.45	5.51	0.74	55.1	12.7
Helicotylenchus spp.	100.0	6.45	39.87	9.50	398.7	55.82
Hemicriconemoides spp.	83.33	5.37	3.33	0.26	30.39	8.96
Iotonchus spp.	100.0	6.45	5.01	10.33	50.1	21.79
Mylonchulus spp.	100.0	6.45	8.59	2.11	85.9	17.15
Paratylenchus spp.	100.0	6.45	2.65	0.63	26.5	9.73
Scutellonema spp.	100.0	6.45	16.08	0.57	160.8	23.1
Tylencholaimus spp.	100.0	6.45	7.70	0.44	77.0	145.9
Tylenchus spp.	100.0	6.45	3.51	0.07	35.1	10.03

Table 4: Community analysis of soil and plant parasitic nematodes associated with *Morus* spp. in Government Silkfarm, Khangabok Wangbal, Thoubal District, Manipur during the year 2006 – 2008.

Nematode genera	AF	RF	RD	RB	PV	IV
Aphelenchus sp.	100.0	6.45	3.86	6.73	38.6	17.04
Axonchium spp.	100.0	6.45	10.65	4.04	106.5	21.14
Basiria spp	100.0	6.45	2.29	6.07	22.9	14.81
Caloosia spp.	86.11	5.55	6.73	0.58	62.45	12.86
Criconemella spp.	91.66	5.91	3.78	0.72	36.18	10.41
Ditylenchus spp.	100.0	6.45	3.71	0.35	37.1	10.51
Dorylaimellus spp.	100.0	6.45	2.81	0.15	28.1	9.41
Dorylaimoides spp.	100.0	6.45	4.13	0.74	41.3	11.32
Helicotylenchus spp.	100.0	6.45	39.87	9.50	398.7	55.82
Hemicriconemoides spp.	72.22	4.65	1.91	0.49	16.23	7.05
Iotonchus spp.	100.0	6.45	3.53	10.97	35.3	20.95
Mylonchulus spp.	100.0	6.45	4.12	0.63	41.2	11.2
Paratylenchus spp.	100.0	6.45	2.06	0.63	20.6	9.14
Scutellonema spp.	100.0	6.45	11.27	0.57	112.7	18.29
Tylencholaimus spp.	100.0	6.45	6.00	0.58	60.0	13.03
Tylenchus spp.	100.0	6.45	2.60	7.50	26.0	10.03

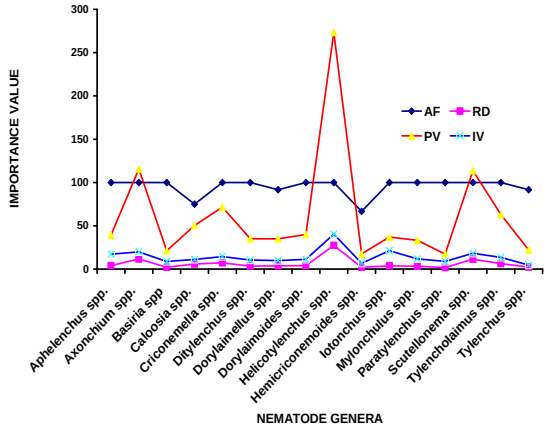

Fig. 1. Graph showing absolute frequency, relative density, prominence value and importance value of soil and plant parasitic nematodes associated with mulberry plants at Govt. Silkfarm, Wangbal, Thoubal District during the year 2006.

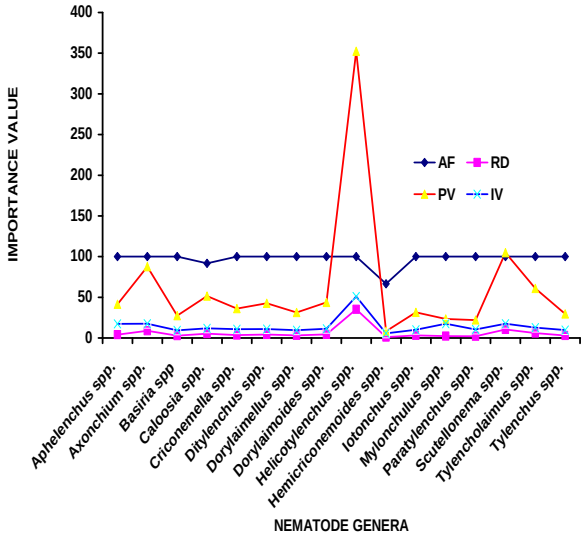

Fig. 2. Graph showing absolute frequency, relative density, prominence value and importance value of soil and plant parasitic nematodes associated with mulberry plants at Govt. Silkfarm, Wangbal, Thoubal District during the year 2007.

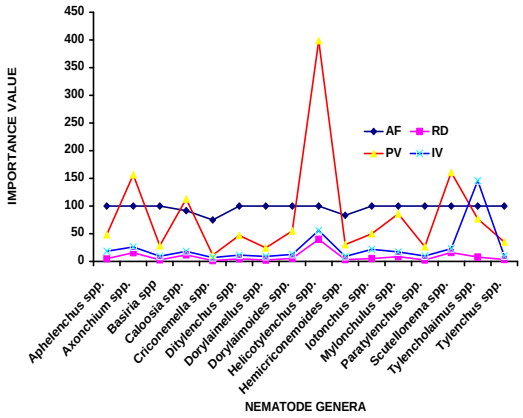

Fig. 3. Graph showing absolute frequency, relative density, prominence value and importance value of soil and plant parasitic nematodes associated with mulberry plants at Govt. Silkfarm, Wangbal, Thoubal District during the year 2008.

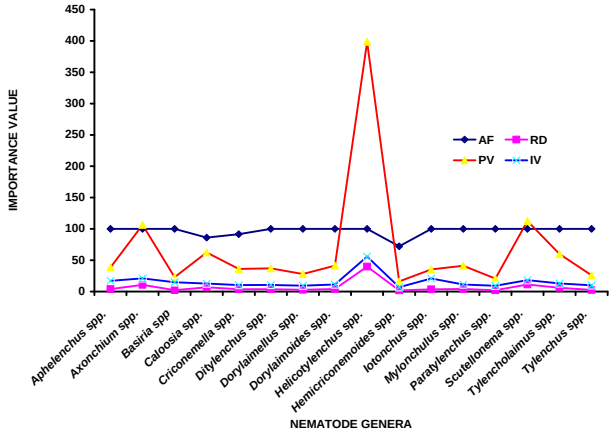

Fig. 4. Graph showing absolute frequency, relative density, prominence value and importance value of soil and plant parasitic nematodes associated with mulberry plants at Govt. Silkfarm, Wangbal, Thoubal District during year the 2006 – 2008.

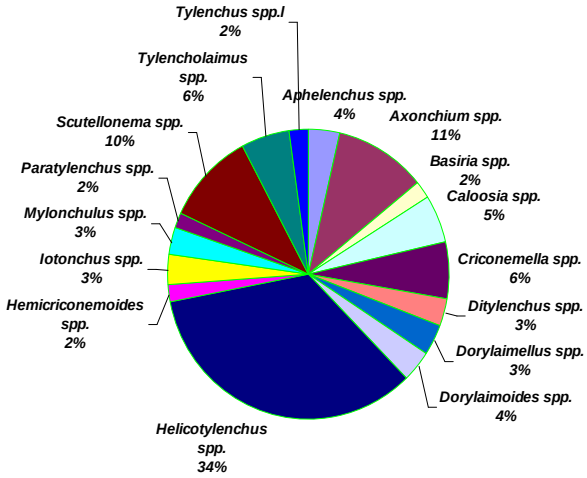

Fig. 5. Pie-chart representation of the nematode genera during the year 2006.

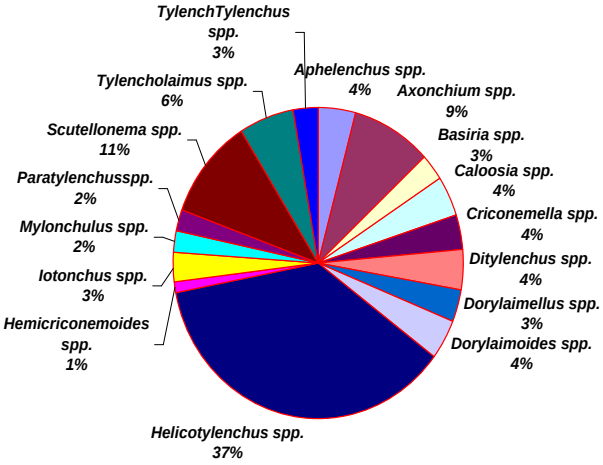

Fig. 6. Pie-chart representation of the nematode genera during the year 2007.

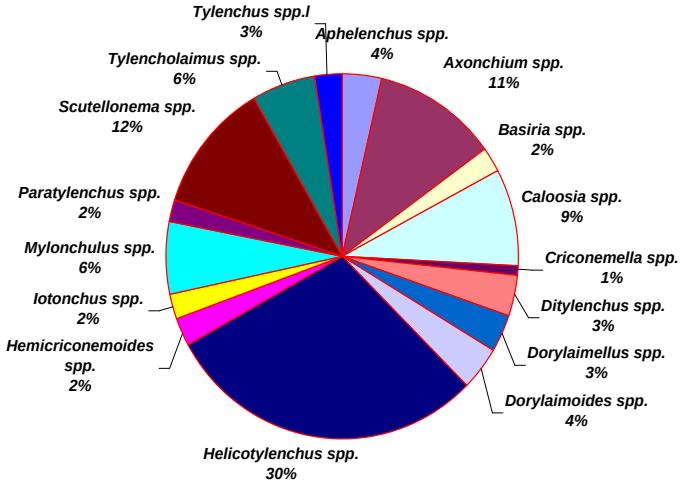

Fig. 7. Pie-chart representation of the nematode genera during the year 2008.

Mylonchulus sp. had greater relative density of 4.12 than *Iotonchus* sp. Relative biomass of *Iotonchus* spp. was greater than that of *Mylonchulus* spp. i.e. 0.63. *Mylonchulus* spp. had greater prominence value of 41.2 than *Iotonchus* spp. whose value is 35.3 while *Iotonchus* spp. had greater importance value of 20.95 than *Mylonchulus* spp. with 11.2.

Among the dorylaims, *Dorylaimoides* spp. had relative density value next to *Tylencholaimus* spp. during all the three years. *Dorylaimoides* spp. had greatest relative biomass value during year 2008 i.e. 0.74 while it was less during year 2007 with a value of 0.57. Its' prominence value was greatest during year 2008 with a value 55.1 followed by the year 2007 with a value of 43.7. The value was gradually increased from 2006 - 2008.

CONCLUSIONS

Out of the sixteen genera, twelve genera showed cent percent absolute frequency in the year 2006, fourteen genera in the year 2007 and thirteen genera in the year 2008. *Hemicriconemoides* spp. showed lowest absolute frequency, relative frequency, relative density, relative biomass, prominence value and importance value in all the three years followed by *Dorylaimellus* spp. while *Helicotylenchus* spp. showed highest relative density, relative biomass, prominence value and importance value in all the three years. Except absolute frequency and relative frequency, relative density, relative biomass, prominence value and importance value showed remarkable shift in values for one species to another during 2006 – 2008.

During the present study too, *Helicotylenchus* spp. showed as predominant nematode genera in all studied seasons followed by *Scutellonema* spp. from mulberry ecosystem of Government Silkfarm, Wangbal, Thoubal District, Manipur. This may be due to the wide range physiological characteristics of the nematode group. It is concluded that *Helicotylenchus* spp. followed by *Scutellonema* spp., *Ditylenchus* spp., *Caloosia* spp., *Criconemella* spp., *Aphelenchus* sp., *Paratylenchus* spp., *Basiria* spp. and *Tylenchus* spp. are most devastating nematodes of mulberry plantation in Manipur, India.

ACKNOWLEDGEMENTS

Authors are thankful to the Head, Department of Life Science, Manipur University Canchipur for providing necessary facilities.

REFERENCES

Ahmad, N. & Jairajpuri, M. (1982). Effect of pH, mineral salts and fatty acids on the predatory nematodes Parahodronchus shakili (Jairajpuri, 1969). *Indian Journal of Nematology*. **12**(1): 22-30.

Azmi, M. I. 1995. Seasonal population fluctuation behavior of plant parasitic nematodes in Caribbean stylo. *Indian Journal of Nematology*. **25**: 189-192.

Chowdhury, B.N. & Phukan, P.N. (1990). Seasonal fluctuation of nematode population in banana. *Indian Journal of Nematology*. **20**: 189-192.

Chowdhury, B.N. & Phukan, P.N. (1995). Study on variations of certain plant parasitic nematodes at different levels of pH. *Indian Journal of Nematology*. **25**: 202-203.

Dalmasso, A. (1969). Etedu anatomigue et taxonomique des generes Xiphinema, Longidorus et. Paralongidorus (Nematoda: Dorylaimidae). *Memoria Museum Historia Natural Paris, Series A, Zoology*. **61**: 33-82.

Das, B.K., Sarkar, J., Sarkar, S., Das, N.K., Ray, I. & Sen, S.K. (1990). Correlation between some edaphic factors and *Meloidogyne incognita* infestation of mulberry in Malda, West Bengal. *Indian Journal of Nematology*. **20**: 91-94.

Edward, J.C., Misra, S.L., Naim, Z. & Misra, S.L. (1963). Survey of plant parasitic nematodes of farm soils of the Allahabad Institute. *Allahabad Farmer*. **37**: 1-8.

Jones , R.K. (1980). Population dynamics of *Helicotylenchus multicintus* and other nematodes on banana from a sub-tropical environment. *Nematology*. **26**: 27-33.

Keereewan, S. & Leeprasert, P. (1975). Seasonal fluctuation and vertical distribution of Hoplolaimus senihorsti on mulberry. *Plant Protection Service Technology Bulletin*. **26**: 6-8.

Khan, A.H., Baseeb, A., Rehman, R., Sazena, S.K. & Khan, A.M. (1980). Population fluctuations of some nematodes around roots. *Geobios*. **7**: 55-57.

Kiryanova, E.S. & Shagalina, L.M. (1976). Parasitic root nematode from the genus Helicotylenchus (Nematoda: Hoplolaimida) in Turmenistan. Izvestiya Akademii Nauk Turmenskoi SSR. *Biologicheskie Nauki*. **15**: 90-92.

Krivtsov, V., Bazginova, T., Salmomd, R., Liddell, K., Garside, A., Thompson, J., Palfregman, J.W., Staines, H.J., Brendler, A., Griffiths, B. & Watling, R. (2006). Ecological interactions between fungi, other biota and forest litter composition in a unique Scottish woodland. *Forestry*. **79**: 201-216.

Krivtsov, V., Garside, A., Brendler, A., Liddell, K., Griffiths, B.S. & Staines, H.J. (2007). A study of population numbers and ecological interactions of soil and forest floor microfauna. *Animal Biology*. **57**: 467-484.

Martelli, G.P. & Raski, D.J. (1963). Observation Su Xiphinema index Thorne [*Eleusine coracana* (L) Gaertn.] Allen, ficoe degenerazione infective deallavite. *Inftore fitopatol*. **13**: 416-420.

Mathu, R.L., Mathur, B.N. & Ghaffar, A. (1969). Addition to host records of root – knot nematodes. *Nematologica*. **15**: 160-161.

Norton, D.C. 1978. Ecology of Plant-parasitic Nematodes. A Wiley- Interscience Publication, New York.268p.

Ohishima, Y., Nishizawa, T., Hirata, A. & Okabe, H. (1971). Nematode fauna of mulberry orchards (Abstract). In: Ann. Meet. *Japanese Society for Applied Entomology and Zoology*. Fachu, Tokyo, April 7-9.

Ramakrishnan, S. & Senthilkumar, T. (2003). Plant parasitic nematodes, a serious threat to mulberry- A review. *Indian Journal of Sericulture.* **42**(2): 82-92.

Swamy, B.C.N. & Gonvidu, H.C. (1965). A preliminary note on the plant parasitic nematodes of the Mysore state. *Indian Phytopathology.* **19**: 233-240.

Swarup, G., Sethi, C.L. & Gill, G. (1964). Some records of plant parasitic nematodes in India. *Current Science.* **33**: 593.