JOURNAL OF PURE AND APPLIED MICROBIOLOGY, March. 2014. Vol. **9**(1), p. 767-776

Biodiversity and Periodical/Seasonal Distribution of Nematode Trapping Fungi from Different Habitats

R.K. Singh[1]*, S.K. Pandey[1] and Anirudha Chattopadhyay[2]

[1]Department of Mycology and Plant Pathology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, India.
[2]Center of Excellence for Research on Pulses, Sardarkrushinagar Dantiwada Agricultural University, SK Nagar, Gujarat-385509, India.

(Received: 15 July 2014; accepted: 21 August 2014)

Nematophagous fungi are a group of micro fungi that are ubiquitous in nature and have been well distributed in variety of ecological habitats and environment worldwide. Their diversity and distribution in soil is mainly associated with various soil parameters, especially with soil organic matter content. This experiment is carried out to explore the biodiversity and seasonal distribution of Nematode trapping fungi from different habitats like decaying woody soil, decaying leafy soil and agricultural rhizospheric soil. For this study, periodical isolation of these fungi in the month of January 2014 and May 2014 was carried out from samples taken from various randomly selected eight locations of three different habitats. In both the season, the higher level of diversity in terms of the population density and species richness was recorded in decaying leafy soils, followed by in decaying woody soil, but in agricultural rhizospheric soil it was less. Moreover, the recorded species are evenly distributed mostly in decaying leafy soil and decaying woody soil whereas, agricultural rhizospheric soil is mainly dominated by single species *i.e., A. oligospora* with 30 % occurrence frequency. This is significantly correlated with variation in quantified nematode population and estimated C:N ratio of the samples of different habitats. These findings clearly indicate the role of these group of fungi in maintaining the fertility status of soil and the importance of their conservation and possible utilization in enhancing the soil health of agricultural soil.

Key words: Biodiversity, Nematode trapping fungi, Decaying leafy soil, Decaying woody soil, Nematode population, C: N Ratio.

Nematophagous fungi are a diverse group of the fungi, which include large variety of species of predaceous, endoparasitic, eggs and cysts parasitic as well as toxin producing in nature. They are varied in terms of the various type of trapping devices that they produced and also in terms of the ability to parasitize on nematodes. These fungi are ubiquitous in nature and have been reported in variety of ecological habitats and environment, from agricultural, horticultural, and forest soil to various aquatic environments. They have the ability to capture and kill nematodes from all these ecological niches. They are attacking living nematode or their eggs and utilize them as a source of nutrients. For this purpose usually special morphological adoption of the fungal mycelium are necessary. Hence, four different strategies so far these fungi have been encountered (Jansson and Lopez Llorca, 2001; Nordbring-Hertz *et al*., 2006). Firstly, there are predatory (or nematode-trapping) fungi which produce special hyphal structure on mycelium of nematode trapping fungi that may be either adhesive or non adhesive, and by which nematode are efficiently capture. Secondly, there exist

* To whom all correspondence should be addressed.
Tel .: +915426702585, +919450530703;
Fax No.: + 91-542-2368381;
E-mail: rakesh_bhuin@outlook.com

endoparcitic fungi which use adhesive or non adhesive spores that adhere to surface of nematode or are ingested by them respectively. Thirdly, there are fungal parasite of cysts and root knot nematodes which attack egg or female of nematode by growth of vegetative hyphae and formation of appressorium like structure, and finally, those who are producing toxins and kill the nematodes before hyphal penetration (Barron and Thorn, 1987). Therefore, these fungal group can be exploited in agriculture and veterinary science as potent biocontrol agents for sustainable management of nematodes of plant and animal parasitic in nature (Chattopadhyay and Singh, 2014).

The occurrence and distribution of nematophagous fungi in various types of ecological, geographical, region and different habitats throughout the world were studied by several workers (Duddington 1951, 1954, Gray 1987, Dackman *et.al.*, 1992; Su *et. al.*, 2007; Mo *et. al.*, 2008, Saxena, 2008). They are being reported from various ecological niches, but being most frequent in soils with higher content of organic matter, especially in decaying plant litters, followed by cultivated soil, compost and soil associated with moss (Saxena, 2008). However, the detailed study on predaceous fungi, in relation to season, cropping pattern, and various soil property like organic matter content, soil pH, etc., is being poorly investigated and needed to be pursued for a good understanding of biological control operative under natural condition. The art of management of plant parasitic nematodes can also being constructed on the basis of our good understanding of ecological relationship among microorganisms, specially the predaceous fungi and population dynamics of nematodes in soil. In this study, we try to explore biodiversity their ecology and seasonal distribution of nematode trapping fungi for their natural conservation and better utilization as potent biocontrol against of these fungi in future use.

MATERIALS AND METHOD

Collection of samples

Samples were collected from the plant rhizosphere of twenty four different selected sites of BHU campus and Varanasi city of district Varanasi, Uttar Pradesh. All these sites were fixed randomly for periodical collection of samples from the same sites. 50 g of samples were collected every time from specific sites of each plant root rhizosphere containing some part of soil and decaying leaf materials and separately taken in polythene bags, which were double-sealed to prevent evaporation and brought to the laboratory for the observation of nematode trapping fungi.

Isolation of nematode trapping fungi

Isolation of all the species of nematode trapping fungi was done by the method as described by Duddington (1955). One gram of each sample was scattered /spread over the surface of several sterile Petri dishes already poured with sterilized water agar medium into petri dishes. Population of saprophytic nematodes cultured on beef extract medium was used as bait. The Petri dishes were incubated at room temperature (25-30^{o}C) for 10-15 days.

Identification and quantification of fungal colony

Incubated plates containing samples from each ecological niche were observed regularly starting from 5th days of incubation to 15th days for identification and quantification of colonies of different nematode trapping fungi under stereoscopic binocular microscope. The taxonomic identification of these nematode trapping fungi was done based on the microscopic observation of trapping structure as well as spore shape and size using identification key provided by Cooke and Godfrey (1964). The observations were recorded based on the occurrence of total number of colonies in all three replications of different rhizospheric habitats/ sites. The percent occurrence of different types of nematode trapping fungi *viz.*, three dimenstional hyphal network forming group (Example. *Arthrobotrys* species), stalked knobs/un-stalked knobs forming group (*Monacrosporium* species), constricting ring forming group (*Drecslerella)*.

Purification and maintenance of cultures

Pure culture of different species of nematode trapping *fungi* was done by single spore isolation technique as described by Tuite (1969). Conidia were picked with the help of sterilized fine needle and dragged lightly across in petri dishes containing water agar medium under aseptic condition. Well separated spores were located under stereoscopic microscope (10X) and an agar block containing a single spore was transferred

into a petri dish containing corn meal agar medium. Several single spores of each fungus were transferred in separate petri dishes and incubated at 25± 1°C for growth and sporulation. After 7 days of incubation, spores of each fungus were transferred aseptically in Petri dishes containing corn meal agar medium and were maintained regularly by sub-culturing.

Identification of nematode trapping fungi

For identification of different species of nematode trapping fungi, different parameters like spore size, spore shape, number of septa in spore, ratio of proximal cell and distal cell of spore, conidiophore size, branching pattern; hyphal width, type of hyphal nets, etc., were measured and compared with the original description given by Drechsler (1937) and Cooke and Godfrey (1964).

Quantification of Nematode population

The nematodes population from one kg of soil of each selected sites/habitats was extracted by the Cobb's decanting and sieving method with differential sieves. The soil was mixed with a large volume of water (normally 3-5 folds) allowing a brief time for heavy particles to settle down and then pouring the mixture through one or more sieves to collect the nematodes of different size. Extracted solution was maintained upto 250 ml in a conical flask. One ml of each sample was taken from 5 ml pipette three times for the counting of nematodes under stereoscopic microscopic and finally nematode population estimated in 250 ml extracted solution.

Estimation of Carbon and Nitrogen ratio

The estimation of carbon and nitrogen content of each sample from all the selected sites was done before the beginning of sample collection (in the month of January, 2014) and after the end of sampling (in the month of May, 2014). Total nitrogen content was determined by digesting sample in sulphuric acid at a temperature 360-420°C. The rate of digestion is accelerated by using copper sulphate as a catalyst and anhydrous potassium sulphate to raise the boiling temperature of H_2SO_4. The digestion was continued for two hours or until the colourless solution is obtained. On completion of digestion, the samples were cooled and diluted as a concentrated alkali, then it was put for ammonium distillation. The distilled ammonia is quantitatively absorbed in boric acid and titrated against standard acid (Bremner *et al.*, 1982). Whereas, organic carbon content of each sample was estimated by chromic acid wet digestion followed by titrimetric measurement of unreacted dichromate (Walkley and Black, 1934). For that five gram sample were taken in a kjeldahl flask containg 3-4 g of digestion mixture (K_2SO_4:$CuSO_4$, 5 H_2O: Selenium powder-100:10:1) and 10 ml of concentrated sulphric acid (Sp. Gr.-1.84, Purity 98%, 36N) and then digested in a block digester (KEL PLUS block digester) for 2 hours, followed by cooling of the flask and addition of 50 ml of 40% NaOH to it for keeping put it for ammonium distillation. The distilled ammonia is quantitatively absorbed in boric acid (4% Boric acid with mixed indicator, pH 4.5) and titrated against acid 0.1 (N) H_2SO_4.

Data Analysis

Total numbers of taxa, their frequency of occurrence, and abundance (total occurrence of all taxa) were recorded and calculated for each sampling site at each habitat. The individual number of a species was counted as one occurrence of a species if it was isolated from any of the three replicates. The species diversity of each sampling site was calculated using Shannon's Diversity Index, *H*' (Shannon and Weaver, 1963) and the Simpson Index, *D* (Simpson, 1949).

$$H' = -\sum_{i=1}^{n} P_i \ln P_i \qquad \text{Where, } P_i = \frac{Ni}{N}$$

$$D = -\sum_{i=1}^{n} P_i^2$$

Where N_i is individual number of *I* species and *N* is individual number of all species. *Pi* is the proportion of *I* species and *n* is the number of species at the site. The frequency of occurrence of each species (*F*) was calculated based on total number of all species by using following formula:

$$F = \frac{\text{Individual number of species}}{\text{Individual number of all species}} \times 100$$

RESULTS

Population dynamics of nematode trapping fungi from different habitats

A diverse group of nematophagous fungi were observed from 24 composite samples collected from three different habitats *i.e.*, decaying woody

soil, decaying leafy soil, and agricultural rhizospheric soil. There was also evident of many endoparasitic and zoosporic fungi but major emphasis was given to the estimation of population of nematode trapping fungi. The species richness is higher in case of decaying woody soil as well as decaying leafy soils with a total of eleven different species in each (Table-2 & 3) in comparison to agricultural rhizospheric soil with only eight species (Table-4). In the habitat of decaying woody soil, constricting ring forming fungus, *Dactylaria brochopaga* was appeared in highest frequency of 24.99% followed by *A. oligospora* with 19.99%, and *A. superba* with 16.66% occurrence frequency , respectively. Their periodical distribution was also varied according to the season. In decaying woody soil, different nematode trapping fungi were appeared in higher rate in the month of January with an average of 36 colonies and in the month of May, only twenty four colonies of these nematode trapping fungi were recorded from the same sites (Table-2). Similarly, in the habitat of decaying leafy soil, the species richness is also very high with the occurrence of eleven different species of nematode trapping fungi (Table-3). There is a close association of hyphal adhesive net forming fungi like *A. musiformis*, *Monacrosporium eudermatum* and *A. oligospora* with decaying leafy soil due to their higher frequency of occurrence. The seasonal distribution of these nematode trapping fungi was also differ with a maximum population of 48 different colonies in the month of January and that of 41 different colonies in the month of May (Table- 3). Thus, the population of nematode trapping fungi is much more diverse in decaying leafy soils in comparison to the decaying woody soils. Whereas, in the agricultural rhizospheric soil, the species richness is much lesser with a count of only eight species of nematode trapping fungi and the seasonal distribution of these fungi was also lower with an average population count of 27 colonies in the month of January 2014 and that of 15 colonies in the month of May 2014. The population of nematode trapping fungi in agricultural soil is mainly dominated by *A. oligospora* with 30 % occurrence frequency followed by *Monacrosporium eudermatum* and *A. superba* with 17.5 % occurrence frequency in both the cases (Table-4) while, the frequency of constricting ring forming fungi *Drecslerella brochopaga* was found in less amount. It is evident that in one hand, the average population density is drastically reduced in agricultural soil with a lesser species richness and in the other hand, the existing population of nematode trapping fungi in agricultural soil is mainly dominated by only one species. Thus, the diversity in the population of nematode trapping fungi habituating in agricultural soil is much lesser in comparison to decaying leafy soil and decaying woody soil.

Population dynamic of nematode population from different habitats

Similar to the nematode trapping fungi, the population dynamics of nematode population was also varied with different habitats. The population density of saprophytic nematodes is always highest in decaying leafy soil followed by decaying woody soil, while it is in lesser number in the samples of agricultural rhizospheric soils (Table-5). Whereas, the estimated nematode population in all the selected sites was found always much higher in the month of January than in May, irrespective to different habitats. Usually, the population density of nematodes was more in

Table 1. Selected sites for collection of samples

S.N.	Habitats		
	Decaying woody soil	Decaying leafy soil	Agricultural Rhizospheric soil
1	Sadar Bazar, Varanasi (DW1)	Botany Garden, BHU(DL1)	Mycology & Plant Pathology, BHU(A1)
2	NCC BHU(DW2)	Varuna Pool, Varanasi(DL2)	Church, Cantoment, Varanasi(A2)
3	39 GTC Varanasi(DW3)	Sarnath, Varanasi(DL3)	Agricultural Farm, BHU(A3)
4	Mint House, Varanasi(DW4)	Phulwaria, Varanasi(DL4)	39 GTC Varararanasi(A4)
5	BGT Hostel, BHU(DW5)	ImliaGhat, Varanasi(DL5)	Central office, BHU(A5)
6	Dairy, BHU(DW6)	Shivpur, Varanasi(DL6)	Phulwaria, Varanasi(A6)
7	IT Chowk, BHU(DW7)	Kariyappa Park, Varanasi(DL7)	ImliaGhat, Varanasi(A7)
8	ImliaGhat, Varanasi(DW8)	IPS Bangla, Varanasi(DL8)	B R O, Varanasi(A8)

Table 2. Occurrence frequency of nematode- trapping fungi on different sites at Decaying Woody soil.

S.N.	Species	January 2014								May 2014								Frequency
		DW 1	DW 2	DW 3	DW 4	DW 5	DW 6	DW 7	DW 8	DW 1	DW 2	DW 3	DW 4	DW 5	DW 6	DW 7	DW 8	
1.	*Arthrobotrys arthrobotryoides*	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	3.33
2.	*A.conoides*	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	3.33
3.	*A. cladodes*	-	1	-	-	-	-	1	-	-	-	-	-	-	-	1	-	4.99
4.	*Monacrosporium eudermatum*	1	-	-	1	-	-	-	-	1	-	1	2	-	-	-	-	9.99
5.	*M. haptotylum*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	3.33
6.	*A. superba*	2	-	-	1	-	1	-	-	2	-	-	2	-	1	-	1	16.66
7.	*A. musiformis*	-	1	-	-	1	-	-	-	-	2	-	-	1	-	-	-	8.33
8.	*A. oligospora*	1	-	1	-	2	-	-	-	2	-	2	1	2	-	-	1	19.99
9.	*M. cinopagum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
10	*.M. ellipsosporum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
11.	*M. gephyrophagum*	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	3.33
12.	*Dactylaria brochopaga*	1	-	2	-	1	-	-	1	2	-	2	-	3	-	1	1	24.99
13.	*A. dactyloides*	-	-	-	1	-	-	-	-	-	-	-	1		-	-	-	3.33
N (Individual no. of all Species)		5	2	4	5	4	1	2	1	7	2	6	8	6	1	3	3	
S (Species no. recorded)		4	2	3	5	3	1	2	1	4	1	4	6	3	1	3	3	
H' (Shannon-weiner index)		1.33	0.69	1.04	1.61	1.04	0	0.69	0	1.35	0	1.33	1.73	1.01	0	1.09	1.09	
Simpson_1-D		0.72	0.50	0.62	0.80	0.62	0	0.50	0	0.73	0	0.22	0.81	0.64	0	0.66	0.66	
Evenness e ^H/S		0.94	0.99	0.94	0.99	0.94	1	0.99	1	0.96	1	0.94	0.43	0.91	1	0.99	0.99	

Table 3. Occurrence frequency of nematode- trapping fungi on different sites at decaying leafy soil

S. N.	Species	January 2014								May 2014								Frequency
		DL 1	DL 2	DL3	DL4	DL5	DL6	DL7	DL8	DL1	DL 2	DL3	DL4	DL5	DL6	DL7	DL 8	
1.	*Arthrobotrys arthrobotryoides*	-	1	-	2	-	-	1	-	-	1	-	1	-	-	2	-	8.96
2.	*A.conoides*	-	-	1	-	-	1	1	-	-	-	-	-	-	2	1	1	7.84
3.	*A. cladodes*	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	2.24
4.	*Monacrosporium eudermatum*	1	-	2	-	-	3	1	1	1	1	2	-	-	2	1	2	19.04
5.	*M. haptotylum*	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	2.24
6.	*A. superba*	1	2	-	2	1	-	-	-	2	2	-	1	1	-	-	-	14.56
7.	*A. musiformis*	1	1	2	-	-	1	-	2	1	2	2	-	-	2	-	3	19.04
8.	*A. oligospora*	-	-	3	-	1	-	2	1	-	-	2	-	2	-	3	1	16.8
9.	*M. cinopagum*	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1.12
10.	*.M. ellipsosporum*	1	-	-	-	1	-	-	-	2	-	-	-	1	-	-	-	5.6
11.	*M. gephyrophagum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
12.	*Dactylaria brochopaga*	-	-	1	-	-	-	-	-	-	-	2	-	-	-	1	-	4.48
13.	*A. dactyloides*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
N (Individual no. of all Species)		4	4	9	6	3	6	5	4	6	6	8	3	4	7	8	7	
S (Species no. recorded)		4	3	5	4	3	4	4	3	4	4	4	3	3	4	5	4	
H' (Shannon-weiner index)		1.38	1.03	1.52	1.32	1.09	1.24	1.33	1.03	1.32	1.32	1.38	1.09	1.03	1.35	1.49	1.27	
Simpson_1-D		0.75	0.62	0.76	0.24	0.66	0.66	0.72	0.62	0.22	0.22	0.75	0.66	0.62	0.73	0.67	0.69	
Evenness e ^H/S		0.99	0.99	0.91	0.94	0.99	0.86	0.94	0.94	0.94	0.94	1	0.99	0.94	0.96	0.94	0.89	

Table 4. Occurrence frequency of nematode- trapping fungi on different sites of *Rhizospheric* Soil

S.N	Species	January 2014								May 2014								Frequency
		R1	R2	R3	R4	R5	R6	R7	R8	R1	R2	R3	R4	R5	R6	R7	R8	
1.	*Arthrobotrys arthrobotryoides*	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	5
2.	*A.conoides*	-	-	1	-	-	-	-	-	-	-	1	-	1	-	-	-	7.5
3.	*A. cladodes*	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	0
4.	*Monacrosporium eudermatum*	-	1	-	-	1	-	1	-	-	2	-	-	1	-	1	-	17.5
5.	*M. haptotylum*	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	0
6.	*A. superba*	-	1	-	-	-	1	-	-	-	1	2	-		2	-	-	17.5
7.	*A. musiformis*	-	1	1	-	-	-	-	-	-	1	-	-		-	-	1	10.0
8.	*A. oligospora*	1	-	-	-	1	2	-	-	2	-	3	-	1	2	-	-	30.0
9.	*M. cinopagum*	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	0
10	*.M. ellipsosporum*	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	0
11.	*M. gephyrophagum*	-	-	-	1	-	-	-	-	-	-	-	1		-	-	-	5
12	*Dactylaria brochopaga*	-	-	-	-	1	-	-	-	-	-	-	-	1	-	1	-	7.5
13.	A. dactyloides	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	0
N (Individual no. of all Species)		1	3	2	1	4	3	1	0	2	4	6	1	5	4	2	1	
S (Species no. recorded)		1	3	2	1	4	2	1	0	1	4	3	1	5	2	2	1	
H' (Shannon-weiner index)		0	1.09	0.69	0	1.38	0.63	0	0	0	1.03	1.01	0	1.60	0.69	0.69	0	
Simpson_1-D		0	0.33	0.5	0	0.75	0.44	0	1	0	0.62	0.64	0	0.80	0.50	0.50	0	
Evenness e ^H/S		1	0.99	0.99	1	0.99	0.94	1	1	1	0.70	0.91	1	0.99	0.99	0.99	1	

the samples having higher organic matter content, quantified in the form of C: N ratio (Table-5). The C: N ratio of agricultural soil samples were less than other habitats due to low organic matter content and this can be correlated with the population density of saprophytic nematode in those samples.

DISCUSSION

The population dynamics of nematode trapping fungi is largely depend upon various interacting factors like population density of nematodes as well as organic matter content in the soil of different habitats. The higher diversity and the species richness in the population of nematode trapping fungi is decaying leafy soil and decaying woody soil is significantly correlated with the higher population density of nematodes than that of agricultural soil. The similar pattern of diversity in the population of nematophagous fungi from different habitats in various countries was also reported by different workers (Gray, 1987; Persmark *et. al*., 1996; Kerry and Hammrick, 2002; Saxena, 2008).According to Gray (1987)**,** the nematode trapping fungi are found throughout the world and in all types of climatic habitats. They usually prefer to grow in the soils having high organic matter content(Duddington, 1962).Thus, they are more frequently encountered from leaf litter, decaying woods, dung and freshly decaying foliage etc. (Duddington, 1940-1962; Soprunov, 1958; Drechsler, 1937-1941; Shepherd, 1955; Maupas, 1915). The highest diversity has also been recorded form the deciduous leaf litter and coniferous leaf litter, coastal vegetation and permanent pasture or temporary agriculture pasture (Duddington, 1951). Similarly, the highest population density of these fungi was recorded in soil associated with decaying leaves followed by cultivated soil, compost and soil associated with moss (Saxena, 2008). Colonization of nematophagous fungi on these

Table 5. Estimation of C: N ratio and nematode population in different periods.

S.N.	Habitat	Sites	January 2014		May 2014	
			C:N ratio	Nematode Population	C:N ratio	Nematode Population
1.	Decaying woody Soil	DW 1	45:1	5820	16:1	3520
		DW 2	42:1	4200	14:1	3180
		DW 3	47:1	2740	16:1	1920
		DW 4	36:1	2080	15:1	1600
		DW 5	33:1	1780	12:1	1240
		DW 6	39:1	1560	13:1	1180
		DW 7	43:1	1140	12:1	960
		DW 8	46.5:1	4440	11:1	1240
2.	Decaying leafy Soil	DL 1	68:1	6760	16:1	3200
		DL 2	70:1	4120	15;1	3850
		DL 3	75:1	11040	14:1	5200
		DL 4	64:1	7900	13:1	3260
		DL 5	63:1	8220	16:1	4840
		DL 6	67.5:1	12020	14;1	10280
		DL 7	73:1	5040	16:1	3840
		DL 8	71:1	7240	15:1	3480
3.	Agricultural Soils	A 1	14:1	1860	10:1	1700
		A 2	12:1	1980	10:1	1620
		A 3	9.0:1	3620	11:1	2060
		A 4	10:1	2240	15:1	1180
		A 5	13:1	2700	9:1	1900
		A 6	10:1	2490	9:1	1760
		A 7	11:1	2620	11:1	1900
		A 8	13:1	3900	12:1	2200

organic substrates is associated with their decomposition and supplies of the food to grow and hence their number is higher than the normal soil. They are also involve in regulating the carbon and nitrogen cycle in soil and help in maintaining the soil fertility. They usually exist both in saprophytic as well as in parasitic mode based on the ecological preference of the nematode trapping fungus to C:N ratio in soil. During saprophytic phase, when C:N ratio is very high(>30) they are involved in the decomposition of organic matter by their cellulolytic and ligninolytic activity. But when nitrogen is a limiting factor in their habitat, to satisfy their nitrogen requirement they switched to their parasitic life and predate on saprophytic nematode population to obtain nitrogen compounds directly from life forms (Barron, 2003). Thus, the abundance of nematodes remain significantly higher in the decaying leafy soil, followed by decaying woody soil where C:N ratio is much higher than normal agricultural rhizospheric soil. Another possible explanation could be that leaves and wood in soil decomposed in faster rate because of favourable C:N ratio and relatively release of nutrients enhance bacteria population which in turn will feed the bacterivorous nematodes, which eventually used by the nematode trapping fungi.

The seasonal distribution of nematode trapping fungi is also largely varied with organic matter content and availability of moisture in soil. In this study, we have found that the population density of nematode trapping fungi is significantly higher in the month of January due to availability of moisture, but reduced in May, during dry summer in Varanasi. This finding is also corroborated with the previous studies on distribution pattern of nematophagous fungi in agricultural, horticultural and forest soil (Kerry and Hammrick, 2002; Persmark *et. al*., 1996) with the report of highest density of nematode-trapping fungi in late summer and autumn. This was also the case for the nematodes population and was agreed with previous findings of Shah (2010) who correlated the fluctuation of nematode population in the rhizospheric zone of mulberry plants in relation to environmental factors like soil moisture content, soil pH, soil temperature, rainfall and moisture content of air for a consecutive period of three years, 2006-2008. So, it is now evident that information on biodiversity and periodical distribution of nematode trapping fungi is important in respect to the maintenance of soil fertility and in improving soil health which is clearly lacking in agricultural soil. Thus, the conservation and exploitation of this fungal population in various agricultural aspects will be very important step to understand the biological control phenomenon in natural condition.

ACKNOWLEDGEMENTS

The authors are thankful to UGC (University Grant Commission), New Delhi, India for providing financial support.

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