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DISTRIBUTION OF BACTERIVOROUS NEMATODES ALONG THE DISTANCE GRADIENT FROM A THERMAL POWER STATION

VIJAY VIKRAM SINGH TOMAR, MOHAMMAD BANIYAMUDDIN, WASIM AHMAD*

Section of Nematology, Department of Zoology, Aligarh Muslim University, Aligarh- 202 002, India; e-mail: ahmadwasim57@yahoo.co.in

Abstract

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The distribution of bacterivorous nematode genera along a distance gradient from a 50 years old Thermal power station was studied. Sampling distances were 500m (A), 1000m (B), 2000m (C) and 4000m (D) from the station. Soil chemical properties were analyzed and the abundance of nematode genera were studied in relation to pH, available carbon, available potash and available phosphates in the soil. The concentration of available carbon increased and consequently decreased with distance *Eucephalobus* was overall dominant genus at the four sites. The abundance of *Acrobeles* and *Eucephalobus* ($P < 0.05$) was significantly correlated with distance from source, while abundance of *Acrobeles*, *Eucephalobus* ($P < 0.05$) and *Plectus* ($P < 0.01$) significantly correlated with available carbon. *Acrobeles, Acrobeloides, Rhabditis* and *Panagrolaimus* were correlated with pH, available carbon and available phosphates while no nematode genus correlated with available potash.

Key words: bacteriovore nematodes, distance gradient, thermal power station

Introduction

Nematodes are important components of soil food webs and play important roles in ecological processes such as nitrogen cycling and plant growth patterns (Neher, 2001). The bacteriovores nematodes are key micro-faunal grazers that regulate ecological processes of decomposition and nutrient cycling, thereby indirectly affecting primary production (Freckman, 1988). An increase in the abundance of these nematodes often enhances microbial

*Corresponding author

activity in soils with non-limiting supply of nitrogen (Wasilewska, 1998). Bacterivorous nematodes are better bio-indicators of the decomposition rate of organic matter than the bacteria themselves and because of their higher position in food web, they integrate both biotic and abiotic factors (Griffiths et al., 1994; Wasilewska, 1998). Thus any change in land management that affects bacteriovores nematodes has the potential to influence critical ecological processes (Yeates, King, 1997). Under field conditions, these nematodes are estimated to contribute (directly and indirectly) about 8 to 19% of nitrogen mineralization in conventional and integrated farming systems, respectively (Beare, 1997).

Although there are many reports, on their abundance in different cropping systems and different land uses (Liang et al., 2005). Sohlenius and Sandor (1987), Yeates et al. (2000), Liang et al. (2005) and Ou et al. (2005) studied the dominance of different genera of bacteriovore nematodes under different land uses, but no study has so far been performed examining the distribution of bacterivorous nematodes along increasing distance from a thermal power plant, as this power plant is the source of carbon which is emitted as smoke and settles in surrounding crop field affecting there available carbon, potash and phosphates in the soil. The present study was planned with objectives to study the distribution of bacterivorous nematodes in relation to soil pH, available carbon, potash and phosphates as influenced by the deposition of smoke released by thermal power station.

Material and methods

The samples for the present study were taken from wheat fields (*Triticum aestivum* L.) in down wind direction from a thermal power station located at Kasimpur in Aligarh district (27.30 N, 79.40 E), which lies on fertile plains of Ganga and Yamuna, called doab, one the most productive regions of India. Annual rainfall ranges from 700–1100 mm, and temperature ranges from 4 °C during winter to 40 °C during summer months. The power plant is functional since over last 50 years and has two long chimneys emitting smoke which settles in surrounding crop fields. Sampling was done at the time of harvesting of wheat crop on 12th March, with the help of cylindrical steel corer of 5 cm diameter from the depth of 0–20 cm, along the distance gradient of 500 m (A), 1000 m (B), 2000 m (C) and 4000 m (D) from the source of smoke. Five replicates of three cores per sample were mixed together to make composite samples, which were then brought to lab for further processing.

Nematodes were extracted from 100 g of fresh weight of soil using Cobb's sieving and decantation and modified Baermann's funnel technique (Tomar et al., 2006). All the bacteriovore nematodes from each extracted sample were counted and identified to genus level, based on stoma and pharyngeal morphology (Baniyamuddin et al., 2007). Genus with 10 or more than 10% of overall proportion was considered dominant.

Chemical analysis of the soil samples was done at government soil laboratory at Quarsi farm, Aligarh. Statistical analysis was performed on nematode genera for different treatments by ANOVA using SPSS statistical software. Differences with $P < 0.05$ were considered significant and $P < 0.01$ as highly significant.

Table 1. Proportional contribution (%) of bacteriovore nematodes to the nematode assemblage along a distance gradient.

	A	B	C	D
Acrobeles	8.7	12.1	3.4	24.3
Acrobeloides	13.8	0.0	8.0	0.0
Chiloplacus	2.9	9.7	10.7	9.8
Cephalobus	20.0	14.2	16.9	22.0
Chronogaster	3.7	3.0	10.7	0.0
Eucephalobus	35.5	13.3	4.6	10.5
Mesorhabditis	4.3	6.2	2.3	0.0
Monhystera	0.0	8.7	11.2	10.0
Plectus	3.7	6.5	11.2	8.7
Panagrolaimus	7.2	12.7	11.4	9.4
Rhabditis	0.0	13.9	9.2	5.2

(where A = 500 m; B = 1000 m; C = 2000 m; D = 4000 m)

Results

Dominant genera of bacteriovores nematodes

In the present study, 9, 10, 11 and 8 bacteriovore nematode genera were recovered from sites A, B, C and D respectively. *Eucephalobus* and *Cephalobus* were found to be the dominant bacteriovore nematode genera at all the four sites of study. Other dominant genera were *Acrobeloides* at site A, *Acrobeles*, *Panagrolaimus*, and *Rhabditis* at site B, *Chiloplacus*, *Chronogaster*, *Monhystera*, *Plectus* and *Panagrolaimus* at site C, and *Acrobeles* and *Monhystera* at site D (Table 1, Fig. 1). *Plectus* and *Panagrolaimus* were present at all the four sites with their abundance showing a gradual increase upto site B and subsequent decrease at site C and D. Except for *Cephalobus,* which had highest abundance at site A, abundance of other nematode genera did not follow any trend. The abundance of *Acrobeles* and *Eucephalobus* was significantly correlated with increase of distance ($P < 0.05$). Soil physical factors such as pH, available carbon and available potash ($P < 0.01$) and available phosphates ($P < 0.05$) were also significantly related with increase of distance from power station. The concentration of carbon gradually increased site B (42g/ha) and then it decreased to site D (25g/ha) (Fig. 2).

Correlation between abundance of genera and soil chemical properties

Abundance of nematode genus *Acrobeles* correlated positively with pH ($P < 0.05$), while *Acrobeloides* correlated negatively with pH and available carbon, while *Rhabditis* ($P < 0.05$) correlated positively with available carbon. No nematode genera were significantly correlated

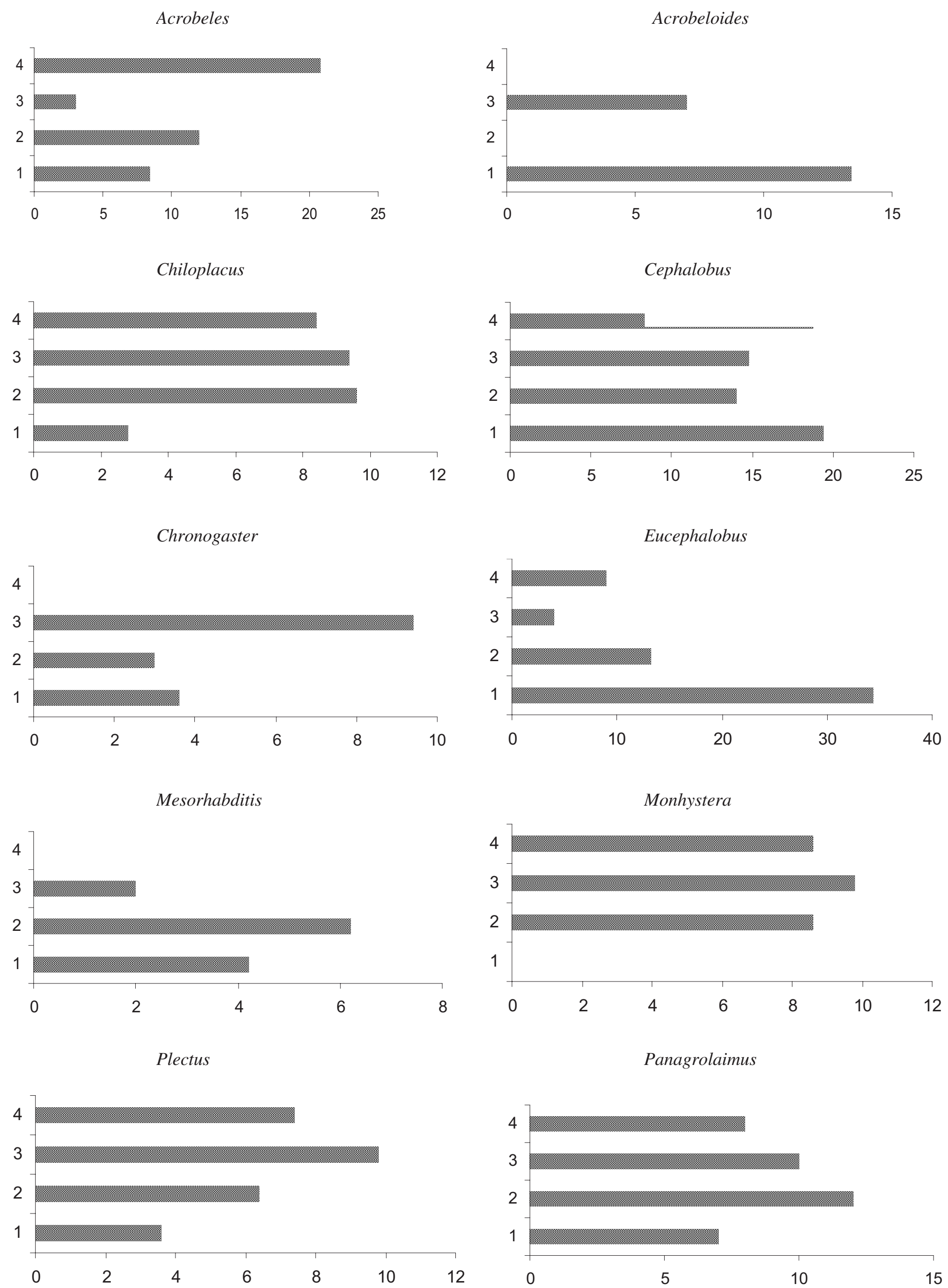

Fig. 1. Abundance of different genera of bacteriovore nematodes with respect to distance (X axis – abundance; Y axis – distance, 1 – 500 m, 2 – 1000 m, 3 – 2000 m and 4 – 4000 m).

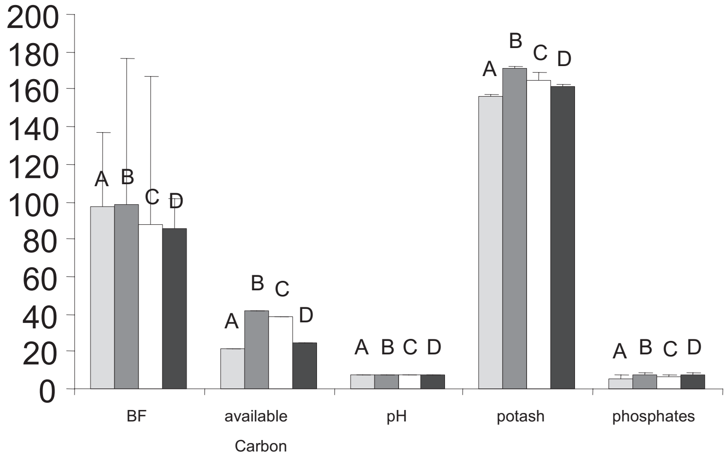

Fig. 2. Abundance of bacteriovore nematodes and concentration of soil chemical properities in relation to distance.

with available potash, but available phosphates showed a high degree of positive correlation with *Chiloplacus* (P < 0.05) (Fig. 3, Table 2).

Discussion

The ecological roles of soil invertebrates include plant herbivory and the mineralization of nutrients in the detrital food web, both of which may be affected by change in carbon-flow patterns and, in turn have important impacts on ecosystems behaviour (Neher et al., 2004). As bacterivorous nematodes play important role in mineralization of soil (Wasilewska, 1998), their abundance had a significant effect on productivity of soils. Enhanced carbon in form of CO_2 can indirectly affect soil organisms through shifts in the quantity and quality of plant litter returned to soil, the rate of root turnover, and the exudation of carbon and other nutrients into the rhizosphere (Couteax, Thomas, 2000; Wardle et al., 2004). In present study, the concentration of available carbon showed significant effect on the populations of *Plectus*, *Acrobeles* and *Eucephalobus* which indicates that carbon plays an important role in their survival. This is in agreement with Berkelmans et al. (2003), who reported higher abundance of bacterial feeding nematodes in crop fields treated with organic manures rich in carbon. The dominance of *Acrobeloides* and *Eucephalobus* in present study confirms well with those of Háněl (2003) for cultivated fields. The dominance of bacteriovores nematodes in tundra, taiga and deserts have been reported and it may due to absence of Angiosperms (Yeates, 1979) as bacterivorous nematodes start feeding as soon as climate change permits while other trophic groups need the development of food chain. Nielsen (1961) reported

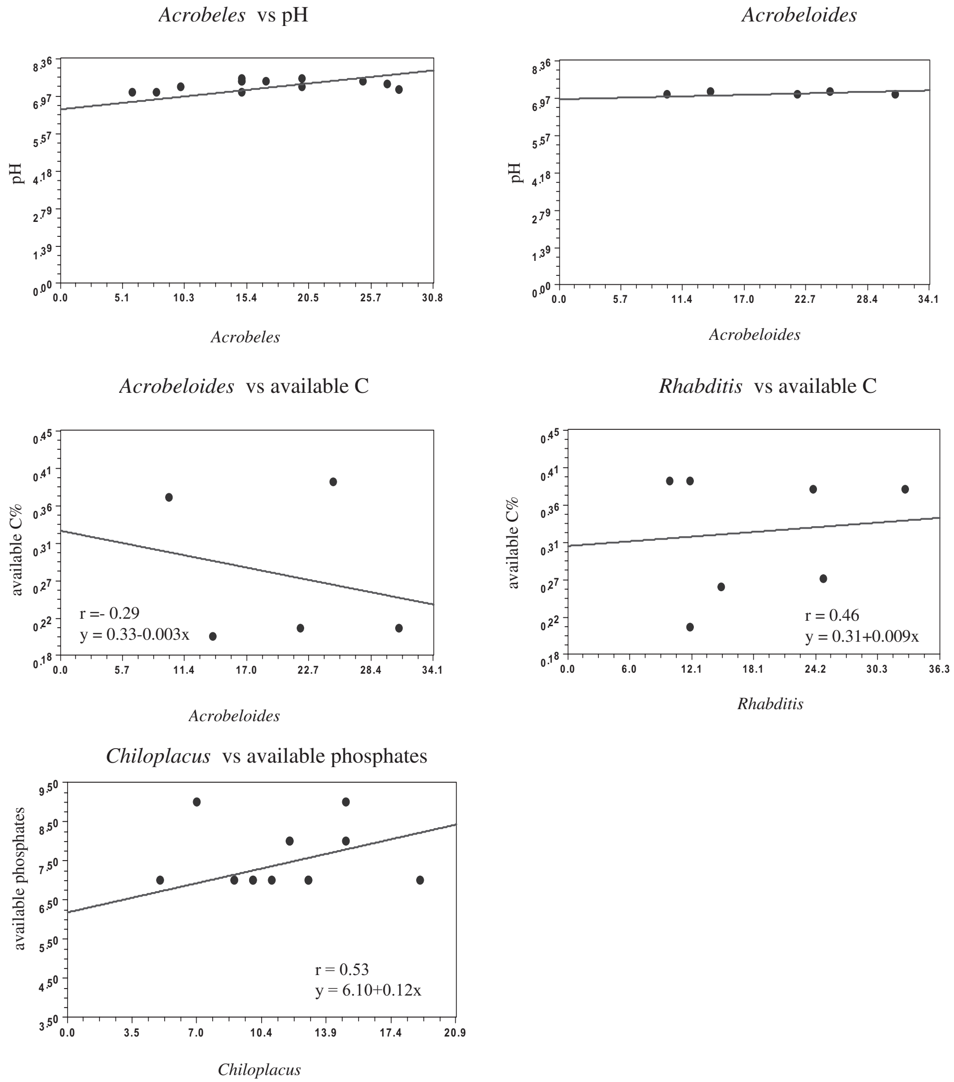

Fig. 3. Correlation between abundance of different nematode genera with abiotic factors.

the increase of bacteriovore nematode population with increase in humus which is rich in organic carbon. Among the bacterivorous nematodes Cephalobidae are often the most abundant group in soils (Yeates, 2003), which may explain the overall dominance of *Eucephalobus* and significant relation of various cephalobids with respect to pH and available carbon. Rhabditidae have been reported to increase with nutrient flux, explaining positive

T a b l e 2. Correlation between bacteriovores nematodes and soil chemical properties

	A	B	C	D	E	F	G	H	I	J	K	L
Acrobeles **(A)**	1.000											
Acrobeloides**(B)**	-.391	1.000										
Chiloplacus **(C)**	.153	-.080	1.000									
Cephalobus **(D)**	-.031	.202	-.058	1.000								
Chronogaster **(E)**	.103	.191	.317	-.220	1.000							
Monhystera**(F)**	.238	-.028	.572**	.194	.349	1.000						
Plectus **(G)**	.203	.099	.475*	.337	.610**	.718**	1.000					
Rhabditis **(H)**	-.011	-.022	.654**	-.086	.423	.665**	.575**	1.000				
pH **(I)**	.456*	-.481*	.246	-.053	-.258	.402	.185	.415	1.000			
avail. carbon **(J)**	-.230	-.292*	.331	-.245	.208	.384	.178	.464*	.277	1.000		
avail. potash **(K)**	-.070	-.484	.245	-.141	-.089	.289	.038	.365	.533*	.900**	1.000	
avail. phosphates **(L)**	.130	-.210	.528*	.148	-.071	.442	.216	.340	.396	.416	.463*	1.000

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

correlation of *Rhabditis* with available carbon. Yeates (2003) reported the dominance of plectids in structurally degraded soils, which may not be in line with present study where *Plectus* was significant with respect to available carbon.

It may be concluded from the present study that while available carbon may plays an important role in life history of certain bacterivorous nematodes, the effects of potash and phosphates need to be further studied.

Translated by the authors

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