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SOIL NEMATODE FAUNAL DIVERSITY FROM CITRUS ORCHARDS OF PUNJAB, INDIA

D. K. KOCHER & N. KAUR

Department of Zoology, Punjab Agricultural University, Ludhiana, Punjab, India

ABSTRACT

Nematodes are most abundant group of multi-cellular animals on earth and virtually inhabit all ecosystems. During this study soil samples were collected from citrus orchards of four districts of Punjab viz; Ludhiana, Bathinda, Hoshiarpur and Ferozepur both in winter and summer. The community analysis of different nematode trophic groups recorded in the soil samples from the selected districts of Punjab was carried out by categorizing them on the morphology of their mouth parts. This survey indicated the occurrence of four types of nematode trophic groups i.e. plant parasitic, bacterivorous, predatory and fungivorous. Plant parasitic nematodes showed 100 per cent absolute frequency as this trophic group was present in all the soil samples, thus this group was found to be pre dominant followed by bacterivorous and predatory nematodes both in winter and summer seasons. Fungivorous nematodes were found in citrus soil collected from Ludhiana district only during winter and no fungivorous nematodes were observed from Bathinda, Hoshiarpur and Ferozepur districts both during summer and winter seasons.

KEYWORDS: Citrus, Diversity, Soil Nematodes, Trophic Groups

INTRODUCTION

Soil nematodes are frequently the most numerous component of the micro fauna and are considered as the most abundant, diverse and highly speciated group of invertebrates present in the soil [1]. The majority of soil nematodes are found within the top 10cm of the soil, although some may be living much deeper [2]. Soil nematodes take up several trophic grades and occupy a central position in the soil food web and correlate with ecological processes such as nitrogen cycling and plant growth. Thus, these nematodes stabilize the soil ecosystem and promote substance cycling and energy flowing [3]. Nematodes have widely differing nutritional behavior and therefore occupy several trophic levels in soil food webs. Nematodes can be grouped into functional or trophic groups on the basis of the type of food they consume, the morphology of their mouthparts and their feeding habits.

The most common groups are bacteriovorous, fungivorous, plant-parasitic, omnivorous and predatory nematodes [4]. An incredible variety of nematodes function at several trophic levels of soil food web. Plant-parasitic nematodes are considered as primary consumers and they affect food web resources through direct herbivory [5]. Bacterivore and fungivore nematodes graze on decomposer microbes such as bacteria and fungi and significantly contribute to nutrient mineralization [6]. Predatory nematodes regulate the food web by preying on nematodes and other invertebrates present in the soil [7]. Although, nematodes represent a relatively small amount of biomass in the soil but their occurrence across multiple trophic levels is vitally important in soil environment [8]. Soil nematodes may be useful indicators of soil quality because of their tremendous diversity and their participation in many functions at different levels of the soil food web [6]. Keeping in mind variations in biodiversity of soil nematodes and their possible role as biological indicators of soil health, the present study was carried out to characterize the nematode communities at the trophic level in soil and their diversity from different locations in citrus orchards of Punjab.

MATERIAL AND METHODS

A random survey of soil nematode population was carried out at different citrus orchards of districts of Punjab like Ludhiana, Bathinda, Hoshiarpur and Ferozepur in the months of March and September. Ten sampling units of soil were taken from each citrus orchard (200cc of soil approximately) from canopy area of plant. While taking the soil samples, 3-4 inches of soil was removed from the top and then the sample was taken upto depth of 8-9 inches. Soil was taken in 4-5 cores from one plant and pooled to have one sample by putting these in polythene bags to maintain the nematodes in the state at which they were collected and samples were stored at 4º C before extraction.

"Cobb's sieving and decantation technique" was used for extraction of nematodes from soil samples. After extraction the nematodes were heat killed and fixed in formalin and acetic acid fixative by mixing them in the ratio of 4:1 (F: A). The picking and transferring of individual nematodes was carried out under the stereo microscope and their genus level identification was carried out using an inverted microscope at 40X magnification. All identified nematode genera were assigned to a trophic group viz; plant parasitic, fungal feeder, bacterial feeder and predatory according to their anterior structures[4]. Then counting of nematodes was carried out with the help of glass counting dish. Community analysis of different nematode trophic groups was carried out with the help of following formulae:

Absolute density = Total population count/200 cc of soil

Absolute frequency (%) =	Number of samples containing a species / Number of samples collected	x 100
Relative density (%) =	Number of individuals of species in a sample / Total of all individuals in a sample	x 100

RESULTS AND DISCUSSIONS

During winter, the soil samples collected from citrus orchards of four districts of Punjab viz. Ludhiana, Bathinda, Hoshiarpur and Ferozepur showed the presence of plant parasitic nematodes from all the soil samples with 100% absolute frequency and their average log transformed values of absolute density was found to vary from 6.21 to 6.68, with its maximum value at district Ludhiana. However, bacterivorous nematodes showed a variation in their absolute frequency ranging from 50-100%, with its maximum log transformed value of absolute density at Bathida district (6.54). The value of absolute density in case of predatory nematodes was less as compared to that of plant parasitic and bacterivorous nematodes in the soils of their respective districts and it was found to lie between 3.47 to 5.42 and the absolute frequency was over all less also (37.5 to 50%). Fungivorous nematodes were found only from the soil samples of Ludhiana orchards with absolute density of 4.16 (log value) only, with 10% absolute frequency value (Table 1).

In summer season also the plant parasitic nematodes were found in all the soil samples collected from citrus orchards of four districts of Punjab as their absolute frequency was found to be 100% and their average log transformed values of absolute density varied from 6.49 to 6.70. Bacterivorous nematodes showed 100% absolute frequency, with its log transformed value of absolute density ranging from 5.98 to 6.27. The value of absolute density in case of predatory nematodes lie between 5.72 to 6.52 and the absolute frequency was found to vary from 66.67 to 90%. Fungivorous nematodes were not found in any of the soil samples collected from different districts during summer (Table 1).

As during both winter and summer seasons the variation of different trophic nematode groups among different districts was found to vary non-significantly, therefore the data of percent relative density of these trophic groups at different districts were pooled for both the seasons and the results have been presented in the form of figure 1. During both the seasons the predominant trophic group of nematodes was found to be plant parasitic with its relative density value of

37.27% in winter and 35.06% in summer. In winter the order of trophic groups of nematodes was plant parasitic > bacterivorous > predatory > fungivorous. However in summer, the bacterivorous and predatory nematodes showed almost similar trend in values of their relative density after the predominant plant parasitic group. However, no fungivorous nematodes were found in any of the orchard soil samples during summer Figure 1. Literature also reveals that plant parasitic nematode group is the most abundant trophic group found in the soil ecosystem affecting the food web resources through direct herbivory [5].

This trophic group is responsible for severe damage to the crops worldwide [9]. Almost 20% of nematode community is of bacterivorous nematodes and these are found to occupy a broad range of soil habitats [10]. Predatory nematode population is comparatively low in soil thus are considered under less abundant trophic group [11] and serve to keep all kinds of nematode population in balance [7]. Fungivorous nematodes has also been noticed by other researchers to be found at lower density in soil than other nematode trophic groups [12], so are categorized as less abundant trophic group.

CONCLUSIONS

The present survey indicated four different types of trophic groups of soil nematodes from citrus orchards of four districts of Punjab with the order of their density predicted by community analysis as; plant parasitic > predatory > bacterivorous > fungivorous nematodes during winter and summer seasons both.

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APPENDICES

Table 1: Survey of Soil Nematode Faunal Trophic Groups in Citrus Orchards of Punjab

Season	Trophic Group	Absolute Density* (% Absolute Frequency)			
		Ludhiana	Bathinda	Hoshiarpur	Ferozpur
Winter (n=10)	Plant parasitic	6.68 (100)	6.39 (100)	6.21 (100)	6.57 (100)
	Bacterivorous	5.96 (70)	6.54 (100)	3.96 (75)	5.97 (50)
	Predatory	5.34 (50)	3.47 (37.5)	4.16 (37.5)	5.42 (50)
	Fungivorous	4.16 (10)	0.00 (0)	0.00 (0)	0.00 (0)
Summer (n=10)	Plant parasitic	6.50 (100)	6.70 (100)	6.57 (100)	6.49 (100)
	Bacterivorous	6.00 (100)	5.98 (87.5)	6.27 (100)	6.05 (100)
	Predatory	5.72 (90)	5.77 (75)	6.52 (66.67)	6.40 (75)
	Fungivorous	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)

*Indicate average log transformed values/200cc of samples

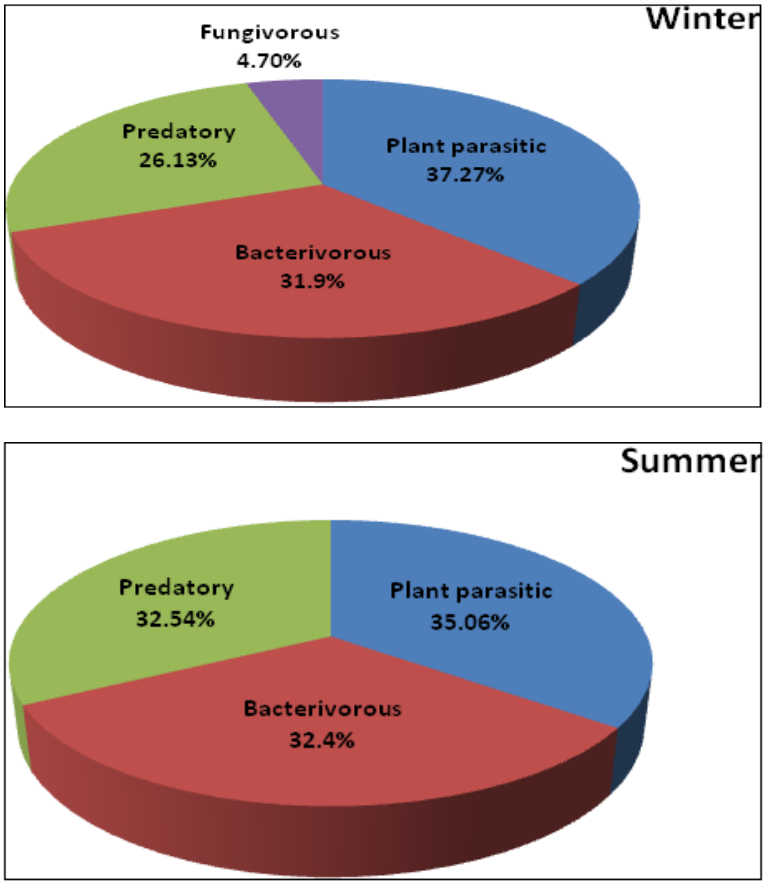

Figure 1: Relative Density (%) of Different Trophic Groups of Nematodes in Soil Samples from Citrus Orchards of Punjab during Winter and Summer Seasons