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Role of Edaphic Factors on the Population Density of Soil Inhabiting Collembola and Oribatid mites in *Acacia* Plantation of Cachar District, Assam

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Abstract

Soil provides habitat for soil-dwelling microarthropods that plays an important role in maintaining the soil fertility. Amongst all the soil microarthropod groups, collembola and oribatid mites were dominant and act as bioindicators to monitor the natural, agricultural and horticultural systems. The composition of soil microarthropods depends upon different soil factors such as the soil moisture, temperature, and organic matter and hence the present study deals with the effect of various soil parameters on the microarthropods population specifically the collembola and oribatid mites. For the purpose of microarthropod extraction modified Tullgren funnel apparatus was used and different standard laboratory methods were followed to assess the various soil parameters. Both the microarthropod groups were extracted in the higher numbers and peak populations were recorded in the month of August, 2016. Moreover, the regression analysis between the soil moisture content with the two microarthropod groups (collembola and oribatid mites) revealed a significant positive correlation. However, other edaphic parameters did not show any significance. Further validation is vital requisite for the assessment of different physicochemical parameters in enhancing the population of the microarthropod community as studies on the effect of edaphic factors on the population density of soil-dwelling microarthropods are very limited.

Keywords: *Microarthropods, Collembola, Oribatid mites, Acacia, Edaphic factors*

1. Introduction

The soil is a natural system comprising of different physical, chemical and biological activities (Coleman et al. 1992) and provides habitat to different soil biota (Fortuna, 2012). The composition of soil-dwelling fauna depends upon different abiotic factors such as the soil structure, soil moisture, soil temperature, vegetation type, and organic matter. Microarthropods play an important role in maintaining the soil fertility by enhancing the process of litter decomposition and also by facilitating nutrient cycling (Lebrun, 1979; Brown, 1995). According to the report of Seastedt, 1984; decomposition process is directly affected by microarthropods through litter fragmentation and fecal production. Microarthropods specifically the collembola and oribatid mites were considered as the most diverse and abundant groups inhabiting in soil (Brussard et al. 1997; Santos-Roch et al. 2011). Higher density and richness of microarthropod groups i.e., the oribatid mites and collembola make them as a suitable bio-indicator to monitor the natural and horticultural system (Minor et al. 2000). In this context, the present study was undertaken to determine the role of the different physical and chemical soil parameters on the fluctuation of

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collembola and oribatid mites population in *Acacia* plantation.

2. Materials and methods

The *Acacia* plantation site is located within the Assam University campus of Cachar district, Assam. Soil samples from the selected plantation site were collected on the monthly basis (April, 2016 to March, 2017) by using a soil auger (2.5cm diameter). From a depth of 0-10cm, randomly ten replicates of soil samples were drawn for the purpose of extraction of microarthropods and five soil replicates were separately mixed to prepare the composite soil mixer for further soil analyses. Modified Tullgren funnel apparatus was used for the extraction purpose (Murphy, 1962). Both the groups (collembola and oribatid mites) were identified and isolated with the help of a stereoscopic binocular microscope (10x X 40x). The population density of encountered collembola and oribatid mites were calculated with the formulae,

$$P=10000\ X\ /0.785d^2;$$

(Where, P=population/m^2, X=population/sample, d=diameter of the augur) followed Singh et al. 1978 using MS Office Excel-2007 software.

Different standard protocols were followed to evaluate the levels of the different edaphic factors. For quantitative analysis of soil moisture content oven dry method was followed and expressed in percentage. A digital soil thermometer was used to record the temperature of the soil. Soil pH was measured in a digital pH meter (Systronics) in 1:2.5 soil-water (w/v) suspensions (Allen et al. 1974). On the other hand, the organic carbon content was determined by Walkley and Black's rapid titration method (Jackson, 1958).

3. Results and discussions

A significant size of both the collembola and oribatid mites population were found in the extracted soil samples of the *Acacia* plantation and peak population densities of collembola (2.59±0.74 No./m^2 X 100^2) and oribatid mites (1.53±0.32 No./m^2 X 100^2) were observed in the month of August, 2016 (Fig. 1).

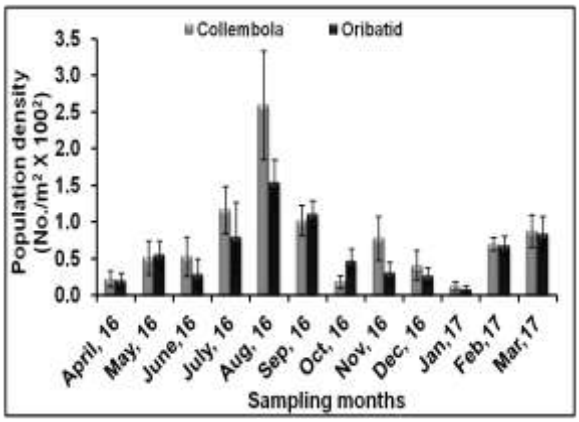

Fig. 1 Population density (No./m^2 X 100^2) of collembola and oribatid mites during the study period (April, 2016-March, 2017) in *Acacia* plantation

Amongst all the other microarthropods, both the groups showed all-time abundance in almost every studied ecosystems observed by various researchers across the world. The abundance of both these groups may be due to their extreme resistant ability, short life cycle and also frequent reproduction. The month, August being within the monsoon season favors the microarthropod sustainability in the soil sample according to Narula et al., 1998; the availability of ample amount of moisture and sufficient parameters of soil in the monsoon season made the period best for the growth and development of microarthropods. Present investigation primarily deals with the quantification of various soil parameters such as soil moisture content, pH, temperature, and soil organic carbon.

During the investigation period (April, 2016 to March, 2017), the moisture content of the soil samples was within the range of 10.37±0.25% to 20.73±0.33% whereas percentage of soil organic carbon content was in between 0.96±0.01% to 2.10±0.01%. The temperature of the soil exhibited

Table 1: Linear regression between the soil parameters and population density of collembola and oribatid mites along with the quantified range of soil parameters (Mean±SE) during the study period

Soil parameters	Quantified range (April 2016-March 2017)	Linear regression analysis					
		Collembola			Oribatid mites		
		Regression equation	'r' value	'p' value	Regression equation	'r' value	'p' value
Moisture content (%)	10.37±0.25−20.73±0.33	0.142x - 1.39	0.66	<0.05	0.090x - 0.77	0.67	<0.05
Temperature (°C)	19.3±0.07−28.9±0.09	0.065x - 0.91	0.34	>0.05	0.044x - 0.53	0.36	>0.05
Organic carbon (%)	0.96±0.01−2.10±0.01	0.826x - 0.52	0.46	>0.05	0.246x + 0.21	0.21	>0.05
Soil pH	4.14±0.06−4.72± 0.05	-0.970x + 5.01	0.29	>0.05	-0.735x + 3.82	0.35	>0.05

a range of variation between (19.3±0.07°C−28.9± 0.09°C) in the selected sites. The value of soil pH throughout the year ranges from 4.14±0.06−4.72±0.05 (Table 1).

The linear regression analysis between the soil parameters and the population density of both the microarthropod groups was studied to explore the relationship of one another in *Acacia* plantation. The quantity of soil moisture content showed significant positive correlation with the collembola ($r=0.66$, $p<0.05$) and oribatid mites ($r=0.67$, $p<0.05$) population. According to Hazra, 1978, the soil moisture is the principal factor for the fluctuation of the microarthropod population and his observations were strongly corresponded with the present findings. Similar trends of correlations were also reported in the studies of Choudhuri and Roy, 1972; Sanyal and Sarkar, 1993; Gope and Ray, 2006. Excluding soil moisture, all the other studied soil parameters such as the organic carbon content, soil temperature, and soil pH did not show any significant correlations with both the studied microarthropod groups. Although the relations were statistically proved to be insignificant, the correlations between both soil organic carbon content and temperature with the two microarthropod groups were observed to be positively influenced. On the other hand, pH content of the soil sample has not shown any positive relationship with both the soil-inhabiting microarthropod groups (Table 1). Corroborative findings of negative correlation of pH with soil microarthropods were also observed by Abbas and Parwez, 2012.

4. Conclusions

In the light of the results and discussions, the present study concludes that both the dominant microarthropod groups found in the *Acacia* plantation were significantly and positively related with the soil moisture content. Even though all the other studied edaphic factors did not show any significant influence on the population, however a positive relationship with most of the soil parameters was exhibited. Till date, the studies on the effect of edaphic factors on the population density of soil microarthropods are limited and also on the *Acacia* plantation the data are very scarce, hence further validation is vital requisite for the assessment of different physicochemical parameters in enhancing the population of microarthropod community.

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