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Diversity of soil microarthropods at three different soil habitats along with soil organic carbon and soil pH range of those soil

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Abstract

Soil microarthropods are tiny invertebrates which have a great role in the assessment of soil quality. Soil quality greatly influences the agriculture, forestry and other purposes of soil. At three different sites i.e. rubber plantation, tea garden and forests located in Tripura state, the sampling was conducted. Microarthropods found during the study belongs to the Subclass Collembola Order Oribatida, Mesostigmata, Scorpiones, Protura, Polydesmida, Hymenoptera, Coleoptera, Cyclopodia, Diptera, Orthoptera, and Blattodea. Among all the microarthropod population of soil found from three different soil samples, Oribatid mites are most abundant followed by Collembola and the abundance of microarthropods was highest in forests followed by tea gardens and rubber plantations. The soils of all studied sites were acidic and organic carbon ranges of all studied soil are also not significantly different from each other.

Keywords: Tullgren funnels, diversity, extraction, microarthropods, soil

Introduction

Soil analysis is done to know about the nutrient level of the studied soil to predict the nutritional values needed for crop production. Physical, chemical and microbiological properties of soil greatly influence the soil quality which are very much important for agriculture, forestry and other purposes. In all types of soil, microarthropods of soil animal communities constitute the major component of soil mesofauna for why they were of prime importance. According to Anderson (1988) [2] Arthropods in soil act as “driving variables” indirectly affecting pathways of energy transfer in soil at levels that are orders of magnitude greater than direct faunal contributions to nutrient and energy fluxes. They play a vital role in soil texture by secreting organic secretions. They exist in large numbers in the soil. According to Coleman *et al.*, (2004) [4] the soil microarthropods are extremely numerous and diverse. Soil fauna are known to improve soil structure by decreasing bulk density, increasing soil pore space, soil horizon mixing, increase aeration and drainage, increase water holding capacity, litter decomposition and soil aggregate structure (Abbott, 1989) [1]. Among the soil fauna the microarthropods form a significant component playing a major role in soil organic matter recycling and soil quality enhancement; hence labelled as one of the most important factors related to soil fertility (Vreeken-Buijs *et al.*, 1998) [17].

Soil microorganism density is greatly influenced by the physical and chemical features of the soil. Brussaard *et al.* (1997) [3] observed that physical and chemical characteristics of the soil are prominent soil characteristics determining the occurrence and functioning of the microarthropods. The abundance of microarthropods is determined by resource availability (i.e., organic matter), macro and micro climate, pH and disturbance (Petersen, 1982; Curry, 1994) [5]. The organic carbon and the pH of the soil are considered as sensitive environmental parameters among various chemical parameters of soil and they have direct rapport on the productivity and fertility of soil.

The present study was undertaken to observe the diversity of soil microarthropods at three different soil habitats along with soil organic carbon and soil pH range of those soil areas of Tripura.

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Materials and Methods

The present study was carried out in three different sites of Tripura like S1: Rubber plantation situated in Udaipur, Tepania, Gomati Tripura, S2: Tea garden situated in Bishalgarh, Sipahijala, Tripura and S3: Forest land situated in Udaipur, Patichari, Gomati Tripura from June, 2016 to June 2017. Samples were collected within an interval of 30 days. 12 samples were collected in and around the 12 selected plots of each site by adopting simple random sampling technique by maintaining a distance of about 50 meters between two samples. Soil samples were prepared by collecting a small portion of soil. Microarthropods extracted by a Tullgren funnel were sorted and preserved in 70% alcohol. Total 995 microarthropods were collected from four different soil habitats. Soil Organic carbon was determined by “Walkley Black” procedure and Soil pH was determined using a digital pH meter.

Results and Discussion

Total 995 microarthropods included Subclass Collembola Order Oribatida, Mesostigmata, Scorpiones, Protura, Polydesmida, Hymenoptera, Coleoptera, Cyclopodia, Diptera, Orthoptera, and Blattodea were recorded from three different study sites (Table-1). Among them microarthropods recorded from forest land were most abundant whereas lowest in rubber plantation land. Mean population of soil microarthropods found from different soils samples are shown in Table-1. From table-1 it is also showed that among the microarthropods found from different selected sites, Arthropods of order Oribatida is highly abundant (32% of total microarthropods) followed by subclass collembola (24%

of the total microarthropods.). The observation matches with Petersen, 1978 and Sharmila et al., 2008; who also found the same result. Norton (1990) ^[10] also found the same observation. Sarkar *et al.*, (2016) ^[15] also found that Oribatida was the most abundant order of microarthropods followed by collembolans in overall collection and in most of the collection efforts. The organic carbon of all the studied soil is not significantly different from each other (1.68%, 2.58% and 1.75% respectively). Table 2 showed the mean % value of organic carbon of different soil samples collected from different selected sites. The pH values of all the studied soils revealed acidic in nature, but soil of the tea garden was strongly acidic with an average of 3.02 - 4.10 (Table-3). Oke *et al.*, (2005) ^[11] found acidic soil in the rubber plantation area. Effiom *et al.*, (2012) ^[6] also found strongly acidic (4.0-4.4) soil with very low (below 2%) organic carbon in rubber plantation soil. Joydev *et al.*, (2008) found low organic matter content containing very low organic carbon, approximately 1.18% and 3.48 to 5.28 pH in the tea garden. Karak *et al.*, (2015) ^[8] also found 2.4 – 47.3 % organic carbon and 3.61 – 6.81 pH in tea growing areas. Pratiksha *et al.*, (2015) found pH-5 and organic carbon 1.03% in the forest soil. Lakshmi & Joseph (2017) ^[9] showed that the occurrence of microarthropods was positively correlated to soil moisture and organic carbon and had negative correlation to soil temperature and soil pH. Constant addition of chemicals, high temperature, heavy rainfall etc may result in severe acidity of the tea garden soil which may affect the nutrient uptake of the tea plantation. Table-4 show the comparative analysis of % of Soil organic carbon, pH and microarthropods.

Table 1: Mean population of microarthropods in different soil samples.

Major groups	Rubber plantation	Tea garden	Forest
Subclass			
Collembola	68	79	89
Order			
Oribatida	98	101	118
Mesostigmata	16	21	24
Scorpiones	11	15	17
Protura	-	09	20
Polydesmida	06	11	12
Hymenoptera	08	21	28
Coleoptera	11	22	29
Cyclopodia	-	18	09
Diptera	13	19	27
Orthoptera	13	08	36
Blattodea	-	06	12
Total	244	330	421

Table 2: Mean percentage (%) of soil organic carbon of the soil sample collected from ten different plots of the same selected sites.

Different plots	% of Soil organic carbon of rubber plantation	% of Soil organic carbon of tea garden	% of Soil organic carbon of forest
Plot-1	1.62	2.19	1.38
Plot-2	2.27	3.50	2.16
Plot-3	1.33	2.25	1.29
Plot-4	1.89	2.12	1.14
Plot-5	1.37	3.04	2.15
Plot-6	2.63	1.85	2.07
Plot-7	0.89	2.13	2.10
Plot-8	2.05	2.52	2.12
Plot-9	1.87	3.53	1.11
Plot-10	2.04	3.30	1.09
Plot-11	1.09	2.29	2.23
Plot-12	1.07	2.21	2.20
Mean	1.68	3.09	1.75

Table 3: Mean pH of the soil samples collected from sampling site-1, sampling site-2 and sampling site-3.

Different plots	Soil pH of rubber plantation	Soil pH of tea garden	Soil pH of forest
Plot-1	4.88	3.28	5.79
Plot-2	4.75	4.10	5.48
Plot-3	5.41	3.37	5.97
Plot-4	4.61	3.51	5.42
Plot-5	5.06	3.33	5.98
Plot-6	5.16	3.28	5.33
Plot-7	4.58	3.23	5.38
Plot-8	4.63	3.02	5.62
Plot-9	4.91	4.01	5.75
Plot-10	5.73	3.28	5.71
Plot-11	4.36	3.38	4.90
Plot-12	4.61	3.19	5.27
Mean	4.89	3.42	5.55

Table 4: Comparative analysis of % of Soil organic carbon, pH and microarthropods

Study site	Microarthropods	Soil pH	% of Soil organic carbon
Rubber plantation	244	4.89	1.68
Tea garden	330	3.42	2.58
Forest	421	5.55	1.75

Conclusion

The current study revealed that among all the microarthropod population of soil found from three different soil samples collected from rubber plantation, tea garden and forest area, Oribatid mites are most abundant followed by Collembola. The result found from the present study matches with the other worker's finding also. From the result it is found that soil organic carbon and soil microarthropods are correlated and it is also concluded that for the assessment of soil quality, use of soil microarthropods is an easier approach when compared to frequent chemical analysis. The forest soil contains the highest amount of microarthropods having acidic and highest soil organic carbon content whereas rubber plantation soil contains the lowest amount of microarthropods having acidic and lowest soil organic carbon content which indicates that soil organic carbon and microarthropod density were positively correlated to each other. From the result it is also concluded that soil pH is not correlated to microarthropod density.

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