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On regional variability of major soil microarthropod groups at four different edaphic systems in the northern alluvial plains of Bengal, India

S. K. Sarkar[1], K. Chakrobarty[2]*, M. N. Moitra[3]

1 Pundari High School (H.S.), Dakshin Dinajpur, West Bengal, India.
2 Department of Zoology, Faculty of Science, Gour Banga University, West Bengal, India.
3 Department of Zoology, P. D. Women's College, West Bengal, India.

E-mail : kaushik_apdcollege@rediffmail.com Contact No. : +91-9434984950

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Abstract

Soil samples were collected from four different sites - an agricultural field, a river basin, a brick field and a forest floor located in the alluvial plains of northern part of Bengal. Soil acarines dominated the region followed by collembolans. In a few collection efforts however, percentage abundances of collembolans appeared higher than acarines. Group-wise variation in microarthropod communities in the area was significant ($p<0.05$). Cluster analysis indicated greater similarity between agricultural field and forest floor than between brick field and river basin.

Key words : Microarthropods, percentage abundance, similarity.

INTRODUCTION

Arthropods are the dominant animal group throughout the world. They are nowhere more readily seen in diverse forms and high numbers than in litter and soil. Although insects and arachnids usually dominate the scene, seven classes of arthropods may be seen in a single sample. And, their abundance bespeaks their importance. Arthropods, generally, are viewed as regulators of decomposition, accelerating or delaying nutrient release from decomposing organic matter [1]. A number of workers have taken up studies on different aspects of soil microarthropods including their ecology, diversity, population dynamics etc with reference to various edaphic and other factors [2, 3, 4, 5, 6]. The present study was taken up to investigate variation of abundance and overall diversity of microarthropods in relation to the variability of soil habitats in the alluvial soils in the northern plains of Bengal encountered in the district of Uttar Dinajpur. No previous record is available of such study in the selected region.

MATERIAL AND METHODS

Geographical Location :

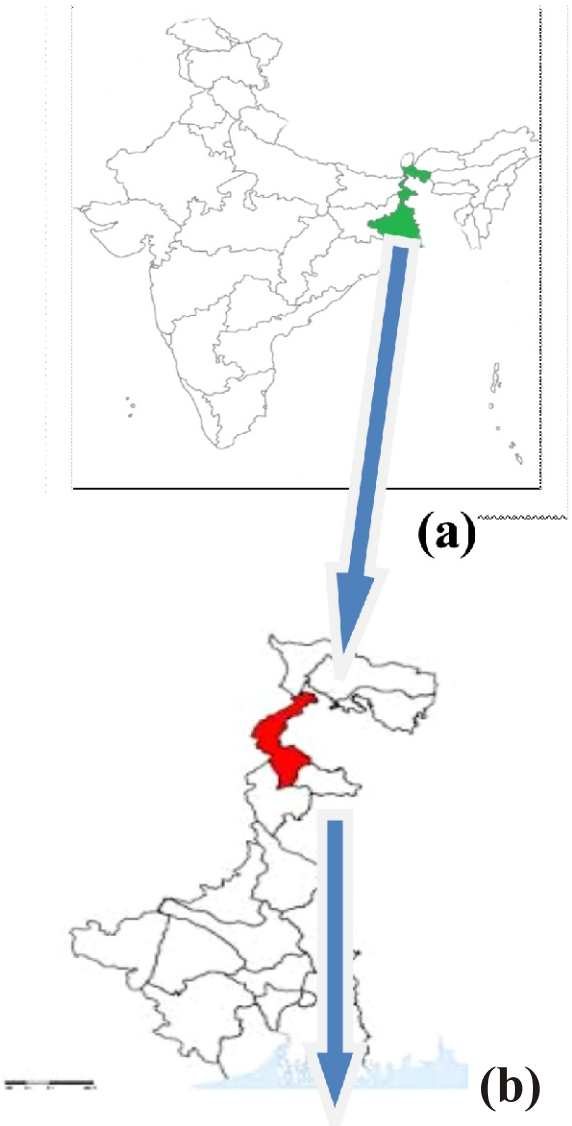
Four areas each having different paedological characteristics have been selected as survey sites. Sites included an agricultural land (S1), a brick field (S2), a river basin area (S3) and a forest area (S4). (Fig. a)

All the areas are separated areally by an approximate distance of 20 kilometer and belongs to the the division Kaliyaganj that is within the administrative boundary of the District Uttar Dinajpur, West Bengal.

An account of the sampling sites has been given in an earlier publication by the same authors [7]

Mode of Sample Collection:

Collection of the soil sample was done periodically and regularly with three replications and then subjected to micro-arthropod extraction process to assess the diversity. Soil samples were collected from four different sites during June to September,



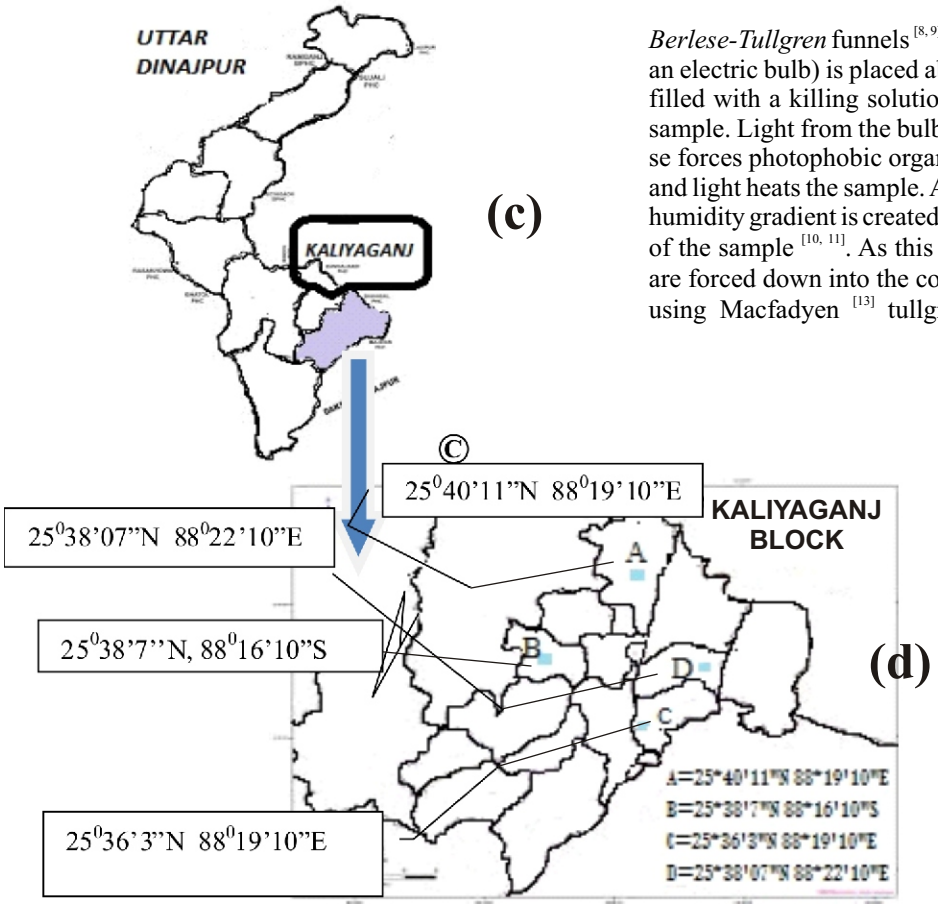


Figure A:
Location of sampling sites.

2014 with an interval of 30 days. Five sub-plots of 1 m^2 area were selected at each site and three cores (5 cm diameter) of samples were collected from each sub-plot. Soil samples were brought to laboratory in plastic packets for subsequent analysis.

Apparatus and Chemicals:

Arthropods are usually retrieved from soil/litter samples with *Berlese-Tullgren* funnels [8, 9]. In these funnels, a source of heat (*i.e.* an electric bulb) is placed above the sample, and a collecting vial filled with a killing solution (85% ethanol) is placed below the sample. Light from the bulb has a double effect because light per se forces photophobic organisms to move away from the source, and light heats the sample. As the sample dries, a temperature and humidity gradient is created between the upper and lower surfaces of the sample [10, 11]. As this gradient moves downwards, animals are forced down into the collecting liquid [12]. Extraction was run using Macfadyen [13] tullgren funnel apparatus after befitting modification.

Data Analysis:

Percentage abundance was calculated upon collection from each of the four sites and upon total collection from all the sites [14]. Cluster analysis was done using Euclidean distance and single linkage method. Logarithmic transformations of data were done as and when necessary.

Table 1: Fluctuatuation of percentage abundances major soil microarthropod groups at different sites.

		Oribatida	Mesostigmata	Prostigmata	Astigmata	Collembola	Others
	June	6.32	2.49	0	0	3.35	2.78
	July	11.4	4.21	0.38	0	7.38	5.08
	August	10.34	4.5	0.1	0.1	5.56	10.44
S1	*September*	8.33	5.84	0	0	7.28	4.12
	June	3.49	5.11	0	0	1.88	2.96
	July	6.99	2.69	0.27	0	8.06	6.72
	August	11.02	9.14	0.27	0	6.18	5.65
S2	*September*	7.8	4.3	0	0	5.91	11.56
	June	4.71	4.52	0	0	5.65	3.2
	July	7.34	3.77	0.19	0	4.52	8.29
	August	10.36	8.1	0	0	11.86	5.65
S3	*September*	6.4	3.58	0.19	0	3.58	8.1
	June	6.58	3.07	0.36	0	4.96	2.61
	July	9.29	1.98	0.09	0	5.5	4.78
	August	13.26	5.86	0.72	0.09	7.84	9.83
S4	*September*	8.39	4.06	0	0	6.85	3.88

Table 2: One-way ANOVA on fluctuation of percentage abundance of different groups of soil microarthropods.

One-way ANOVA: ORB, MS, PRS, AST, COLL, OTH

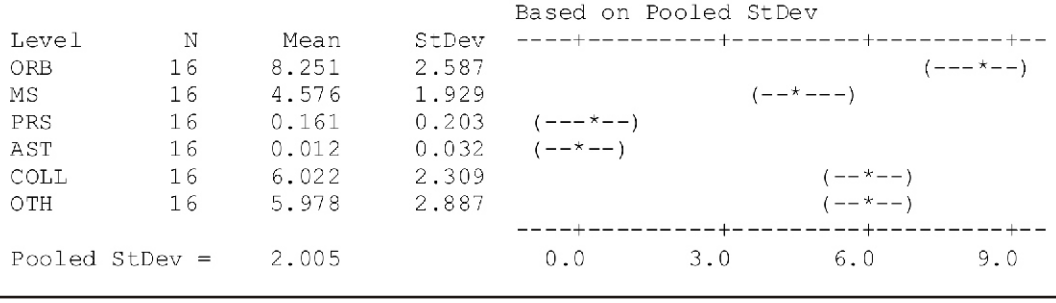
Analysis of Variance

Source	DF	SS	MS	F	P
Factor	5	910.20	182.04	45.28	0.000
Error	90	361.79	4.02		
Total	95	1271.99			

Level	N	Mean	StDev
ORB	16	8.251	2.587
MS	16	4.576	1.929
PRS	16	0.161	0.203
AST	16	0.012	0.032
COLL	16	6.022	2.309
OTH	16	5.978	2.887

Pooled StDev = 2.005

Individual 95% CIs For Mean Based on Pooled StDev



(DF = Degree of Freedom, SS = Sum of square, MS = Mean square, F = F statistics, StDev = Standard deviation, CIs = Confidence Intervals, Or= Oribtida, Ms= Mesostigmata, Coll= Collembola and OMcr= Other microarthropods. Individual confidence intervals given in dotted line indicate (with 95% confidence) the probable range of occurrence of the mean. The asterix in the middle of the line marks the current mean. The ranges of mean within parentheses not overlapping implies that those means are different)

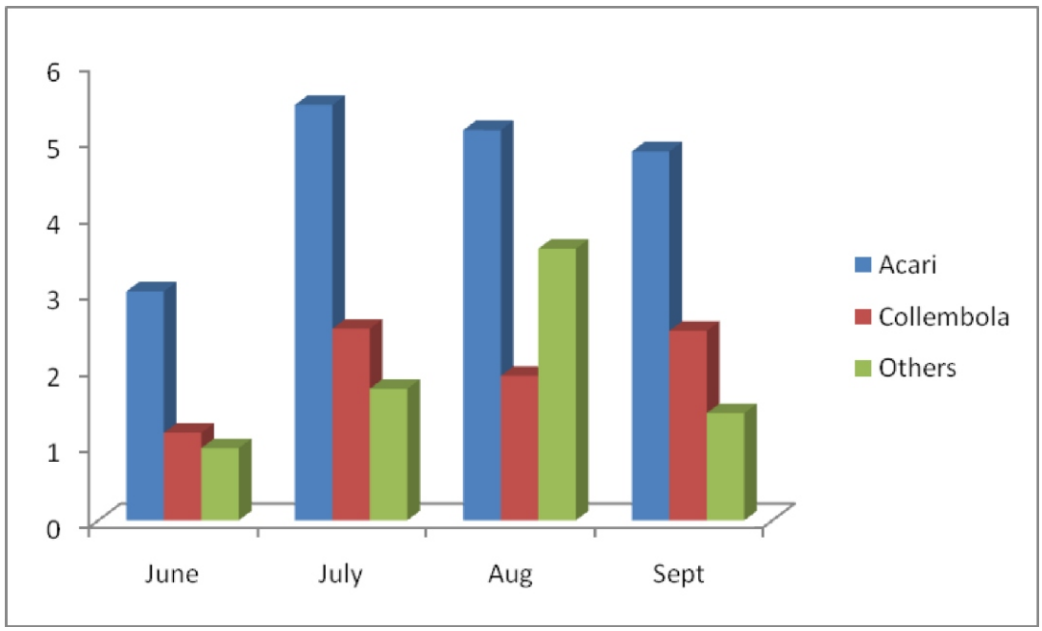


Figure 1: Variation in over-all percentage (on total collection from four sites) abundances of major groups of soil microarthropods at S1.

RESULTS

Soil samples were periodically collected from four different paedological sites *i.e.,* an agricultural field, a river basin, a brick field and a forest floor from the district Uttar Dinajpur, West Bengal during the year 2014. Grossly, soil insect density and group diversity of insect population varied considerably among all of the sites so selected and the result is delineated below:

In Consideration of Seasonal Variability:

Abundance of microarthropods was relatively higher during post monsoon and the lower at the onset of monsoon (Figs. 1-4). It matches with the observations made by Bhattacharya and Ray choudhury [15], Bhattacharya *et al*., [16]. Lowest abundance during June may due to high temperature and low rainfall.

In Consideration of paedological diversity and site-wise similarity:

Variation of paedological dissimilarity was firmly noted on the arthropod population. Gross variation of both relative abundance and group abundance of all the taxa studied was noted

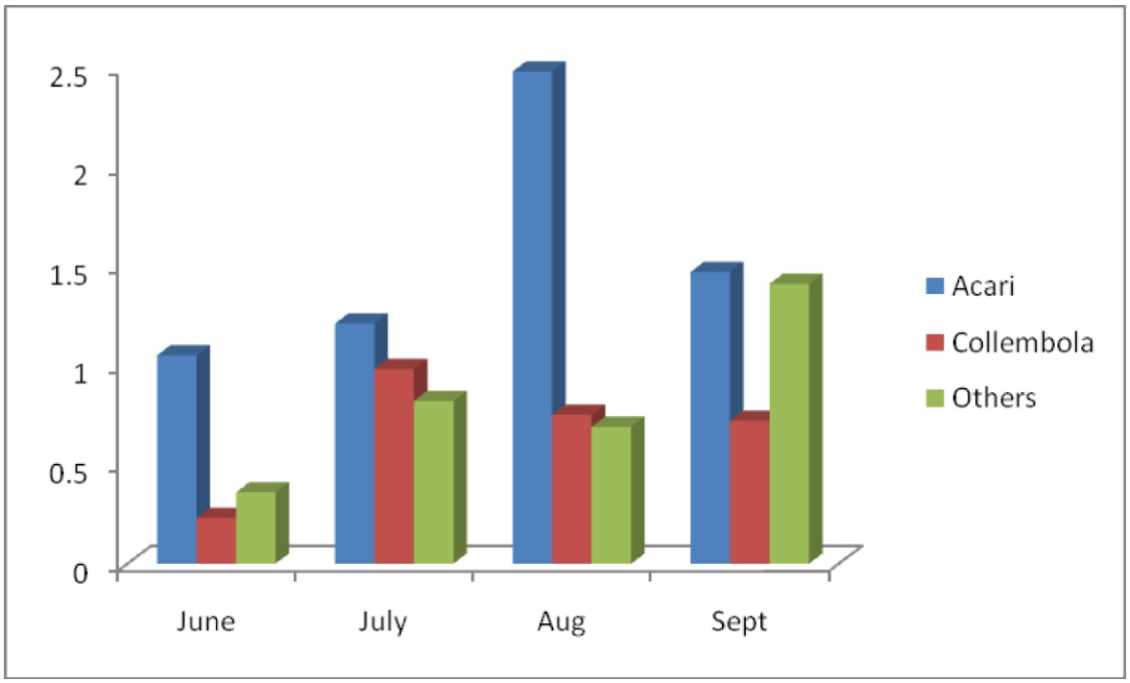


Figure 2: Variation in over-all percentage (on total collection from four sites) abundances of major groups of soil microarthropods at S2.

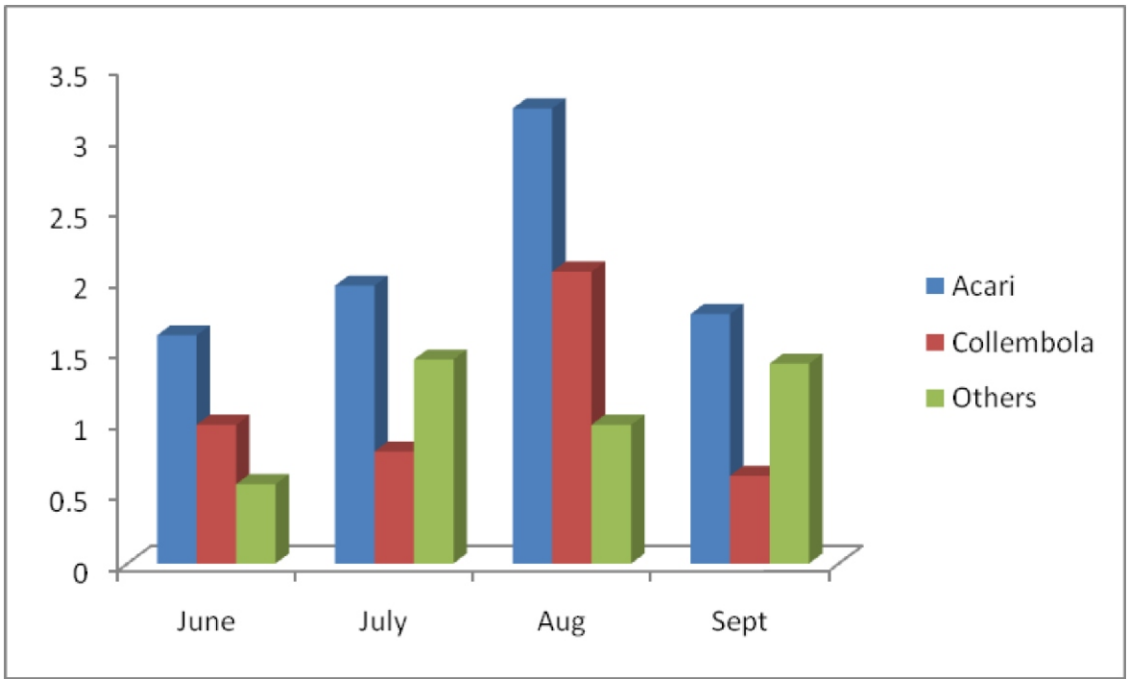


Figure 3: Variation in over-all percentage (on total collection from four sites) abundances of major groups of soil microarthropods at S3

(Table 1, Figures 1-4). In cluster analysis it was found that S1 and S4 were more similar than S2 and S3 and formed separate cluster. Over all similarity was below 29% and clusters of S1-S4 and S2-S3 exhibited similarity greater than 76 % (Figure 5).

Observation on percentage abundance*:*

Percentage abundance of major groups of microarthropods varied considerably from one site to another. Fluctuation of group-wise abundance was significant ($p<0.05$) (Table 2).

Observation on Group Abundance*:*

Soil oribatid mite was the largest fraction of micro arthropod groups as followed by collembolans in most of the collection effort. Abundance of collembola however exceeded the abundance of oribatids at S2 and S3 during the month of July and August respectively.

DISCUSSION

The purpose of the present study was to observe how the

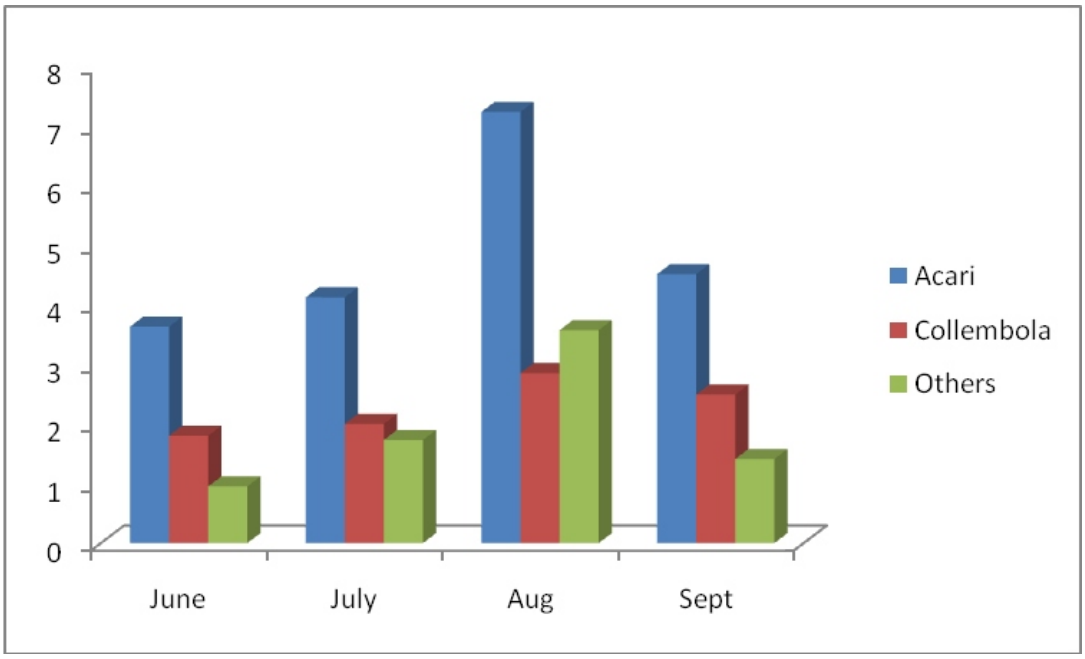


Figure 4: Variation in over-all percentage (on total collection from four sites) abundances of major groups of soil microarthropods at S2.

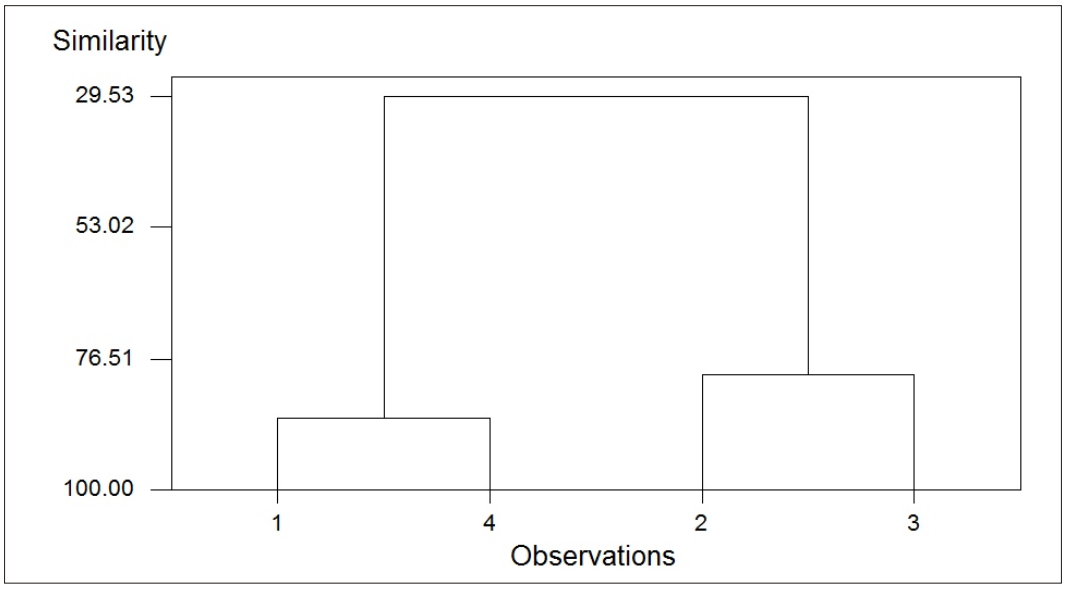


Figure 5: Cluster analysis of sampling sites upon group diversity (based on Eucledean distance and single linkage method).

proportional abundance and group-wisr variability of microarthropods was affected by soil characteristics that varied as per sites. Observation of dominance of oribatid mites was in conformity with the observations made by Sanyal [17, 18], Bhattacharya and Chakraborti [3], Ghosh and Roy [19], and Moitra *et al*., [15]. Variation in observation may occur for a number of reasons. Soil arthropods are more sensitive to increasing temperature or decreasing humidity than litter arthropods, in which case the use of light during extractions would made arthropods inactive before leaving the sample and thus their apparent abundance might decrease. Furthermore, litter arthropods in forest area inhabit a clear and warm habitat (litter) [20] and thus may require an increase in temperature and in light incidence to exit the samples.

CONCLUSION

Greater similarity in diversity between agricultural field and forest floor might be due to relatively low harshness and disturbance in comparison to the brick field and the site at river basin. The brick field was without any large tree and sparsely vegetated with low herbs and shrubs, same was the condition of river basin. Condition of vegetation seems to play significant role in the makeup of microarthropod communities at the selected sampling sites. Further study is required to get an insight of species level variability among the sites.

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