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Observation on abundance and group diversity of soil microarthropods with special reference to acarines at four differently used soil habitats.

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Abstract- Soil samples were collected from four different types of sites –agricultural field, river basin, brick field and forest floor. Density and group diversity varied considerably among the sites, the statistically significant difference in mean abundance both for total microarthropods and acarines however existed only between forest site and brick field, difference of group diversity was not significant. All the sites showed post-monsoon population maxima. Oribatids were the single largest order at the sites followed by collembolans.

Index Terms- microarthropods, acari, oribatid mites, density, group diversity

I. Introduction

Soil microarthropods including acarines play an important role in the physico-chemical dynamics of soil and has drawn attention of a number of workers in and outside of India (Sanyal, 1982; Bhattacharya and Chakraborti, 1994; Norton, 1994; Crossley and Coleman, 1999; Chitrapati and Singh, 2006). Information however, is scanty on ecology and diversity of soil micrarthropods occurring in the northern plains of Bengal. The current work therefore was taken up to address this scarcity of data. A comparative approach among different habitats was attempted in the present study.

II. Materials and Methods

Soil samples were collected from four differnt sites during June to September, 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 and extraction was run using modified tullgren funnel apparatus (Macfadyen, 1953). microarthropod groups were sorted from the extract using needles and fine camel hair brush. They were preserved in 85% alcohol.

Group diversity was calculated using Shannon's Index following Cancela da Fonseca and Sarkar (1998). Logerithmic transformation of data were made for statistical analysis whenever needed.

Collection sites:

i. Site-I: Agricultural field near Dalimgaon Rail Station (25° 38'07"N, 88° 22'10"E) which is used for cultivation of jute , cereals, pulses etc.

ii. Site-II: Brick field at Madanpur (25° 38'7"N, 88° 16'10"S where soil is peebly in nature. Large trees , herbs and shrubs were few in number; scattered patches of grasses were present here.

iii. Site-III: River basin region at Tungail bill para (25°40'11"N, 88°19'10"E), soil appeared as clayee. A few numbers of plants, herbs and shurbs were present. The area was used as a grazing land.

iv. Site-IV: Forest area at Anaun (25°36'3" N, 88 °19'10"E) with plenty of trees, herbs and shurbs are there.

All the places which are being used as observation sites, locate in Uttar Dinajpur of West Bengal, India.

III. Result and Discussion

Mean abundance of soil microarthropods as well as acarines was highest at site-IV followed by site-I while the same was lowest at site-II (Table 1; Figure 6). Mean density of microarthropods ranged from around 3156 /m^2 (site-II) to 9409 /m^2 (site-IV) in the study region (Table 2). It was well within the range generally recorded in West Bengal and other parts of India by earlier workers (Chitrapati and Singh, 2006; Devi and Singh, 2006; Joy, 2006)

One-way analysis of variance (ANOVA) revealed significant difference in the fluctuation of population of soil microarthropods and acarines as well among the sites ($p < 0.05$). As per Tukey test, statistically significant difference among mean abundance was observed between sites II and IV and sites III and IV. There was so significant difference of mean between other sites (Table 3, 4).

In all the sites, highest abundance of microarthropods was observed during the month of August, i.e., during post monsoon and the lowest abundance was recorded during the month of June (Table 1, Figs. 6, 7). This observation is in conformity to the observations made by Bhattacharya and Raychoudhuri (1979), Bhattacharya *et al*., (1980). Lowest abundance during June may due to high temperature and low rainfall.

Soil acarines was the largest fraction among the microarthropod groups as recorded in the sites. Oribatid mites constituted the largest single order followed by collembolans at

the sites (Figures 1 - 4). They were the most abundant order among soil acarines and microarthropods as well. Similar observations were reported by workers like Sanyal (1981a, 1981b, 1982), Bhattacharya and Chakraborti (1994), Joy and Bhattacharya (1997), Cancela da Fonseca and Sarkar (1998), Ghosh and Roy (2004), Chitrapati and Singh (2006) and Moitra *et al*., (2007).

Among soil acarines, Mesostigmata was the second highest abundant group. Other two orders – Prostigmata and Astigmata were less numerous (Table 1). Though oribatids were highest in abundance at site-IV but mesostigmatids were most abundant at site-I. It is generally observed that most oribatid species are less tolerant to environmental or mechanical disturbances (Norton and Palmer 1991). Site-IV being a forest site, it was subjected to less disturbance while site-I was located in the vicinity of railway tracks.

Fluctuation (coefficient of variation) of abundance of microarthropod population was highest at site-IV while the same for acarines was highest at site-II (Table 2). Environmental harashness of site-II might be responsible for high fluctuation of acarines. Relative abundance of orders of mites other than Oribatida was highest at site-II. Though oribatids have relatively a long life span but other groups often show a rapid rise and fall of abundance as per the environment and have shorter life span (Philips, 1990; Norton, 1994; Crossley and Coleman, 1999; Behan-Pelletier). High relative abundance of oribatids at forest site and other mites groups at site-II collectively might have contributed in such observation.

Group diversity, which basically varied upon evenness as the number of group made fixed, was relatively high at site-IV. The lowest value also, interestingly, was recorded at site-IV in the month of July (Fig. 5). It might be due to high relative abundance of oribatids at this site. Group diversity did not vary significantly from one site to another (Table 5). Observation however might be different had the calculation included all the orders available at each site.

Further investigation for longer duration is needed to critically assess the scenario, the spatial and the temporal changes in the edaphic environs in the region.

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Table 1: Mean abundance of different groups of microarthropods at collection (individual / core).

Site-I							
Months	**Oribatida**	**Mesostigmata**	**Prostigmata**	**Astigmata**	**Collembola**	**Others**	**Total**
June	4.40	1.73	0	0	2.33	1.93	10.40
July	7.93	2.93	0.27	0	5.13	3.53	19.80
August	7.20	3.13	0.07	0.07	3.87	7.27	21.60
September	5.80	4.07	0	0	5.07	2.87	17.80
Mean±SE	**6.33±0.78**	**2.97±0.48**	**0.09±0.06**	**0.02±0.02**	**4.1±0.66**	**3.9±1.17**	**17.4±2.46**
Site-II							
June	0.87	1.27	0	0	0.47	0.73	3.33
July	1.73	0.67	0.07	0	2.00	1.67	6.13
August	2.73	2.27	0.07	0	1.53	1.40	8.00
September	1.93	1.07	0	0	1.47	2.87	7.33
Mean± SE	**1.82±0.38**	**1.32 ± 0.34**	**0.04± 0.02**	**-**	**1.37± 0.32**	**1.67± 0.45**	**6.2± 1.03**
Site-III							
June	1.67	1.6	0	0	2	1.13	6.4
July	2.6	1.33	0.07	0	1.6	2.93	8.53
August	3.67	2.87	0	0	4.2	2	12.73
September	2.27	1.27	0.07	0	1.27	2.87	7.73
Mean± SE	**2.55± 0.42**	**1.77± 0.37**	**0.04± 0.02**	**-**	**2.27± 0.66**	**2.23± 0.42**	**8.85±1.37**
Site-IV							
June	4.87	2.27	0.27	0	3.67	1.93	13
July	6.87	1.47	0.07	0	4.07	3.53	16
August	9.8	4.33	0.53	0.07	5.8	7.27	27.8
September	6.2	3	0	0	5.07	2.87	17.13
Mean±SE	**6.93±1.04**	**2.77±0.607**	**0.22±0.12**	**0.02±0.02**	**4.65±0.48**	**3.9±1.17**	**18.48±3.23**

(SE = Standard Error)

Table 2: Mean density (individuals/ m^2) and fluctuation of total soil microarthropods and acarines at different sites.

		Site-I	Site-II	Site-III	Site-IV
Total microarthropods	Density (±SE)	8858.17±1252	3156.36±525	4505.45±696	9409.68±1642
	CV	26.61	33.23	30.9	37.07
Acari	Density (±SE)	4785.45±570	1612.12±335	2214.54±378	5056.96±836
	CV	23.82	41.56	34.18	33.06

(SE = Standard Error; CV = Coefficient of variation)

Table 3: One-way ANOVA for microarthropods and acarine populations at different sites.

One-way ANOVA: Total microarthropods versus Sites

```
Analysis of Variance for tm
Source     DF        SS        MS        F        P
Sites       3     3.441     1.147    10.17    0.001
                  Error      12     1.354     0.113
```

One-way ANOVA: Acari versus sites

```
Analysis of Variance for Acari
Source     DF        SS        MS        F        P
Site        3     4.023     1.341    13.34    0.000
Error      12     1.207     0.101
Total      15     5.230

                                 Individual 95% CIs For Mean
                                 Based on Pooled StDev
Level       N      Mean     StDev  ---+---------+---------+---------+---
Site-I      4    4.9233    0.2722                     (-----*-----)
Site-II     4    3.8035    0.3782   (----*-----)
Site-III    4    4.1400    0.3079        (-----*-----)
Site-IV     4    4.9678    0.3005                       (-----*-----)
                                 ---+---------+---------+---------+---
Pooled StDev =   0.3171             3.60      4.20      4.80      5.40
```

DF = Degree of Freedom, SS = Sum of square, MS = Mean square, F = F statistics, StDev = Standard deviation, CIs = Confidence Intervals

[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 present mean. The ranges of mean within parentheses not overlapping implies that those means are different]

Table 4: Tukey's pairwise comparisons for total microarthropods and soil acarines

Total microarthropods

```
           Site-I   Site-II Site-III

Site-II    0.3421
           1.7528

Site-III -0.0330  -1.0805
           1.3777   0.3303

Site-IV  -0.7614  -1.8089  -1.4338
           0.6493  -0.3981  -0.0230
```

Soil acarines

```
           Site-I   Site-II Site-III

Site-II    0.4539
           1.7857

Site-III   0.1173  -1.0025
           1.4492   0.3294

Site-IV  -0.7104  -1.8302   -1.4937
           0.6214  -0.4984   -0.1618
```

Table 5: t test for comparing group diversity of different sites.

	Site-I	Site-II	Site-III
Site-II	$-1.51_{(ns)}$		
Site-III	$-1.25_{(ns)}$	$0.64_{(ns)}$	
Site-IV	$-0.38_{(ns)}$	$0.29_{(ns)}$	$0.11_{(ns)}$

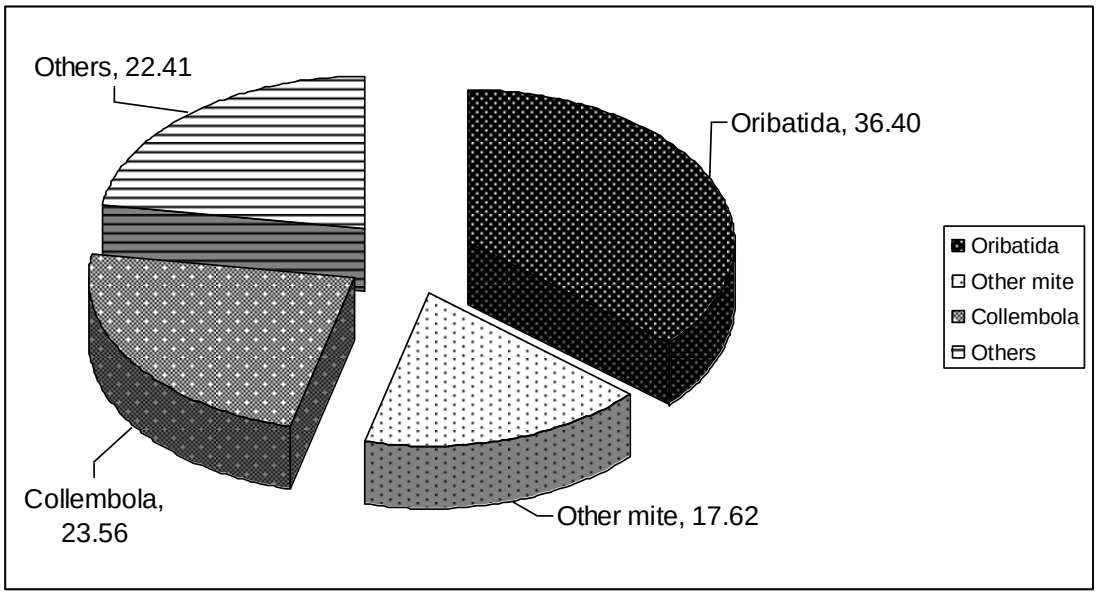

Figure 1: Relative abundance (%) of four major groups of microarthropods at site- I

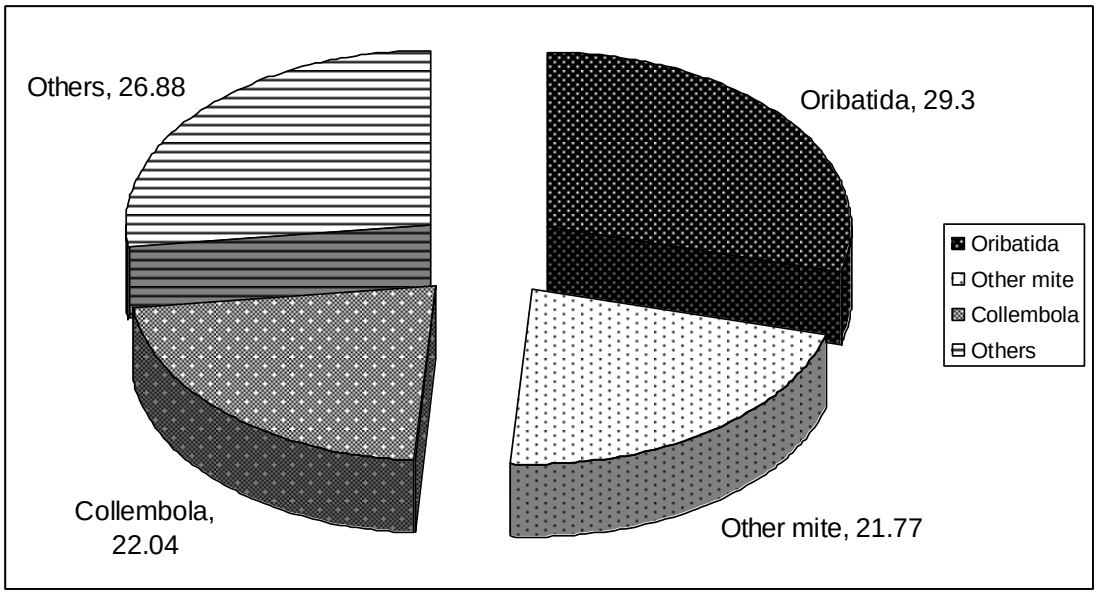

Figure 2: Relative abundance (%) of four major groups of microarthropods at site-II.

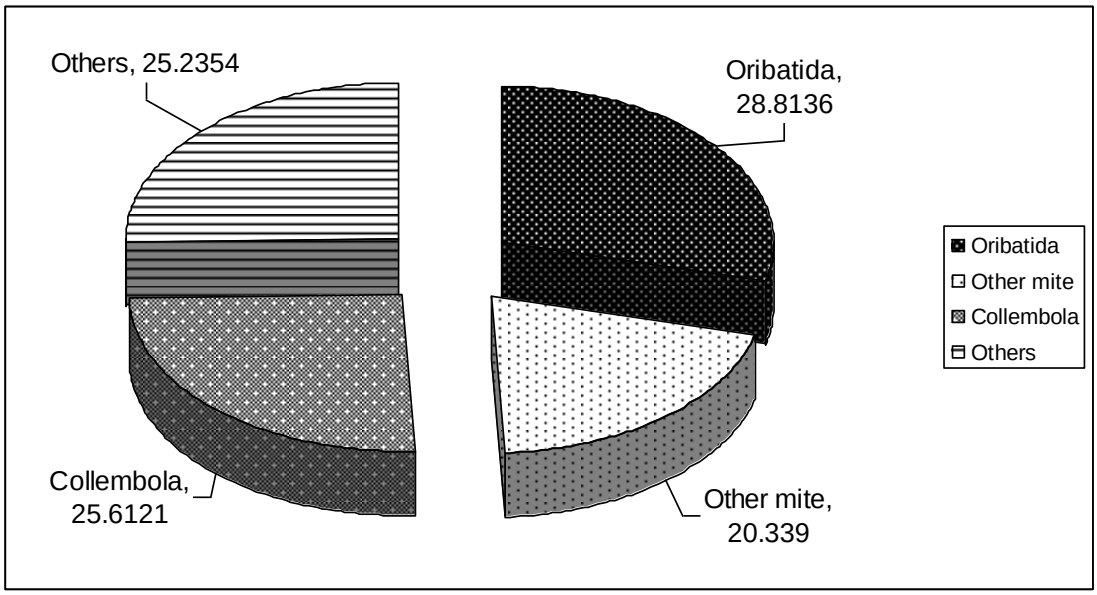

Figure 3: Relative abundance (%) of four major groups of microarthropods at site-III.

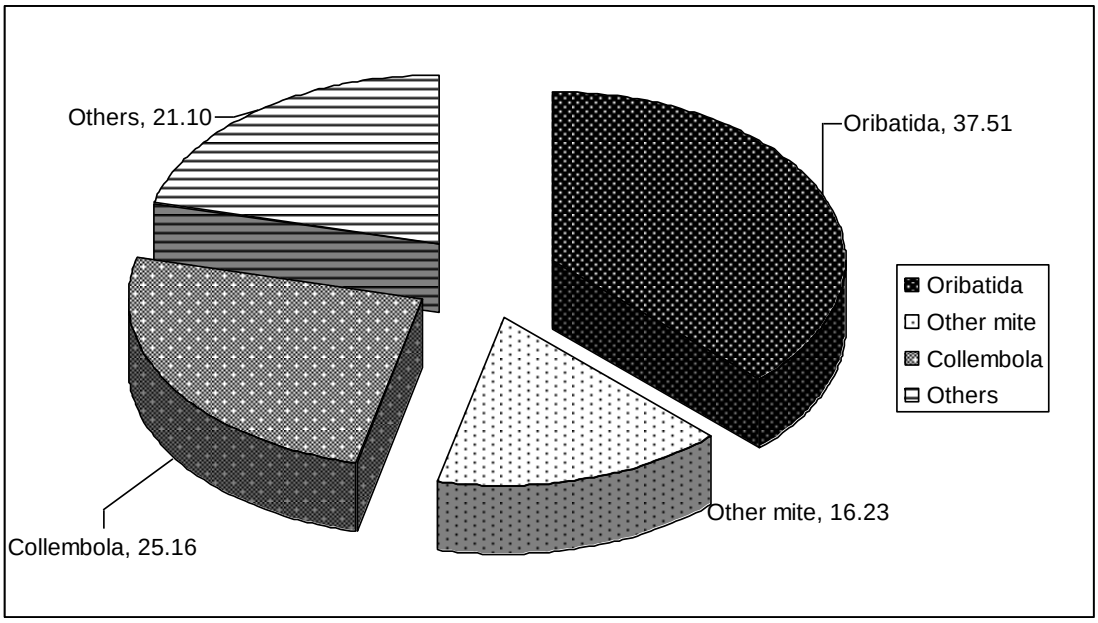

Figure 4: Relative abundance of four major groups of microarthropods at site-IV.

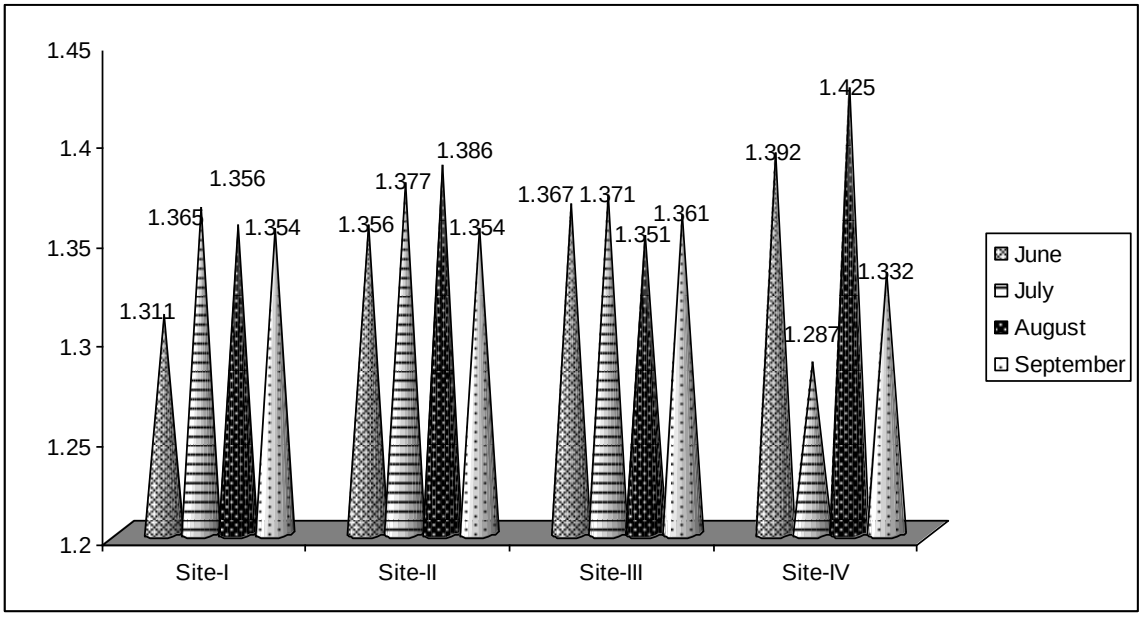

Figure 5: Variation of group diversity of soil microarthropods at different sites.

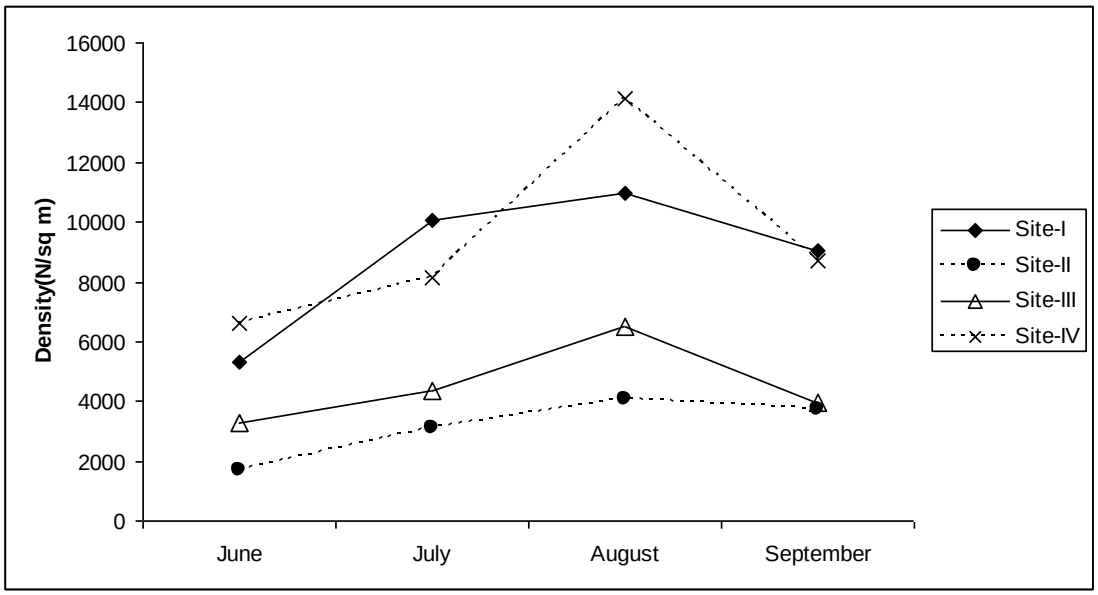

Figure 6: Monthly fluctuation of density (individual/m^2) of soil microarthropods at different sites.

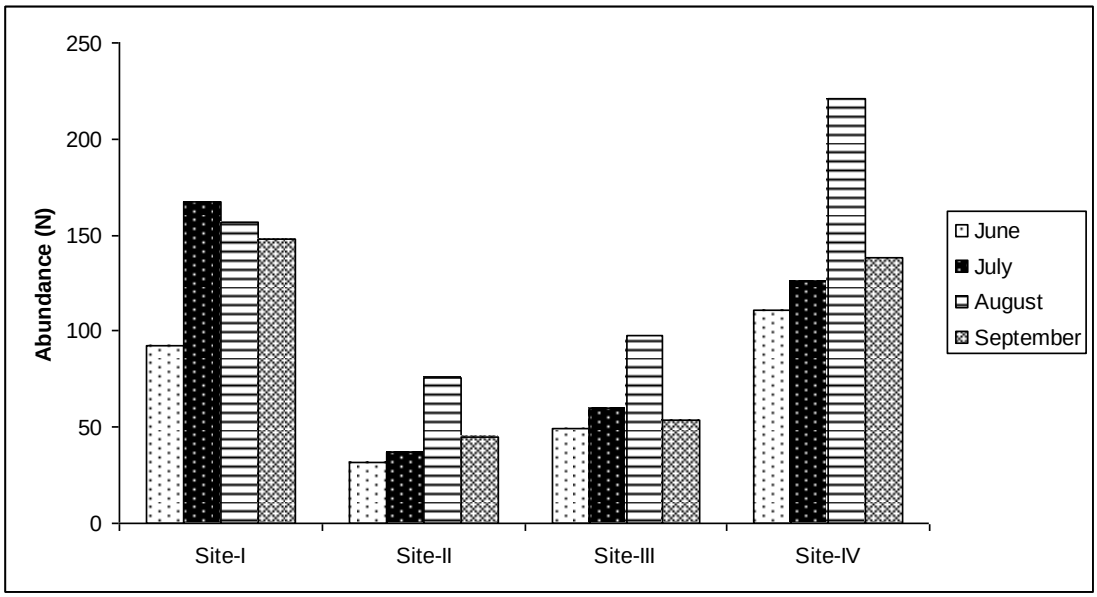

Figure 7: Monthly variation of numerical abundance of soil acarines at different sites.