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STUDIES ON SOIL MICROARTHROPOD POPULATION IN THREE DIFFERENT GARDEN PLOTS OF 24 PARGANAS, WEST BENGAL—A PRELIMINARY REPORT

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INTRODUCTION

Soil is a stratified mixture of organic materials both of which are decomposition products. The parent material, the soil forming rocks undergo physical and chemical processes of weathering resulting in the formation of mineral constituents of soil. Organic components of soil are formed either by decomposition of dead remains of plants and animals or through metabolic activities of living organisms present in the soil. According to Wallwork (1970) soil is the general habitat which harbours rich and varied communities, for living organisms find in the soil an environment providing food, shelter, anchorage and concealment from the predators. Soil microarthropods occur in all types of soil. They are of immense importance in maintenance of various ecological systems. They plan a very important and significant role in soil formation, increasing the porosity of the soil, soil aeration and in the promotion of the soil fertility by breaking down organic matters through the intricate process of digestion. The importance of these organisms in soil zoology and agriculture are enough to warrant more extensive studies on their bionomics and taxonomy.

The population density of soil microarthropods depends on various physico-chemical properties of soil such as porosity and permeability of the soil, soil temperature, soil moisture and the presence of inorganic elements and components, organic matters and the pH of the soil. Application of chemical fertilizers, pesticides, weedicides, etc. in the garden and adoption of various cultural methods like use of resistant varieties of seeds, tilling, raking, weeding and watering of the garden greatly affect the natural microarthropod population of the soil.

A study on the microarthropod population reveals that soil mites and collemboles occur predominantly in all type of soils. They are the major constituents of the soil. The studies on the population densities of the soil mites and other microarthropod organisms in India came to the

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limelight of scientific investigation chiefly through the works of Singh and Mukherjee (1971), Singh and Pillai (1975), Bhattacharya, Joy and Joy (1981), Mazumdar and Deb (1991a, 1991b), Sanyal (1991), Sanyal and Sarkar (1993), Sengupta and Sanyal (1991), Sarkar, Sanyal and Chakraborty (2007).

MATERIALS AND METHODS

A total of 120 litter mixed soil samples were collected from three selected cultivated plots in a garden. Five samples were collected at random from each plot in every month for a period of 8 months i.e. October, 2006 to May, 2007. The samples were drawn by means of stainless steel corers, each measuring 5 cm in diameter, from the sub-soil layer approximately 4-6 inches deep into the soil. The samples were taken in polythene bags, loosely tied by rubber bands and brought to the laboratory for extraction of soil inhabiting microarthropods. The larger insects were sorted out from the samples by handpicking method. The microarthropods were extracted from the soil samples by using a Tullgren funnel extractor as modified by Macfadyen (1953). The mites and other microarthropods extracted were studied after following the usual procedure of cleaning in an equal mixture of 90% alcohol and lactic acid.

Soil moisture, temperature and pH were measured by infra-red moisture meter, soil thermometer and pH meter respectively.

SITE DESCRIPTION

Three plots in a garden containing different plants were selected for study in Dum Dum areas, district 24 Parganas, West Bengal. The soils of the three plots were gangetic alluvial in nature, blackish-greay in colour and dry to semi-wet in texture. The brief characteristics of the plots are given below :

1. **Plot A** : The plot was a cultivated flower garden of about 550 sq. ft. having regular cultivation of seasonal flowers like Hibiscus–*Hibiscus rosa sinensis*, Rose–*Rosa damasciana*, Marigold–*Tagetes patula*, Dopati–*Impatiens balsamina* and Jasmine–*Jasminum sambac.*

2. **Plot B** : It was a plot in a cultivated vegetable garden of about 700 sq. ft. in area growing varieties of vegetables like Gourd–*Lagenaria ciceraria*, Pumpkin–*Cucurbita maxima*, Spinach, Cauliflower–*Brassica oliracea* and Squash–*Sechium edule* thoughout the period of study.

3. **Plot C** : This plot was an uncultivated area of about 400 sq. ft. having thick growth of varieties of weeds like *Oxalis corniculata, Cleome rutidosperma, Portuloca quadrifida, Sida acuta* and *Sida mysorensis.*

The cultivated garden plots under study were properly manured with bio-fertilizers like cowdung, rotten oil cakes and decomposed fruit and vegetable peel. Tilling, raking and watering of the plots were done before cultivation. To prevent insect depredation suitable pesticides like Rogor, Sevin, Blitoxin and Phosphamidon in prescribed doses (1 ounce of pesticide in 10 litres of water) were applied.

Table 1 : Arthropod Population and Mean Values of Soil Factors in Plot A (October 2006-May 2007)

Arthropods/sq.m and Soil Factors	October	Novem-ber	Decem-ber	January	Febru-ary	March	Apirl	May
ACARINA	18140.13	14777.07	12433.12	12840.76	29146.49	35465	39439	33936
COLLEMBOLA	12433.12	11312.1	14777.07	8458.59	10496.82	21911	22318	15898
COLEOPTERA	1121.02	509.55	101.91	1222.93	509.55	1222.9	917.2	407.6
ANT	2445.86	305.73	0	1630.57	1324.84	5605.1	5299	3669
SPIDER	407.64	407.64	305.73	1324.84	0	305.73	203.8	0
HEMIPTERA	1019.11	1630.57	509.55	3261.15	509.55	1019.1	1019	305.7
DIPTERA	305.73	0	0	1834.39	203.82	101.91	509.6	203.8
CENTIPEDE	101.91	305.73	101.19	917.19	101.91	1222.9	0	0
Temperature (Degree C)	31.3	29.7	26.1	20.1	22.2	29.1	36.2	36.3
Moisture (%)	31.2	30.2	29.1	25.1	26.3	26.2	23.8	23.5
pH	6.6	6.4	6.3	6.23	6.1	6.7	7.1	7.1

Table 2 : Arthropod Population and Mean Values of Soil Factors in Plot B (October 2006-May 2007)

Arthropods/sq.m and Soil Factors	October	Novem-ber	Decem-ber	January	Febru-ary	March	Apirl	May
ACARINA	16101.91	22012.74	22420.38	17732.48	33019.11	30369.4	31287	30573
COLLEMBOLA	7235.67	12535.03	15388.54	2547.77	6420.38	8662.42	9375.8	11618
COLEOPTERA	101.91	0	305.73	713.38	509.55	1121.01	101.91	0
ANT	1222.93		1324.84	1630.57	5197.45	1630.57	1936.3	1019.1
SPIDER	407.64	203.82	305.73	203.82	509.55	407.64	305.73	203.82
HEMIPTERA	203.82	305.73	509.55	101.92	0	1426.75	305.73	101.92
DIPTERA	203.82	305.73	305.73	713.38	101.91	1630.57	0	0
CENTIPEDE	407.64	0	305.73	305.73	0	713.38	407.64	305.73
Temperature (Degree C)	31.3	29.7	26.1	20.1	22.2	29.1	36.2	36.3
Moisture (%)	31.2	30.2	29.1	25.1	26.3	26.2	23.8	23.5
pH	6.6	6.4	6.3	6.23	6.1	6.7	7.1	7.1

Table 3 : Arthropod Population and Mean Values of Soil Factors in Plot C (October 2006-May 2007)

Arthropods/sq.m and Soil Factors	October	Novem-ber	Decem-ber	January	Febru-ary	March	Apirl	May
ACARINA	26700.64	30471.34	22726.11	15694.27	16305.73	21503.2	26395	34650
COLLEMBOLA	10394.9	18038.22	10598.73	14980.89	16713.38	13248.4	10497	10191
COLEOPTERA	509.55	815.29	0	101.91	203.82	305.73	101.91	407.64
ANT	1732.48	3261.15	0	6114.65	3668.79	5401.27	8662.4	2038.4
SPIDER	101.91	101.91	305.73	0	305.73	305.73	0	407.64
HEMIPTERA	101.91	101.91	101.91	0	0	0	0	0
DIPTERA	509.55	0	203.82	0	203.82	0	203.82	0
CENTIPEDE	101.91	407.64	0	101.91	101.91	203.82	203.82	203.82
Temperature (Degree C)	31.3	29.7	26.1	20.1	22.2	29.1	36.2	36.3
Moisture (%)	31.2	30.2	29.1	25.1	26.3	26.2	23.8	23.5
pH	6.6	6.4	6.3	6.23	6.1	6.7	7.1	7.1

RESULTS

Faunal Composition : Altogether 12408 arthropods belonging to 9 different groups *viz.*, Acarina, Collembola, Hemiptera, Isopoda, Diptera, Spider, Centipede, Ant and Coleoptera were collected. As the population of Lepidoptera, Orthoptera, Diplopoda, Chilopoda and Pseudoscorpion were very low and irregularly distributed, these groups were not considered for calculation. A comparison between arthropods of the uncultivated weed filled plot and the flower and vegetable plots showed that the uncultivated plot was rich in faunal groups in comparison to the cultivated garden plots. In all the 3 plots, Acarina was the most dominant group. It formed 203515.92/m^2, 196178.36/m^2 and 194445.85/m^2 of the total densities of other soil microarthropods obtained from the vegetable garden, flower and the weed growing plot respectively. In the latter the second, third and fourth dominant groups were Collembola (104662.43/m^2), Ant (30878.98/m^2) and Isopoda (5197.39/m^2) respectively.

Similarly, in Plot A, Collembola (117605.09/m^2), Ant (20280.24/m^2) and Isopoda (15898.08/m^2); and in Plot B Collembola (73783.43/m^2), Ant (16509.55/m^2) and Isopoda (7133.74/m^2) occupied first, second and third position according to the order of dominance (Tables–1, 2, and 3).

Edaphic Factors : All the three plots were more or less identical in their edaphic characteristics. The maximum and minimum temperatures recorded were 36°C (April-May) and 20.1°C (January) in all the three plots. The average temperature recorded was 21.71°C. The average moisture content

of the soil recorded was 26.8% when the maximum and the minimum soil moisture content recorded were 31% and 23.2% respectively. the soil pH recorded was within the normal range (6.10-7.00) (Tables–1, 2 and 3).

Population Fluctuation : The total number of arthropods collected showed population maxima in February, March and April in the cultivated flower and vegetables gardens. Arthropods were minimum in number in April in the plot growing weeds whereas in the cultivated flower and vegetable gardens it varied depending upon the types of plant grown as well as the usual cultural practices of tilling and weeding in the respective gardens (Figure-1).

The population of different groups of arthropods showed an irregular trend of fluctuation during the sampling period but there was a tendency to increase their number in February–April in the cultivated plots. The Collembola population recorded was maximum in April and December in the flower and vegetable gardens respectively and in November in the plot growing weeds (Figures-2, 3, 4).

DISCUSSION

The studies of population densities of soil arthropods in different plots reveal that application of insecticides though in minimal doses and concentrations as well as at long intervals may also affect the population densities of soil dwelling organisms in comparison to cultivated fields where the effect is more profound due to extensive applications of insecticides (Joy and Chakraborty, 1991).

The soil mites were usually most abundant in autumn and winter in all the three types of plots when the soil moisture was moderate and least abundant in summer when the soil moisture was low. Similar observations were also made by Sengupta and Sanyal, 1991; Sanyal and Sarkar, 1993 and Sheela and Haq, 1991.

The pH values of the soil samples being within the tolerance range do not seem to have any effect on the soil microarthropod population. This observation is supported by the works of Joy and Bhattacharya (1981) and Sanyal (1991).

Besides, the kitchen garden areas do not remain undisturbed because of frequent human interference in the form of caring of the garden which may force the soil organisms to take refuge either in the horizontal or in the vertical direction from the place of disturbance for concealment and shelter.

These observations are supported by the earlier works of Sanyal (1991) and Sanyal and Sarkar (1993). The study recorded that when there was standing crop in the field, the number of mites and other soil microarthropods were increased. The Acarina population decreased immediately after tillage. It was further observed that when there was no crop in the cultivated fields for a long time, the number of soil microarthropods increased to a good number. Mazumdar and Deb (1991a, 1991b) also reported that microarthropod population was poor in cultivated fields and suggested a crop-dependent association.

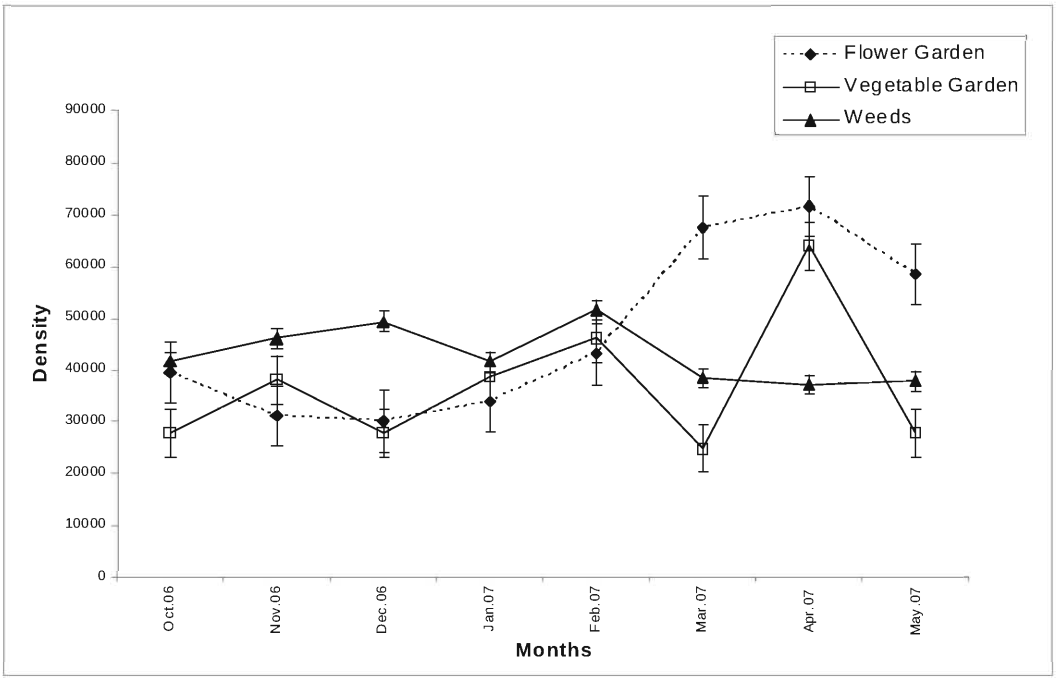

Figure 1. Shows the fluctuation of soil microarthropods at three plots.

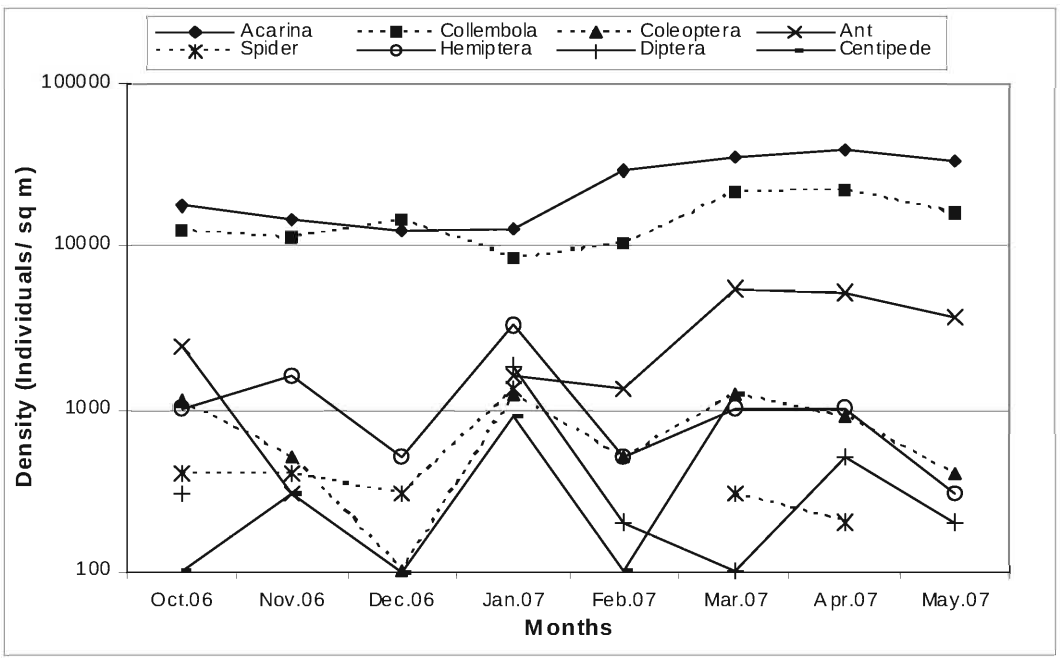

Figure 2. Shows the fluctuation of different groups of microarthropods at plot-A.

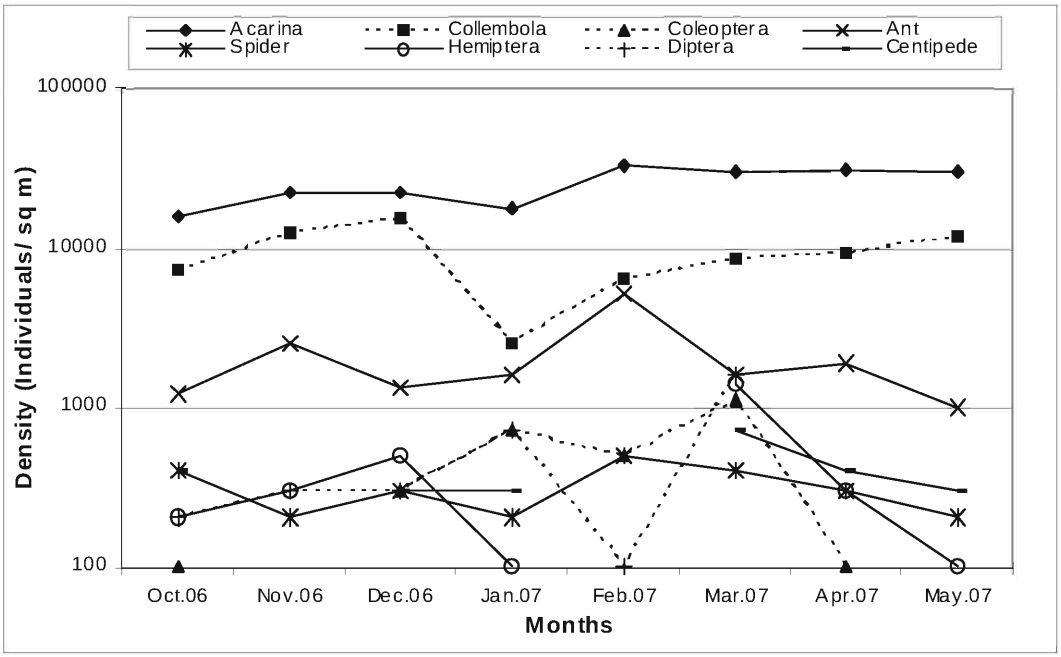

Figure 3. Shows the fluctuation of different groups of microarthropods at plot-B.

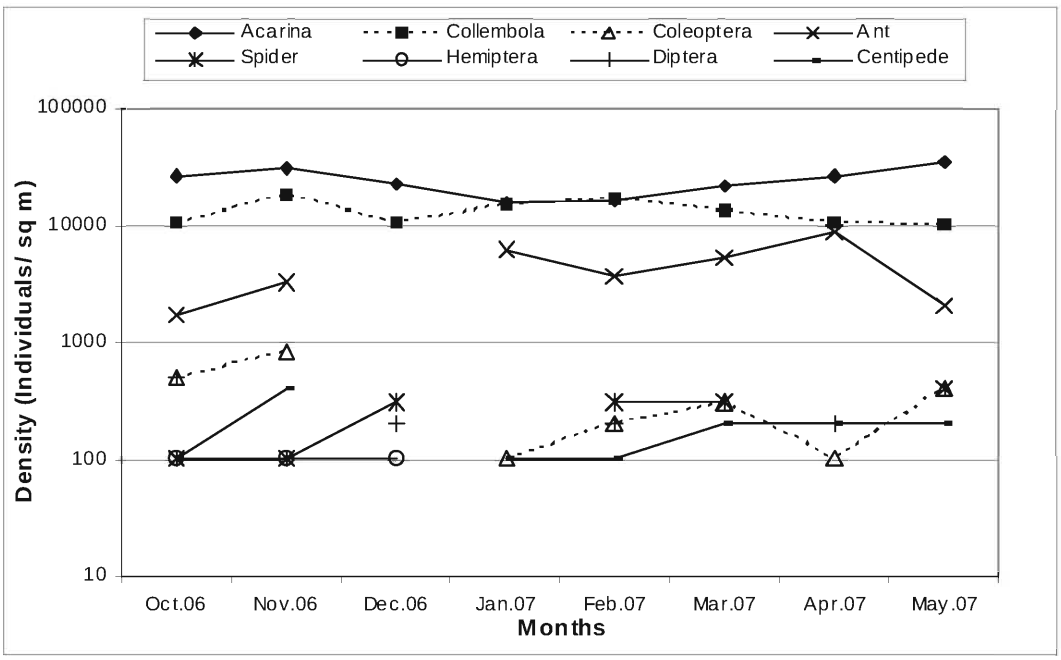

Figure 4. Shows the fluctuation of different groups of microarthropods at plot-C.

SUMMARY

The seasonal abundance of soil inhabiting arthropod fauna and their interrelationship with the edaphic factors like temperature, moisture and pH in flower and vegetable gardens and in a plot growing weeds in West Bengal were stuided. The soil arthropods were extracted with the help of modified Tullgren funnel apparatus. Altogether 12408 arthropods belonging to 9 groups were extracted from the soil samples which were collected at random from each of the three plots every month for a period of eight months (October 2006-May 2007). Of the total population Acarina was the most dominant group (47% approx.) which was followed by Collembola and Ant population. The plots where weeds were grown was quantitatively rich in fauna as compared to that of the flower and vegetable gardens where different insecticides and manures were applied and traditional means of garden nurturing that include tilling, raking, weeding, etc. were followed. The arthropod population showed seasonal variation with peak in February-April in almost all the three different plots.

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