

EFFECTS OF ORGANIC MATTER AND WATER CONTENT OF SOIL ON THE
DISTRIBUTION OF COLLEMBOLA (INSECTA) IN AN UNCULTIVATED
FIELD OF WEST BENGAL * †

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ABSTRACT

The present study deals with the influence of two major soil factors on the distribution of collembolan fauna extracted by modified Tullgren funnel methods at Barsul village, Burdwan District, West Bengal, during the period from January, 1971 to December, 1973 at monthly interval.

A total of 1,902 individuals were extracted belonging to ten genera. *Lepidocyrtus (Acrocyrtus) heterolepis* was the most abundant taxon comprising 12.93% of the total population. The peaks of the density of collembola occurred in July, when the factors like organic carbon and water content of soil also attained their respective maximum concentration.

A regression, correlation and analysis of variance was done between the two soil factors and abundance of collembola and their inter-relationships are discussed.

INTRODUCTION

There is a vast and varied assemblage of animals in the soil ecosystem, the profound importance of which in the formation of soil and increasing its fertility has in recent year, been brought to light by many workers through a series of ecological studies.

The important influence of soil moisture and organic matter (organic carbon) separately on the population density and the distribution of collembola has been studied notably by

Agrell (1941), Rapoport and Tschapek (1967), Vannier (1970), Joosse (1970), Asharf (1971), Choudhuri and Roy (1972) and Kaczmarek (1975). Observations are, however, lacking for the cumulative effects of the organic carbon and water content of soil on the distribution of collembola in an uncultivated alluvial field of Burdwan district, West Bengal. In the present studies the influence of these two main factors on the seasonal variations and the distribution of different species has been discussed.

* This investigation was carried out in the Department of Zoology, University of Burdwan during 1971-74.

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SAMPLING SITES AND METHODS

This work was carried out in a large uncultivated area which were thickly covered with herbs and shrubs (At Barsul village, Burdwan district).

The soil found there, were alluvial in

nature. Three plots, each 5 meter square were selected. From each plot 36 randomly distributed samples were drawn at monthly intervals over a period of three consecutive years (from January, 1971 to December, 1973) with the help of a soil sampler cf. Auerbach and Crossley (1960). Extraction of material from the soil was carried out in the modi-

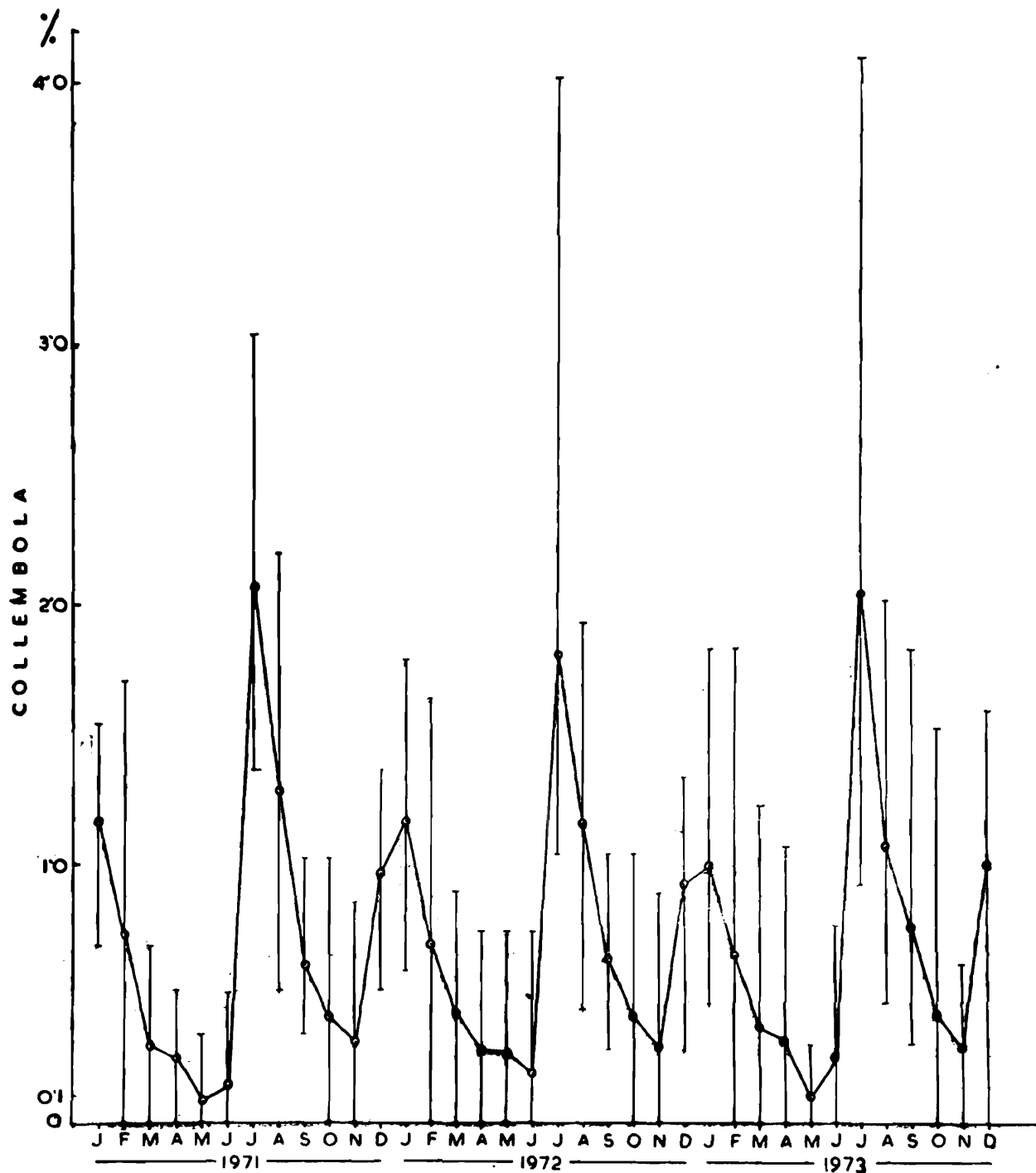


Fig. 1. Seasonal change in total number of Collembola for each month in percentage.

fied Tullgren's apparatus (Murphy 1962) for five days at 40°C temperature, water content of soil was determined as a percentage difference between dry and wet weight of soil after drying for 24 hours at 105°C. Organic carbon of soil was determined by titration (Walkley and Black 1934) method.

RESULTS

A list of the collembola extracted is presented in table 1 together with their individual percentage in each month. The species of collembola obtained from all the samples belonged to ten genera *Lepidocyrtus*, *Folsomides*, *Isotomina*, *Subisotoma*, *Alloscopus*, *Folsomina*, *Pseudosinella*, *Cyphoderus*, *Entomobrya* and *Lobella* (Table 1). The species *Lepidocyrtus (Acrocyrtus) heterolepis* was most dominant being found in all samples and comprising 12.93% of the total population. In order of dominance other forms were *Cyphoderus javanus* (11.98%), *Isotomina thermophila* (10.56%), *Lepidocyrtus (L.) medius* (8.83%), *Folsomina* sp. (8.30%), *Folsomides purvulus* (7.99%), *Cyphoderus albinus* (7.88%), *Pseudosinella* sp. (7.8%), *Subisotoma fitchoides* (7.51%), *Lobella (L.) maxillaris* (6.62%), *Entomobrya* sp. (5.88%) and *Alloscopus tetracantha* (4.31%).

SEASONAL VARIATION

From figure 1, it would be seen that the percentage of total number of the collembola had single excessive peak in July and minimum in May except in the year 1972 when the minimum number were obtained in the month of June might be due to untimely heavy rain fall during the 2nd week of May. Throughout the sampling period ranging from January, 1971 to December, 1973 it actually exhibited gradual increase from last week of June and attained its peak in July followed by gradual decline upto end of November and partial higher peak during December-

January might be due to prevalence of winter maxima, caused by population fluctuation (rise) of a few species of collembola (Table 1).

SPECIES WISE MONTHLY FAUNAL CHANGE

Figure 2 shows the monthly change of

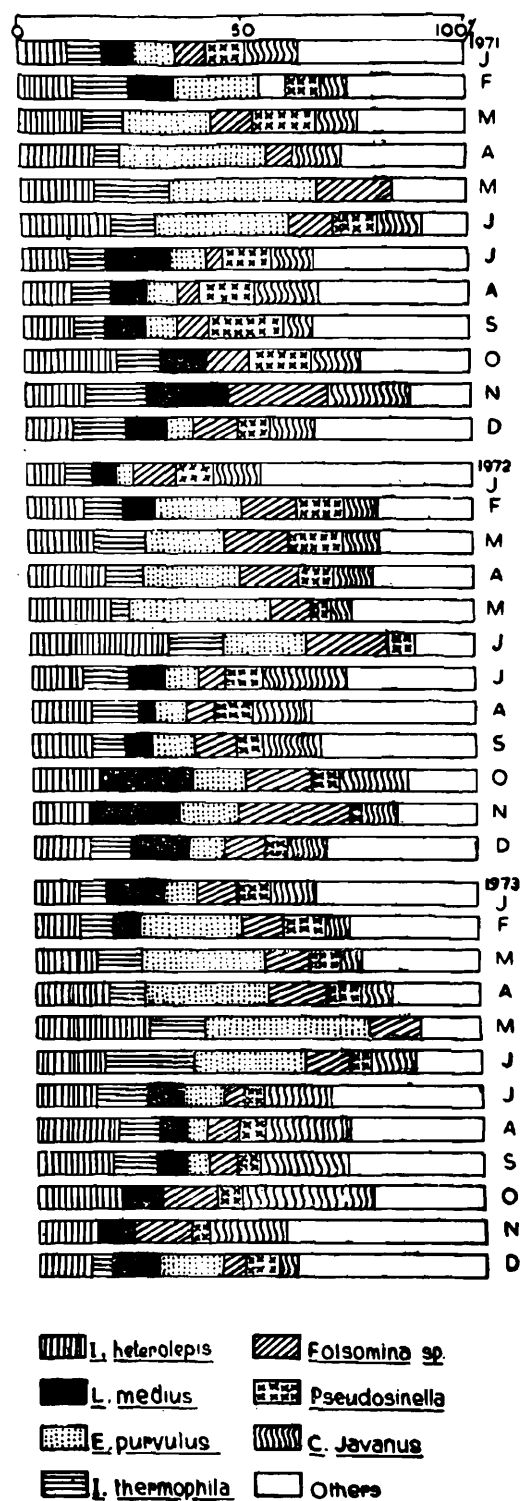


Fig. 2. Seasonal change in percentage of dominant species of collembola for each month.

TABLE 3. Showing mean value of soil factors and Collembola population in different months.

MONTH	1971			1972			1973		
	Collembola (Mean)	Water Content (%)	Organic Carbon (%)	Collembola (Mean)	Water Content (%)	Organic Carbon (%)	Collembola (Mean)	Water Content (%)	Organic Carbon (%)
Jan.	82	10.5	2.18	94	11.5	2.38	78	11.0	1.75
Feb.	51	9.0	1.68	56	7.5	1.14	51	10.5	1.67
Mar.	21	9.0	1.28	34	7.0	1.27	29	9.5	1.62
Apr.	18	9.3	1.22	23	6.5	1.12	25	9.2	1.42
May	6	8.3	1.06	22	7.0	1.24	8	8.5	1.32
Jun.	10	9.5	1.02	16	7.5	1.17	20	9.0	1.53
Jul.	146	16.0	3.52	146	15.5	2.87	161	16.5	2.73
Aug.	89	14.0	2.07	93	14.5	2.18	84	15.5	2.38
Sep.	43	12.5	2.17	51	12.5	1.73	60	13.5	2.87
Oct.	29	11.1	1.36	33	11.5	1.49	33	12.0	1.62
Nov.	22	10.0	1.76	24	10.0	1.29	23	11.0	1.24
Dec.	68	12.0	2.03	75	11.0	1.5	78	11.5	1.89

faunal structure. The percentage of dominant species of each month are shown in table 2.

SOIL FACTORS

Soils of these plots were alluvial in nature dark grey in colour with mean water holding capacity 41.92%. In May water content of soil was 8.3% in 1971, 7% in 1972 and 8.5% in 1973 and organic carbon content was 1.06% in 1971, 1.24% in 1972 and 1.32% in 1973. Month of July in each sampling year showed maximum water content (16% in 1971, 15.5% in 1972 and 16.5% in 1973). Amount of organic carbon was usually found to be maximum in July. However, in 1973 content of organic carbon was maximum in September. Mean values of soil factors (Table 3) revealed more or less identical edaphological characteristic of

plots concerned. Mechanical analysis of soils sampled showed high percentage of clay matter (Table 4).

TABLE 4. Showing mechanical analysis of soil.

Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
4.00	10.00	31.5	54.00

STATISTICAL TREATMENT OF DATA

Data pertaining to soil factors and population density were subjected to statistical analysis for finding out regression correlation and dependence of number of collembola

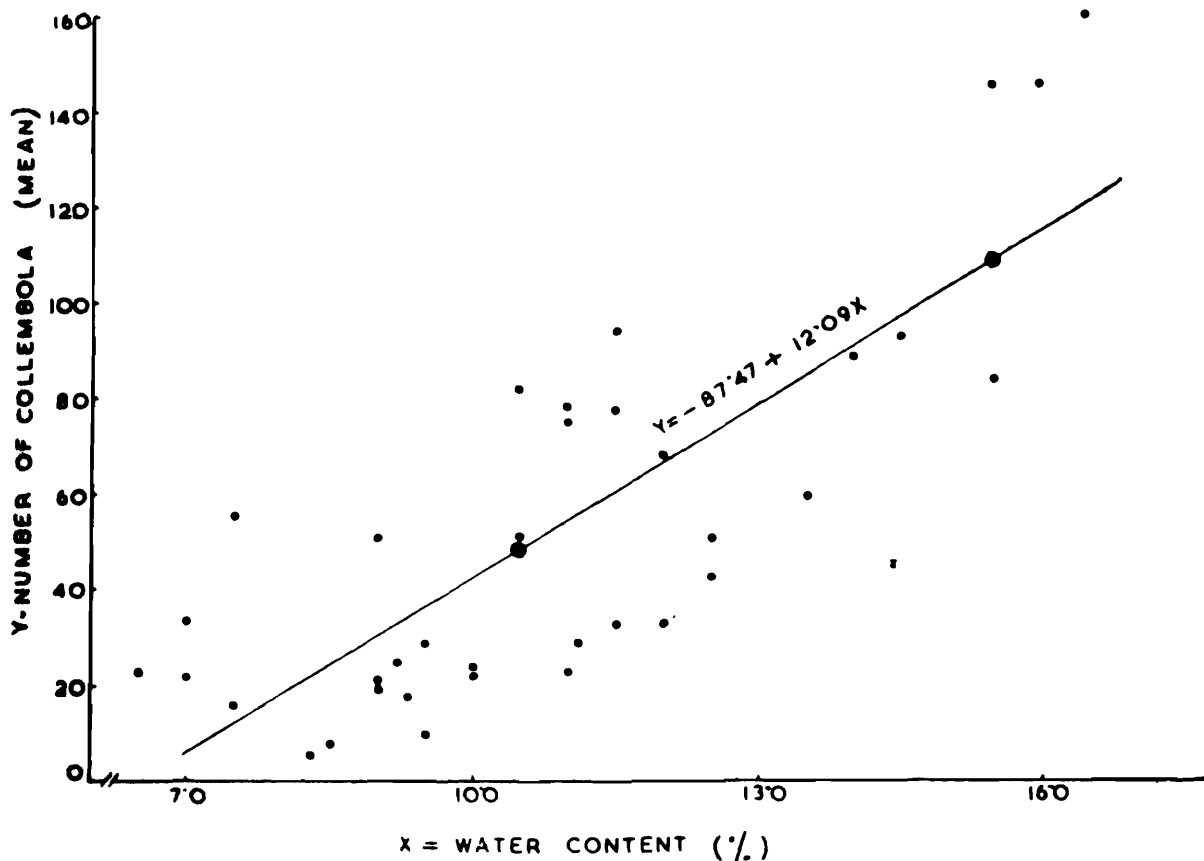


Fig. 3. Regression line with scattered diagram of Collembolans on water content (%).
Zoo.—3

(Y) on each of two variables (organic carbon and water content) considered here (Table 5).

sampling years and between months of a sampling year and the monthly variation was reasonably constant throughout.

TABLE 5. Showing relationship between collembolan population and soil factors.

	Mean	Correlation coefficient between no. of collembola and two factors	Regression line of no. of collembola (Y) on factors (X). $Y = a + bx$
Y : No. of Collembola	52.83		
Water content	10.86	0.8003 **	$Y = -78.47 + 12.09x$
Organic carbon	1.74	0.8562 **	$Y = -47.25 + 57.52x$

** Significant at 1% level.

Regression lines were obtained by pulling together data for all three years observed. These combined regression lines drawn along with respective scattered diagrams were shown in figures 3 & 4 correlation coefficient study (second column of table 5) showed the significant positive correlation with population density.

Analysis of variance study (Table 6) showed that the difference exists between

DISCUSSION

The total population of collembolan fauna extracted from this site when considered together showed numerical variation with the change of season (Table 2) it was lowest in May and maximum in July (Fig. 1) this finding confirms the results of Choudhuri and Roy (1972). This pattern of fluctuation appeared to be a bit different from Europe and America Weis-Fogh (1948),

TABLE 6. Showing analysis of variance.

	Year	Month	Error	Total
Degree of freedom	2	11	22	35
Sum of squares	312	55046	561	55919
Mean square	156.00	5004.18	25.50	
Frequency	6.1176	196.2424 **		

** Significance at 1% level.

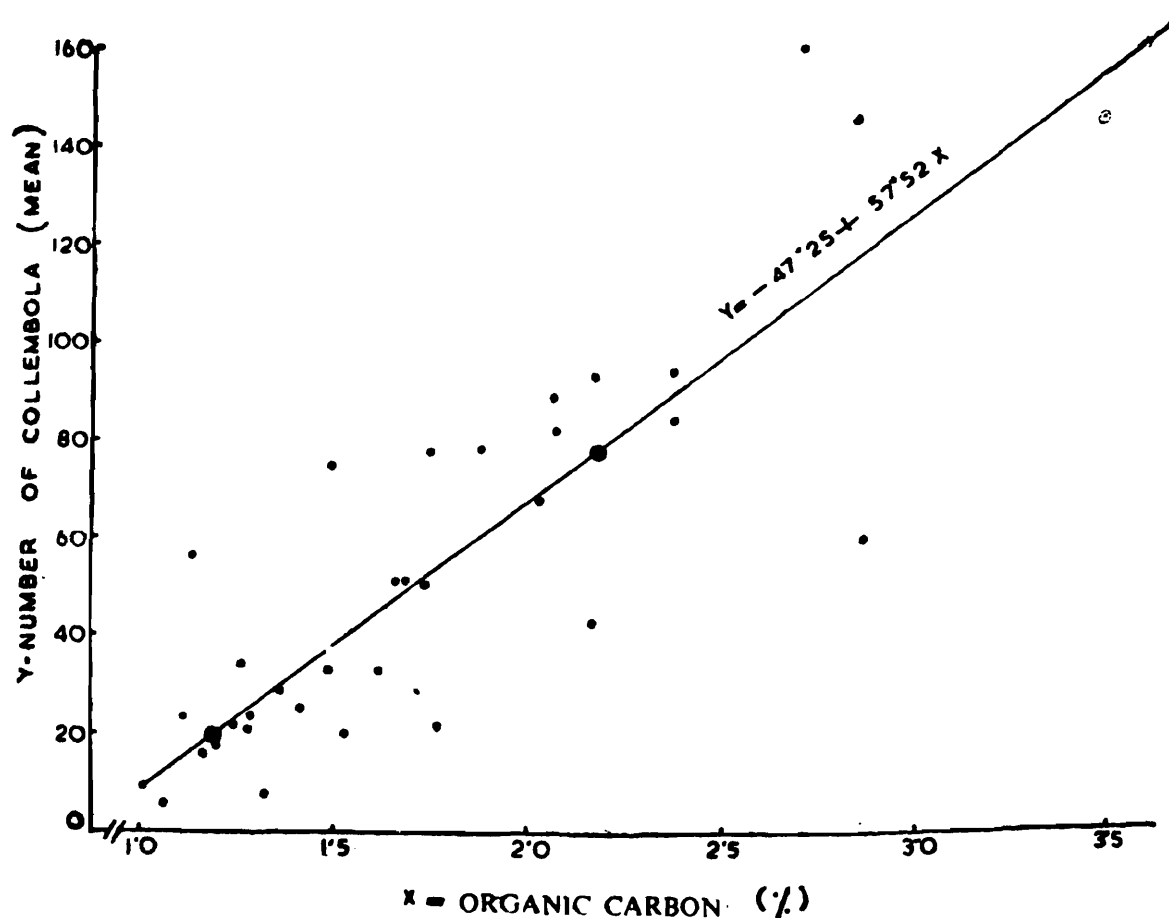


Fig. 4. Regression line with scattered diagram of collembolans on organic carbon (%).

Macfadyen 1952) Sheals (1957), Haarlov (1960) and others observed that collembolan population attained their maxima at some period between late autumn and early spring and fell to minimum in summer months. In this study the dominant species like *Lepidocyrtus* (*Acrocyrtus*) *heterolepis*, *Cyphoderus javanus*, *Lepidocyrtus* (*Lepidocyrtus*) *medius* etc. attained their respective maximum peak in July. When factors like water-content and organic carbon (except in 1973) attained their maximum concentration. Haarlov (1960), Christiansen *et al.* (1961), Davis, (1965), Vannier (1970), Joosse (1970), Choudhuri and Roy (1972) and Kaczmarek (1975) have studied the effects of either of soil moisture or of organic matter as important ecological factors in the life of collembola.

The results obtained in this investigation not only confirm the above views but also clearly indicate that in the given alluvial soil field the water-content and the organic carbon were very important on the distribution of population density.

The content of these two factors exhibited a strong positive correlation with the collembolan population in this study, maximum population density of collembola grew with the increasing organic carbon and water-content level during higher precipitation periods while during lower precipitation period in the summer months it decreased.

It can be suggested that the organic carbon and water-content of soil exerted the following influence on the collembolan

population either singly or jointly (a) maintained the soil reaction, (b) controlled humification and nitrification (c) stimulated the growth of macro-and microflora. Moreover it seemed likely that in some instances wetness or dryness as such influenced the soil fauna indirectly rather than directly since these factors particularly organic carbon largely determined the type and density of vegetation which in turn contributed towards the augmentation of soil organic matter. The latter not only served as a source of food but also influenced the amount of living space available for microarthropods.

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* Not seen in original.