

EFFECTS OF MONOCULTURE ON COLLEMBOLA AT A CROP FIELD IN NADIA (WEST BENGAL)

S. K. MITRA, B. BHATTACHARYYA and A. K. HAZRA
Zoological Survey of India, M-Block, New Alipore, Calcutta

INTRODUCTION

The distribution, abundance and seasonal changes in the population density of Collembola were investigated both in India and abroad by numerous workers. Notable amongst them are Bellinger (1954), Sheals (1957), Harrlov (1960), Christiansen (1964), Choudhuri and Roy (1972), Mitra *et. al.* (1977), Addison (1980), Hazra (1984), Hazra and Choudhuri (1983, '90), Alfred *et. al.* (1991) and Hazra and Sanyal (1996). Though Mitra *et. al.* studied the distribution of Collembola in accordance with different vegetation, the influence of sugarcane crop on the distribution of Collembola in India has not been reported so far. The present report forms part of a study of a longterm project on the qualitative and quantitative composition of collembolan fauna of a controlled monoculture of sugarcane crop persisting in the field through out the period of observation.

MATERIAL AND METHOD

A total of 108 soil samples were drawn, 9 from each of the 3 plots (5 sq. m) at monthly intervals over a period of one year. Each plot was sampled at random by using stainless steel samplers having 8.55 cm² in cross sectional area. The soil samples were extracted through the Tullgren funnel, modified by Macfadyen (1953).

THE EXPERIMENTAL SITE

The site was located within the experimental crop fields of Sugarcane Research Station at Bethuadahari in the district of Nadia, West Bengal, about 120 km north of Calcutta. The field underwent monoculture of sugarcane throughout the year. No chemical or organic manure was applied except a cover of sugarcane leaves undergoing decomposition with grasses like *Cynodon dactylon*, *Dichanthium annulatum*, *Physelis* sp., *Arundinella* sp. growing naturally in the field. The soil was brownish in colour and sandy silt in texture.

OBSERVATION

The analysis of extracts revealed the presence of 19 collembolan species belonging to 18 genera. The most predominant was *Salina indica* (35.0%) followed by *Lepidocyrtus* sp. (a)

(24.95%), *Isotomurus* sp. (20.45%), *Cyphoderus javanus* (4.8%), *Seira* cf. *indica* (3.2%), *Lepidocyrtus* sp. (b) (2.77%), *Sminthurides* sp. (2.59%), *Isotomiella minor* (2.0%). The species like *Dicyrtoma* sp. (0.69%), *Xenylla* sp. (0.51%), *Ballistrura* sp. (0.51%), *Dicranocentrus* sp. (0.51%), *Temeritus* sp. (0.34%), *Arrhophalites* sp. (0.34%), *Heteromuricus cercifer* (0.34%), *Entomobrya* sp. (0.17%), *Homidia* sp. (0.17%), *Yosiia dehradunia* (0.17%), *Dicranocentroides* sp. (0.17%) occurred only once or twice throughout the sampling period (Table. 1, Fig. 1).

Table 1 : Monthly abundance of collembolan fauna (in percentage)

	←—1996—→						←—1997—→			Total			
	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		Jan.	Feb.	Mar.
<i>Lepidocyrtus</i> sp. (a)	0.86	0.17	0.17	1.55	0.69	1.03	0.17	0.86	0.69	7.27	7.97	3.46	24.95
<i>Lepidocyrtus</i> sp. (b)	—	—	—	—	—	—	0.17	0.36	—	2.25	—	—	2.77
<i>Entomobrya</i> sp.	—	—	—	—	—	—	0.17	—	—	—	—	—	0.17
<i>Homidia</i> sp.	0.17	—	—	—	—	—	—	—	—	—	—	—	0.17
<i>Seira</i> cf. <i>indica</i>	—	0.17	3.11	—	—	—	—	—	—	—	—	—	3.2
<i>Yosiia dehradunia</i>	—	—	—	—	—	—	—	—	—	—	0.17	—	0.17
<i>Heteromuricus cercifer</i>	0.17	—	—	—	—	0.17	—	—	—	—	—	—	0.34
<i>Cyphoderus javanus</i>	0.17	0.17	0.17	0.17	2.25	0.34	—	—	—	0.17	1.03	0.34	4.8
<i>Dicranocentroides</i> sp.	0.17	—	—	—	—	—	—	—	—	—	—	—	0.17
<i>Dicranocentrus</i> sp.	0.51	—	—	—	—	—	—	—	—	—	—	—	0.51
<i>Salina indica</i>	1.38	0.17	0.51	6.41	16.63	2.77	2.07	0.86	0.17	2.07	1.03	0.86	35.0
<i>Isotomurus</i> sp.	—	—	—	—	1.38	0.17	0.17	0.86	—	—	12.13	5.71	20.45
<i>Isotomiella</i> sp.	—	—	0.34	—	—	0.17	—	—	—	0.86	0.69	—	2.0
<i>Ballistrura</i> sp.	—	—	—	0.17	—	0.34	—	—	—	—	—	—	0.51
<i>Xenylla</i> sp.	—	—	—	—	0.34	—	—	0.17	—	—	—	—	0.51
<i>Arrhophalites</i> sp.	—	0.34	—	—	—	—	—	—	—	—	—	—	0.34
<i>Sminthurides</i> sp.	0.17	0.34	—	—	—	0.34	—	—	—	—	1.38	0.34	2.59
<i>Dicyrtoma</i> sp.	—	—	—	—	0.69	—	—	—	—	—	—	—	0.69
<i>Temeritus</i> sp.	—	—	—	0.34	—	—	—	—	—	—	—	—	0.34
TOTAL	3.63	1.38	4.33	8.66	22.01	5.37	2.77	3.11	0.86	12.82	24.26	10.74	

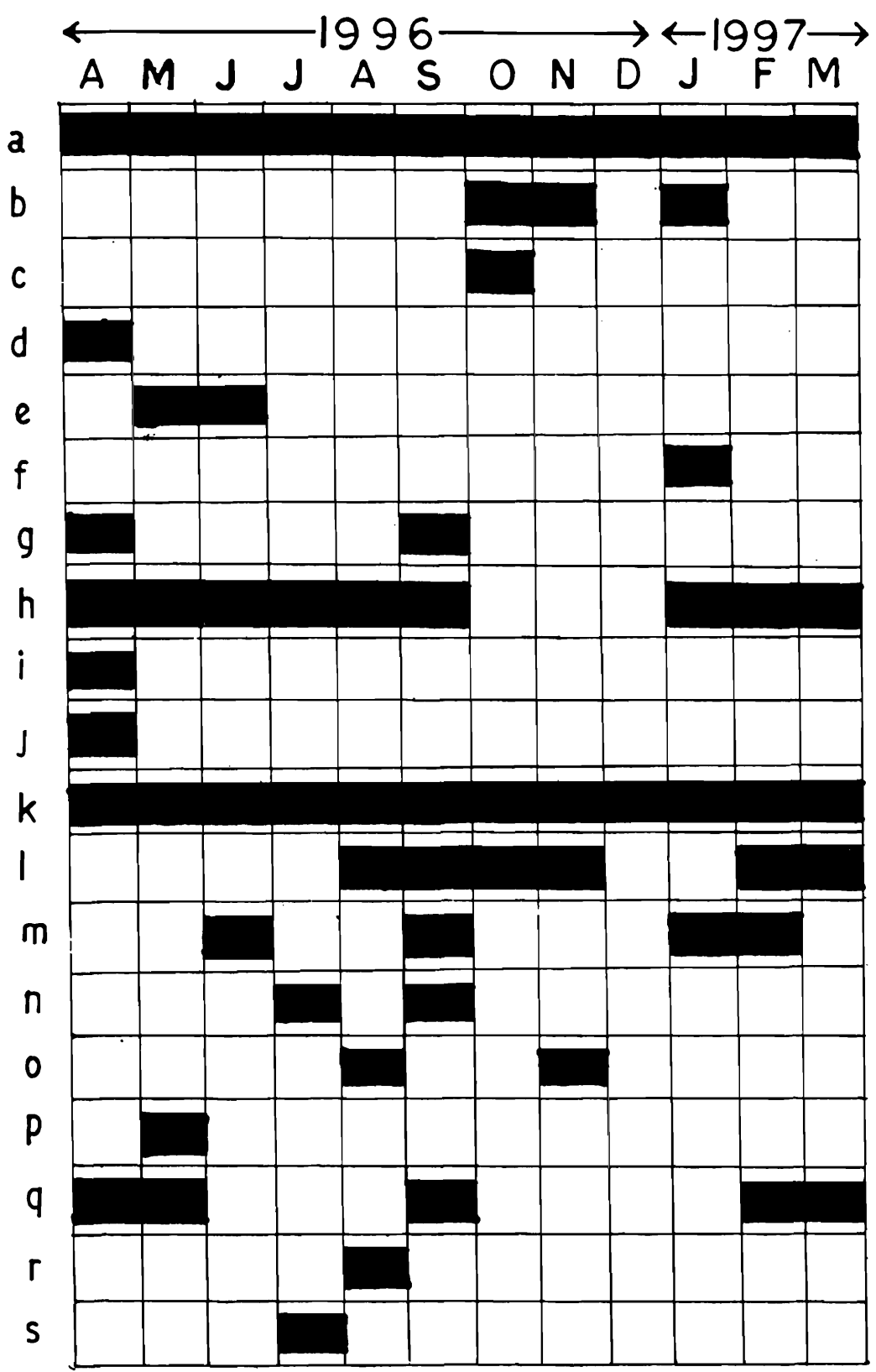


Fig. 1. : Monthly occurrence of different species of Collembola.

Explanations : a. *Lepidocyrtus* sp. (a), b. *Lepidocyrtus* sp. (b), c. *Entomobrya* sp., d. *Homidia* sp., e. *Seira* cf. *indica*, f. *Yosiia dehradunia*. g. *Heteromuricus cercifer*, h. *Cyphoderus javanus*, i. *Dicranocentroides* sp., j. *Dicranocentrus* sp., k. *Salina indica*, l. *Isotomurus* sp., m. *Isotomiella* sp., n. *Ballistrura* sp., o. *Xenylla* sp., p. *Arrhophalites* sp., q. *Sminthurides* sp., r. *Dicyrtoma* sp., s. *Temeritus* sp.

MONTHLY DYNAMICS IN POPULATION

The collembolan population showed its highest peak (24.26%) in the month of February '97 and minimum (0.86%) in the month of December '96. A second peak (22.01%) was found in August followed by smaller peaks (12.82% and 10.74%) during January and March '97 (Fig. 2).

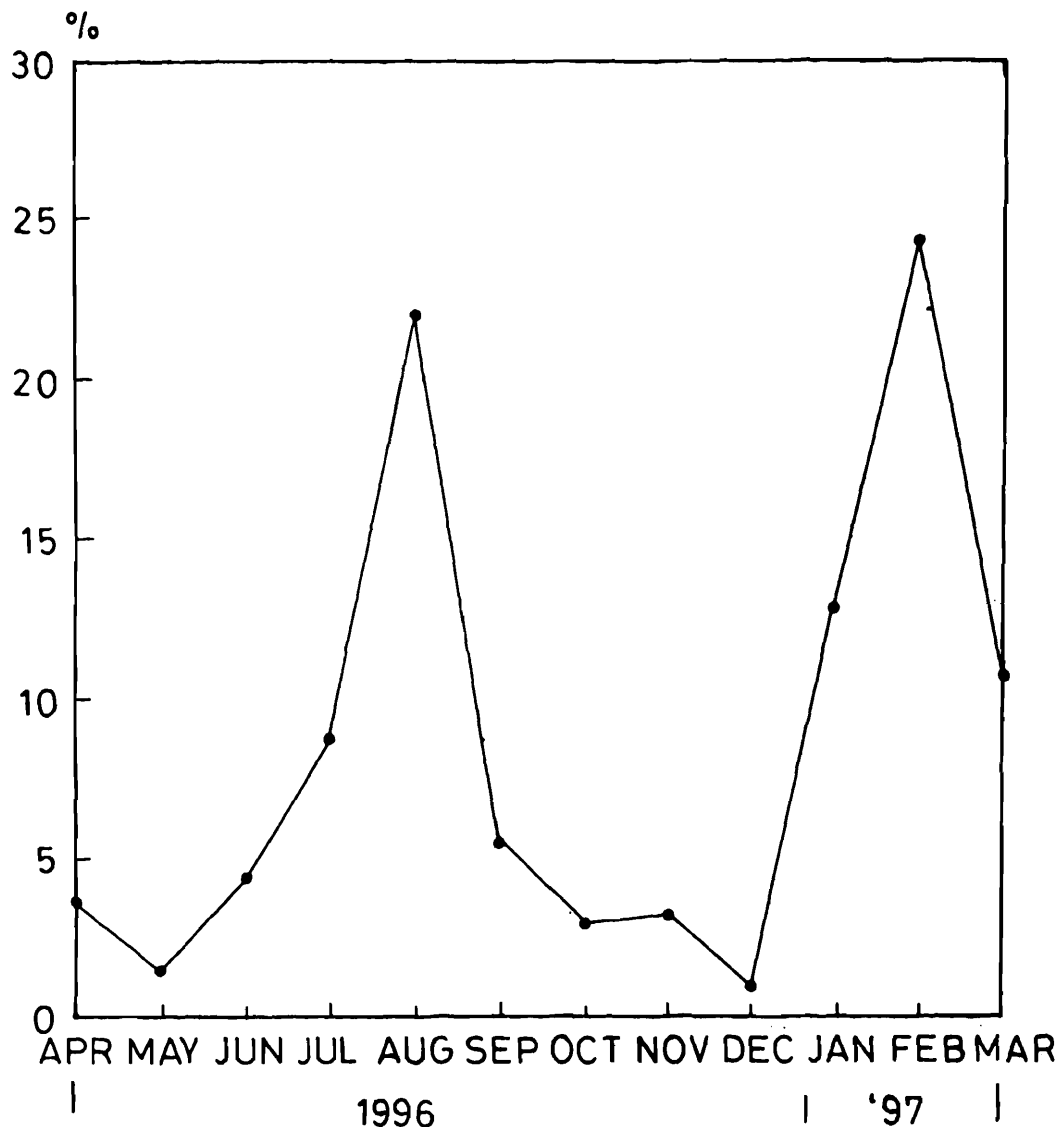


Fig. 2. : Dynamics of Collembolan population.

Salina indica occurred through out the year being specially abundant during the rainy season (July-September) with highest peak in August (16.63%), and with moderate build up (0.86%-6.41%) during rest of the year barring May and December when it was only 0.17% of the total collembolan population. The second dominating species *Lepidocyrtus* sp. (a) was also found through out the sampling period and it was maximum during February (7.97%). The *Isotomurus* sp. was dominant during February (12.13%) but it was infrequent in occurrence. While, *Cyphoderus javanus* had minimum population build up (0.17%-1.03%) (being absent in samples of October to December) but showed its peak of population during August (2.25%).

Seira cf. *indica* appeared in samples of May (0.17%) and June (3.11%) i.e., at the very beginning of the cultivation. *Sminthurides* sp. and *Isotomiella minor* comprising 2.59% and 2.0%

respectively of the total population did not show any regular occurrence throughout the sampling period (Table. 1).

DISCUSSION

The result presented here is based on the random sampling from a monoculture crop field (sugarcane) which is retained in the field for over a year. The collembolan population from this sugarcane field was represented by 18 genera involving 19 species. In earlier reports, the peak of population of Collembola was observed in the month of July-August and minimum in May by Choudhuri and Roy (1972), Mitra (1976) and Hazra (1976) in vegetational sites other than sugarcane, dealt with in this study. In the present study, Collembola exhibited the highest peak in February and the minimum in December. This difference might be due to the effect of no cultivation in the February (Mitra, 1993). The plantation at the site was done in late March when there was no undergrowth in the field. Further, no pesticides or insecticides were used throughout the period of cultivation. Eventhough, the field underwent handweeding during monsoon, the diversity of species was significant in comparison to the individual population buildup of each species.

SUMMARY

The present investigation is based on the monthly soil sampling made during April '1996 to March '97 with a view to assesing the diversity of collembolan fauna, both qualitatively and quantitatively, in a sugarcane crop-field at Nadia, West Bengal.

Extraction of 108 soil samples yielded 1154 examples of Collembola belonging to 18 genera and 19 species. The species belonged to *Salina* sp., *Lepidocyrtus* sp., *Isotomurus* sp., *Cyphoderus* sp., *Seira* sp., *Sminthurides* sp., *Isotomiella* sp. Frequency of occurrence of most of the species during this period has been infrequent barring *Salina indica* (Imms), being most predominant in the sugarcane field. Two peaks of population were observed, one during February, followed by the another in August.

ACKNOWLEDGEMENT

Authors are grateful to Dr. J. R. B. Alfred, Director of Zoological Survey of India, for providing laboratory facilities. Authors are also deeply indebted to Dr. A. K. Ghosh, former director for his constant inspiration and support for conducting this work.

REFERENCES

- Addison, J. A. 1980. Influence of individual plant species on the distribution of Arctic Collembola. In : *Soil Biology as related to land use practice* (ed) D. L. Dindal (EPA, Washington, DC) pp. 704-715.

- Alfred, J. R. B.; Darlong, V.T.; Hatter, J. S. and Paul, D. 1991. Micro arthropods and litter conservation in some North east Indian soil. In. *Advances in management and conservation of soil fauna*. (ed.) G. K. Veeresh. *et. al.* (Oxford and IBH Publsing Pvt. Ltd. New Delhi) pp. 309-320.
- Bellinger, P. F. 1954. Studies on soil fauna with special references to Collembola. *Comm. Agric. Expt. Sta. Bull.* **583** : 1-67.
- Choudhuri, D.K. and Roy, S. 1972. An ecological study on Collembola of West Bengal, India. *Rec. Zool. Surv. India.*, **66** (1-4) : 81-101.
- Christiansen, K. 1964. Bionomics of Collembola. *Ann. Rev. Ent.*, **9** : 147-178.
- Haarlov, N. 1960. Microarthropods from Danish soil, ecology and phenology, *Okios. Suppl.*, **3** : 1-165.
- Hazra, A. K. 1976. Influence of soil factors on the distribution of collembolan fauna in cultivated and uncultivated fields of West Bengal. Ph. D. thesis submitted at. Burdwan University, W.B. India.
- Hazra, A. K. 1984. Ecology of above-ground and underground insect fauna in relation to the respective floral changes of Botanic Garden grassland, West Bengal, India. *Proc. Indian. Acad. Sci. (Anim. Sci.)*, **93** (7) : 675-689.
- Hazra, A. K. and Choudhuri, D.K. 1983. A study of collembola communities in cultivated and uncultivated sites of West Bengal in relation to three major soil factors. *Rev. Ecol. Sol.*, **20** (3) : 385-401.
- Hazra, A. K. and Choudhuri, D. K. 1990. Ecology of subterranean micro and macro arthropod fauna in different degraded and polluted soil environment of West Bengal, India. *Rec. Zool. Surv. India*. Occasional paper no. **120**.
- Hazra, A. K. and Sanyal, A. K. 1996. Ecology of Collembola in a periodically inundated newly emerged alluvial island in the river Hooghly, West Bengal. *Proc. Zool. Soc., Calcutta.*, **49** (2) : 157-169.
- Macfadyen, A. 1953. Notes on methods for extraction of small soil arthropods. *J. Anim. Ecol.*, **22** : 65-77.
- Mitra, S. K. 1976. Studies on genus *Dicranocentroides* Imms (1912) (Collembola : Entomobryidae; Paronellinae) from India. *Rec. Zool. Surv. India.*, **74** (1-4) : 57-95.
- Mitra, S. K. 1995. Effects of continuous cultivations and other agronomic practices on some soil microarthropods. A unifying concept of agriculture and ecology for tropical agroecosystem. *Rec. Zool. Surv. India*. Occasional Publication No. **151**, pp. 1-177.
- Mitra, S. K.; Hazra, A. K. and Sanyal, A. K. 1977. Ecology of Collembola at Eden Gardens. Calcutta. *Ecol. Bull.* (Stockholm), **25** : 539-544.
- Sheals, J. G. 1957. The Collembola and Acarina of uncultivated soil. *J. Anim. Ecol.*, **26** : 125-136.