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Seasonal Fluctuation of Different Edaphic Microarthropod Population Densities in Relation to Soil Moisture and Temperature in a Pine, *Pinus kesiya* Royle Plantation Ecosystem*

by

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ABSTRACT. – Seasonal fluctuations of soil and litter microarthropod populations in a pine, *Pinus kesiya* Royle plantation of North Eastern India were investigated between November 1976 and November 1977. Three major groups were recognized: (a) Collembola, (b) Acarina and (c) miscellaneous. Collembola was the most abundant group and was dominated by *Isotoma trispinata* (MacGillivray). The total microarthropod density ranged from 26,800 per m^2 to 145,200 per m^2. Collembola densities ranged from 10,000 to 121,200 per m^2, Acarina densities ranged from 8,800 to 41,600 per m^2, and the miscellaneous group ranged from 1,200 to 6,400 per m^2. Soil moisture was positively correlated with total arthropod, Collembola and Acarina densities. Soil temperature was positively correlated only with Acarina. Densities of Collembola and Acarina were negatively correlated.

INTRODUCTION

Edaphic arthropods living in forest/plantation soils play a significant role in litter decomposition (Crossley, 1978). Their densities and their activity, however, vary with season. Studies to determine seasonal patterns of arthropod populations in tropical and sub-tropical forests have been few, particularly in the Indian subcontinent (Singh and Singh, 1975; Prabhoo, 1976). Little is known about the relationships between arthropod populations and the abiotic environment of Indian pine forests and plantations. The objective of this study was to determine how the seasonal abundance of major groups of soil and litter microarthropod populations might be related to soil moisture and temperature in a pine (*Pinus kesiya* Royle) plantation near Shillong (Meghalaya), North Eastern India.

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MATERIALS AND METHODS

The pine plantation studied in the present report has been described by Reddy (1981a). Monthly soil and litter samples were taken with a 5 x 5 x 10 cm soil sampler during the early morning hours from November 1976 to November 1977. On each occasion ten random samples were taken and carefully placed into the polythene bags for transport to the laboratory. Within five to six hours of collection, the samples were placed into a series of modified Tullgren funnels and processed for six to seven days. Microarthropods were collected in 80% ethyl alcohol. In addition to soil and litter samples, soil temperature was monitored at a 5 cm depth and an extra set of soil samples was collected for a gravimetric determination of soil moisture (Piper, 1944). Finally, correlation coefficients were determined between monthly mean densities of the various microarthropod groups and monthly soil temperatures and moisture readings.

RESULTS

Microarthropods from samples were grouped into the following categories: (a) Collembola, (b) Acarina and (c) miscellaneous. The latter group included Isopoda, Thysanoptera, Hymenoptera, Araneidae, Protura Diplura, Chilopoda, Diplopoda, Symphyla, Pauropoda, microcoleopteran adults and their larvae and Dipteran larvae. The Collembola being the most dominant group among the microarthropods at this site, was represented by five families (Isotomidae, Entomobryidae, Onichiuridae, Sminthuridae and Hypogastruidae) and dominated by *Isotoma trispinata* (MacGillivray). Acarina was represented by Prostigmata, Mesostigmata and Cryptostigmata being dominated by Prostigmata. Astigmata was absent. The total arthropod population consisted of 63.16% Collembola, 31.79% Acarina and 5.05% miscellaneous species.

Seasonal fluctuations of total microarthropod population ranged from 26,800 per m^2 in September of 1977 to 145,200 per m^2 in July of 1977 (Fig. 1). The density per m^2 of Collembola ranged from 10,000 in January of 1977 to 121,200 in July of 1977. Acarina ranged from 8,800 in May of 1977 to 41,600 per m^2 in November of 1977. Finally, the miscellaneous group ranged from 1200 in May of 1977 to 6,400 per m^2 in November of 1976. Collembola dominated the total population from April to October, 1977 whereas Acarina dominated during November 1976 to March 1977 and again in November of 1977. The correlation coefficient between the monthly abundance of Collembola and Acarina was negative ($r = -0.3$, $P<0.2$).

Mean soil temperature taken at the various sample times ranged from 16°C in December of 1976 to 24°C in August of 1977. Soil moisture ranged from 12% in January to 36% in July of 1977 (Fig. 1).

The correlation coefficient for microarthropods and soil moisture were positive and significant for total arthropods, Collembola and Acarina (Table 1). The correlation coefficient for microarthropods and soil temperature were significant and positive only for Acarina.

DISCUSSION

The Collembola group, which was dominated by *Isotoma trispinata,* and the Acarina group comprised 95% of the total microarthropods in this study. Similar finding have

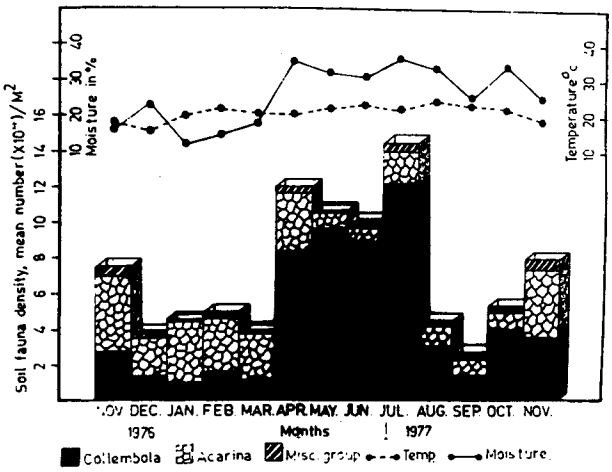

Fig. 1. Histogram showing seasonal population abundance of different soil mesofaunal groups of a pine wood (Pinus kesiya-royle) Soil (N.E. India) in relation to soil moisture and temperature.

Table 1. Correlation coefficients among various groups of edaphic microarthropods, and soil moisture and temperature in a pine, *Pinus kesiya* plantation ecosystem. (n = 13).

Variable "X"	Variable "Y"	Coefficient correlation (r)	Computed value of "t"	Level of significance
Total arthropods	Moisture	+ 0.5693	2.296	P<0.05
Collembola	Moisture	+ 0.7251	3.492	P<0.01
Acarina	Moisture	+ 0.6274	2.653	P<0.05
Miscellaneous group	Moisture	+ 0.1500	0.510	P<0.7[a]
Total arthropods	Temperature	+ 0.1295	0.433	P<0.7[a]
Collembola	Temperature	+ 0.3262	1.144	P<0.3[a]
Acarina	Temperature	+ 0.6178	2.606	P<0.05
Miscellaneous group	Temperature	− 0.2400	0.830	P<0.5[a]

a = Not significant

been reported for summer populations in tea nursery beds (Reddy, 1981b) and rose-garden soil (Mukharjii and Singh, 1970). However, Fujikawa (1970) and Price (1973) reported that Acarina was a dominant group in their studies of forest soil. Variation in population densities have also been reported (Poole, 1961; Price, 1973). Crossley and Bohnsack (1960) reported a microarthropod density of 102,00 per m^2 in a pine forest in Tennessee. Such variations both in species composition and density are probably due to differences in the physical and biological conditions of the various study sites (Im-

madate and Kira, 1964). That the physical environment is important in this regard is implied by the positive correlations between Collembola and Acarina and soil moisture and Acarina and temperature. Positive correlations between microarthropods and soil moisture have also been reported by others (Price, 1973; Nijima, 1975; Kaczmark, 1975; Choudhuri, Hazra and Roy, 1978). With the exception of Acarina, the correlations between microarthropod densities and temperature were not significant. Durant and Richard (1966) observed no correlations between density and temperature in their study.

The fact that the correlation between Collembola and Acarina were negative may indicate an antagonistic relationship between them, possibly due to predation of mites on Collembola (Nijima, 1971; Reddy, 1980).

I. trispinata which was most dominant and recorded through out the year may be designated as an indicator species of the system.

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