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Comparative Assessment on the Effectiveness of Rainfall on Soil Microarthropods Population

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Abstract: ***The Aligarh region, a semi arid zone of Western U.P. in India. Normally experiences rain in the months of July and August. Over the time due to increase in population of soil microarthropods, the region has a long dry spell from March to June with temperature rising up to 45.5^{o}C. Rains are less with monsoon having high humidity and high atmospheric temperature. This is the normal climatological condition of this region since last ten years. In the year 2008 as stated by the met office, due to global warming there were major changes in the climate. Mumbai experienced a low temperature of 6^{o}C in January and Aligarh experienced untimely incessant rains in the month of May and June. This rain brought a sudden decline in the atmospheric temperature (31.5^{o}C) as well as in the soil temperature (27.3^{o}C). This sudden change and unexpected rain had a direct effect on the population of soil microarthropods. Soil microarthropods are ecologically important in terms of soil structure, nutrient cycling and as food for others. They are however sensitive to soil contaminants, reclamation activities and quickly respond to the change in physical and chemical properties of the habitat. Environment conditions, determine survival and reproduction by individual insects but in turn insect activities alter vegetation cover, properties and community organization. A small field study highlights the importance of rainfall patterns for the growth and development of soil microarthropods in litter and sub-soil of teak plantation. The main aim of this study is to compare the effect of rainfall on the population density of soil microarthropods in the year (2008).***

Keywords: Global warming, Soil Microarthropods, Rainfall pattern

1. Introduction

Trehan (1945) was the earliest to work on Indian soil arthropods. Arthropods with in the soil and litter play vital role in maintaining soil. Fertility, health and productivity (Niwa Christine G., Peck Robert W. et. al 2001). Below ground communities have a key role in the process of humus formation in governing ecosystem functioning (Berdgett et. al 1988, Hopper et. al 2000 and Wardle et. al 2004). The importance of soil animals in the formation of humus is becoming increasingly realized. The number of different types of soil mesofauna directly or indirectly involved and the number of temporary soil and litter inhibiting species is exceedingly large.

Seasonal differences in the abundance of soil arthropods have been demonstrated by various workers (Salt 1952, Davis 1963, Erasmas and Ryke 1970, and Lasebikan 1975). They reported that microarthropods undergo enormous fluctuations in numbers. These being susceptible to small changes in micro-environment and water are a primary factor influencing population size. In tropical areas, detailed studies on seasonality of arthropods have been based mostly on insect population (Bigger 1976, Janzeen 1976 and Wolda 1978) but there is very little information on the temperate region concerning with fluctuation in microarthopods population comparing with the rainfall pattern. Rainfall being one of the most important factor for the development of soil mesofauna.

The aim of this study was to compare the effect of untimely on the densities of soil microarthropods in Teak-Community, with the hypothesis that environmental variations in two contrasting environments influence the fluctuation in the population of soil microarthropods. Furthermore, various soil abiotic factors such as soil temperature, soil moisture, pH, nitrate, organic carbon, potash were also studied comparatively.

2. Material and Methods

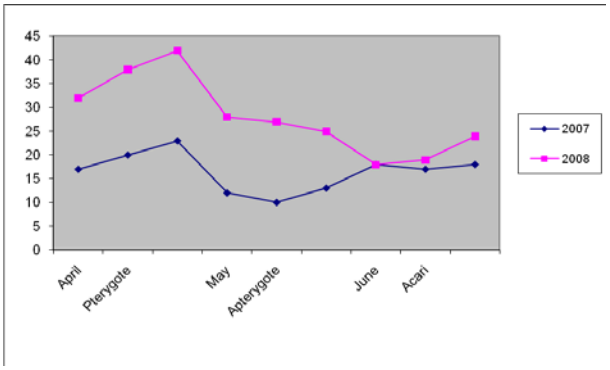
In the present study mineral soil samples were collected from depth of 5cm with the help of a corer modified by Averbach and Crossly (1960). The soil samples were collected bimonthly for a period of three months. Extraction of microarthopods was done in a modified Tullegren-Funnel. The insects collected were preserved in 70% alcohol and identified in a Steriozoom microscope. Analysis of edaphic factors such as soil temperature, soil moisture, pH, content of organic carbon, nitrate and phosphate were done by standard laboratory methods. Temperature was measured by directly inserting the soil thermometer into the soil up to the required depth, relative humidity by a Dial Hydrometer, pH by electric pH meter and soil moisture (water content) by Dowdeswell's (1959) method. Organic carbon was estimated by rapid titration method as described by Walkey and Black (1934), nitrogen content (N) by Jackson (1966) method, phosphorus content (P) by molybdenum blue test and Potash content (K) by Jackson (1966) method.

3. Result and Discussion

The site under study was a teak plantation near the university polytechnic along the road. Though the trees gave a monocle forest appearance but the litter deposition was negligible. Reasons are very clear as the leaves are picked up by the local people for their personal use secondly the plantation is within the campus, the area is cleaned daily by the conservancy people and is also used by students as a shortcut route, thirdly being a part of the horticulture department the plantation floor is mechanically titled annually. The university campus is

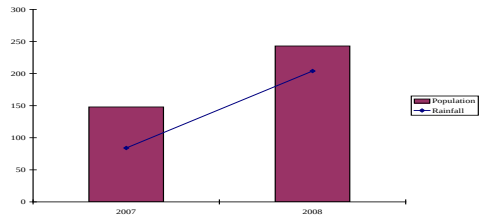
lush green full of big old trees, shrubs and gardens as a result the population of birds is also very rich. Peacocks, pigeons, crows and eagles are in large number and they utilize these trees and shades as a safe refuge. Therefore we were unable to collect substantial amount of litter for insect extraction. So, we collected only the soil samples at a depth of 5cm.

The insectan population collected during the period (April-June) consisted of numbers of the order: Isoptera, Coleoptera, Diptera and Hymenoptera both adult and larval forms of these pterygote groups. The apterygote insects belonged to order Collembola and Diplura. Acarina were also collected in good number. On making a comparative study of the data collected in the previous year within the same stipulated periods when the rainfall was as usual very less during April to June, population of soil microarthropods wes relatively less. The total number of insects in 2007 was 189, whereas in 2008 the total insecton population was 243.



Compression between soil microarthopods population in 2007-08 at Teak plantation

The edaphic factors also varied during this period. When the moisture content is high, the accumulation of organic matter, due to decomposition of dead animals and plant material is also on a higher side. The phosphate and potash content also increase the soil fertility along with water. Hence the collection of a good population of soil microarthropods in the period of heavy rainfall indicates that they increased the soil health along with nutrient cycling as we are able to collect adult and larval forms from the soil samples. Our observations also supported by Coulson S.J. Sanna – Maria (2001). The occurrence of Acarina from the soil samples during their period also indicates a good chain in the subsoil ecosystem. Our main prediction was that there would be a positive relationship between micro arthropod diversity, abundance and high rainfall.



Correlation between rainfall and soil microathropods population in 2007 and 2008 at Teak plantation

Months / Edaphic factor	April		May		June	
	2007	2008	2007	2008	2007	2008
Soil temperature (^{o}C)	31	34	32	30	33.5	28.5
Relative Humidity(%)	40	31	36	32	42	45
Organic carbon (%)	0.23	0.78	0.24	0.66	0.35	0.69
Soil moisture (%)	5.10	0.30	4.98	0.81	4.81	2.56
Nitrate (ppm)	0.83	0.97	0.84	0.89	0.98	0.84
Phosphate (ppm)	6.0	10.8	7.5	10.4	7.2	9.0
Potash (ppm)	109	242	122.5	238	110.5	233

Comparison between edaphic factors of 2007 to 2008 at Teak plantation

The microarthropod population was higher at the time of sudden rainfall may be due to a number of reasons:

1. Soil Water Content (SWC) was very high due to heavy rainfall.
2. Sudden decrease in soil temperature and atmospheric temperature.
3. The soil became fertile due to accumulation of soil organic matter, nitrogen content. Phosphate and potash contents.

Soil water content and soil temperature indicate greater sensitivity of these soil microarthropods. According to Singh (1970) that there is a certain correlation between moisture content and the population dynamics of soil micro arthropods. We also observed a positive correlation between soil microarthropods and population growth of soil arthropod (Jain et. al 1998). Samiuddin and Haider (1999) also reported a relation between population dynamics of soil mesobiota and soil temperature IPSA Bandhopadhya et al (2002) obtained a relationship between microarthropod population and soil temperature. Hina Parwez et. al (2004) confirms this hypothesis that the temperature and moisture content play a significant role in regulating the population density of soil mesofauna our findings are in accordance with Maria (2005) who suggested that drought decreased soil water content and increased soil temperature hence decreased in microarthropod species. Won Ti Choi et. al (2006) reported a modeling study of soil temperature and moisture effected population dynamics of Paronychiurnus kimi (Collembola) suggesting that soil moisture is a major limiting factor on field population of P. kimi. Our finding supports Malmstron A. (2008) who studied the temperature tolerance in soil microarthropods and confirms a positive relation. The occurrence of the higher density of soil microarthropods during sudden rainfall may be due to input of organic matter which is known to enhance the population of soil microarthropods. (Pimented and Warneke, 1989). The result obtained in this study confirms to those of Alfred & Darlong (1982), William et. al (1987), Vreeken – Buijs M.J. et. al (1994) and Filser, J.I. (2002). It is evident from the present study that the rainfall

and moisture content of soil play a significant role in regulating the population density of soil microarthropods.

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