

## Circannual Variation and Interrelationship of Edaphic Factors With the Soil Micro Arthropods in Agro Forestry Habitats



### Biology

**KEYWORDS :** soil microarthropods, edaphic factors, biodiversity.

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### ABSTRACT

*Soil and litter habitats have become recognized repositories for biodiversity. They are also dominated by some of the smallest animals the microarthropods. They play a vital role to evaluate the soil health and make them economically viable as well as environmentally sustainable. Economic viability and soil degradation are major issues in agro forestry of western planes of U.P. in India. Soil microarthropods are ecologically important in terms of soil structure, nutrient cycle and as food for others. The objective of this study was to identify the patterns of diversity in a below ground community of micro arthropods in agro forestry in a semi arid zone of western U.P. in India. The extraction of soil micro arthropods was done by modified Tullegren funnel and analyses of edaphic factors such as- soil temperature, soil moisture, organic carbon, available nitrogen, phosphate were done by standard laboratory methods. The result showed that the total number of microarthropods obtained from this site showed an irregular trend of fluctuation during the investigation period. Apterygote population dominated by Collembola and Diplura were as Pterygote population was dominated by order-Diptera, Isoptera, Hymenoptera and Coleoptera. Among edaphic factors- Soil temperature varied between 15 °C to 34 °C, Soil moisture 0.30% to 4.27%, Organic carbon 0.59 to 0.79% and available nitrogen varied between 226.8 to 253.4 ppm. This study strongly suggests that edaphic factors are responsible for the diversity of microarthropod population.*

### INTRODUCTION:

Soil micro arthropods are considered to play an important role in the nutrient turnover of soils. although the contribution of micro arthropods to the total nutrient turnover is marginal (Verhoef and Brussaard 1990), it is assumed that soil micro arthropods have an indirect effect on soil nutrient due to their ability to fragment decaying organic material and thereby increase its ability for micro organisms (Peterson and Luxton 1982). They also show aggregated distribution (Usher M.B. 1976), it should be possible to relate their population to edaphic factors. soil arthropod population have been related in numerous studies to various edaphic factors (Stanton N.L. 1979 Coulson S.J. Sanna - Maria (2001). The amount and depth of edaphic factors affect the population density of soil micro arthropods (Asraf M. 1971, Wong M.H. et al 1977, William block 1981 and Persson T. 1989). The purpose of this study is to investigate the relation of edaphic factors to soil micro arthropods in an agro forestry habitat.

### 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 crossley (1960). The soil samples were collected bimonthly for a period of three months. Extraction of microarthropods was done in a modified Tullegren-Funnel. The insects collected were preserved in 70% alcohol and identified in a stereozoom 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 inciting 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.

### RESULT AND DISCUSSION

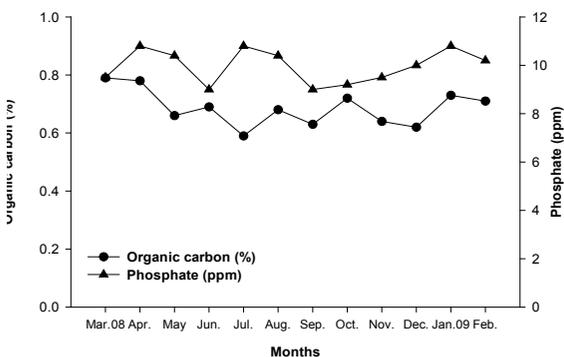
Plantations are a part of Agro forestry schemes planned by the government to serve the ecosystem and create a green belt. The site of our experiment was a Teak plantation (*Tectona grandis*), our campus has teak plantation at two different locations along-

side various departments. The idea was to beautify the campus as well as enhance the fertility of soil. The teak leaves are fairly big in diameter, but the leaf fall is annual. The litter deposition is negligible as the leaves are picked up by local residents as they use them as fuel. Humus formation is also negligible as the leaf deposition is negligible. The influence of litter and humus has been studied by Walwork (1959) who observed the influence of litter and humus on soil mites. The population of Pterygotes from this site comprised of Isoptera, Diptera, Coleoptera and Hymenoptera. The presence of Pterygotes is also attributed to the edaphic factors and atmospheric factors. There is either positive or negative correlation between temperature, moisture, pH, organic carbon and available nitrogen. In case of Isopterans Rajagopal (1983) stated that the population density and fluctuation in cast composition with seasons vary from species to species. The Apterygote and Acari population was quite variable. We were not able to collect the collembolans in very large numbers in any month of year as compared the catch of Acari was very good throughout the year. When we compare the population with the edaphic factors it becomes clear that through the soil temperature and moisture was suitable for the microarthropod population still they were not collected in large numbers. Reasons we tried to analyze. According to Hattenschwiler Stephan et al. (2005) the biodiversity and litter decomposition in terrestrial ecosystems shows empirical and theoretical evidence for the functional significance of plant litter diversity and the extra ordinary high diversity. When there is rich plant litter on the floor the decomposer community will be on a higher side.

The population of insects and Acari from the investigation site all were statistically proven to be falling in line with the observations of the previous workers. The low and high of the population is also interrelated with the edaphic factors. Among the edaphic factors studied temperature showed a marked variation with the change of season ranging between 15°C to 34°C. Physical factors like temperature, moisture being interlinked are perhaps inseparable in natural conditions. Choi Ti Won (2006) postulated a modeling study of soil temperature and moisture effects on population dynamics of *Paronychiurus Kimi* (Collembola; Onychiuridae) and suggesting that soil moisture is a major limiting factor on field population of *P. Kimi*. In the present investigation, it may be noted that direct influence of temperature on distribution pattern is difficult to evaluate because in this

study the insects belong to different orders in which Collembola and Diptera is positively correlated with the moisture as compared to other members of the insectan population.

The soil moisture is an important factor governing the survival of the soil biota. The moisture content of soil exhibited a wide range of variation (minimum 0.30% and maximum 4.27%) at this site. Increases in moisture content promote the growth of fungi which is the chief food for Termite, Collembola and Oribatid mites. Humidity was the most important factors determining distribution, abundance and survival of soil Collembola in the tropical forest (Wiwatwitaya D. and Takeda H. 2004). The relationship between the insects both the Pterygote and Apterygote with Acarina collected in the study was statistically analyzed. The correlation and regression between Apterygote and Pterygote with soil moisture and soil temperature was highly significant in this study. The organic carbon content of the soil varied between 0.59 to 0.79% and exhibited a strong positive correlation with insectan population except Dipterans. The increase in population with the increased organic matter in soil has been reported by Alfred and Darlong (1982) and William et al. (1987). Another important edaphic factor is phosphate which is present in both organic and inorganic form in the soil. In our findings, the phosphate present in the soil varied between 9.0 to 10.8 ppm throughout the period of investigation at this site. It shows positive correlation with the population of soil microarthropods except Coleoptera and Diptera. In our result, it might be suggested that relation between the soil phosphates were not regular perhaps due to the fact that all of the phosphate in the soil was not available to the living system. Our findings support Choudhury and Roy (1972) who observed either positive or negative correlation of collembolan population with phosphate content. In our findings it might be that phosphate as single factor did not exert any significant influence on the population but it in combination with any other factor might contribute to the fluctuation of other factors. Next important edaphic factor was available nitrogen which varied between 226.8 ppm to 253.4 ppm and there was a slight increase with onset of monsoon. They show the positive correlation with insectan population except in Coleoptera. However there are reports that increased nitrogen content in the soil detritus to the population of soil arthropods namely Collembolans and coleopterans. (Bleger and Curry 1980). According to Kunhalt (1963), nitrogen acts as an attractant for the arthropods. In conclusion, it is evident from the present study that the edaphic factors play a significant role in the regulating of population density of soil micro arthropods.

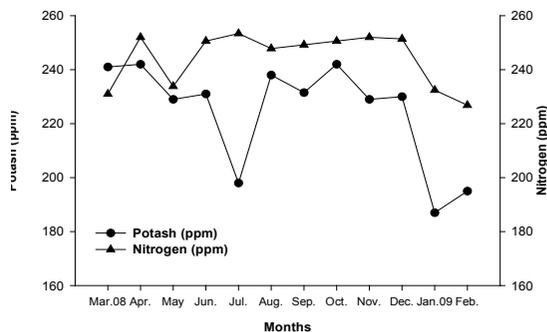


(a) Correlation between organic carbon and phosphate at teak plantation.

|       |                   |              |
|-------|-------------------|--------------|
| Order | Variation ratio F |              |
|       | Between Columns   | Between Rows |

|             |         |      |
|-------------|---------|------|
| PTERYGOTE   |         |      |
| Isoptera    | 504.02  | 1.53 |
| Diptera     | 259.02  | 2.64 |
| Coleoptera  | 195.40  | 2.21 |
| Hymenoptera | 1165.25 | 1.12 |
| APTERYGOTE  |         |      |
| Collembola  | 818.15  | 3.25 |
| Diplura     | 1134.52 | 1.10 |
| ACARI       | 720.32  | 3.84 |

Table. Significance of population fluctuations of various insect groups as determined by ANOVA test during 2008-09 at teak plantation.



(b) Correlation between potash and nitrogen at teak plantation

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