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Effect of Edaphic Factors on the Population Density of Soil Microarthropods in Agro Forestry Habitat

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Abstract: *Soil fauna is a group of animals which spend all or only part of their life cycle in soil. They are called Soil micro arthropods. They play a significant role in the breakdown of soil organic matters to access the nutrient reservoir process.They are involved in soil formation and maintenance of soil structure. The abundance of soil microarthropods is greatly affected by climate, intensive agriculture and different type of enviormentalfactors (Banerjee S.(1976).The most important variables influencing micro arthropods communities are soil temperature, soil Ph and organic matter (Klironomos and Kendrick 1995).The objective this study was to know the effect of edaphic factors on the population density of soil microarthropodsin 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 microorthopods obtained from this site showed an irregular trend of fluctuation during the investigation period. Apterygote population dominated by Collemola and Diplurawhere asPterygote population was dominated by order-Diptera, Isoptera, Hymenoptera, Hemiptera and Coleoptera. Among edaphic factors- Soil temperature varied between 14˚Cto 29˚C, Soil moisture 0.68 to 3.79 % , Organic carbon 0.62 to 0.88% and available nitrogen varied between 211.5 to 278.0 ppm. This study strongly suggests that no single factor is responsible for the diversity of microorthopod population but all factors have a cumulative effect and soil microorthopods contribute in the healthy soil so they are potentially valuable for monitoring the soil health.*

1. INTRODUCTION

The earliest work on the Indian soil arthropods was done by Trehan (1945). 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 (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 1963and 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 (Janzeen 1976 and Wolda 1978) but there is very little information on the temperate region concerning with fluctuation in microarthopods population comparing with the edaphic factors.

In the present study an attempt has been made to study the effect edaphic factors on the population densitity of soil microarthropods in agro forestry habitat (Teak-Community).

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 twelve 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, organic carbon content, 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

Plantations are a part of Agroforestry schemes planned by the government to serve the ecosystem and create a green belt. The site of our experiment under the agroforestry was Teak plantation (*Tectonagrandis*). The population of pterygotes from this site comprised of Isoptera, Diptera, Coleoptera and Hymenoptera. 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. 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 analyse. 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 well be on a higher side. The population of insects and Acari from the plantation 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.

As the role of edaphic factors it might be assumed that the factors studied in this study exerted significant or insignificant effect.Among the edaphic factors studied temperature showed a marked variation with the change of season ranging between 14^0C to 29^0C. Physical factors like temperature, moisture being interlinked are perhaps inseparable in natural conditions. HaimiJari et al. (2005) studied the impact of Co_2 and temperature on the soil fauna boreal forest. Similarly Choi Ti Won (2006)postulated a modeling study of soil temperature and moisture effects on population dynamics of *ParonychiurusKimi* (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 shade of teak trees reduces the rate of evaporation and hence the moisture allowed the presence of Apterygote and Pterygote insects with Acarina throughout the year. So, this was the reason for abundance of Apterygote and Pterygoteinsects.

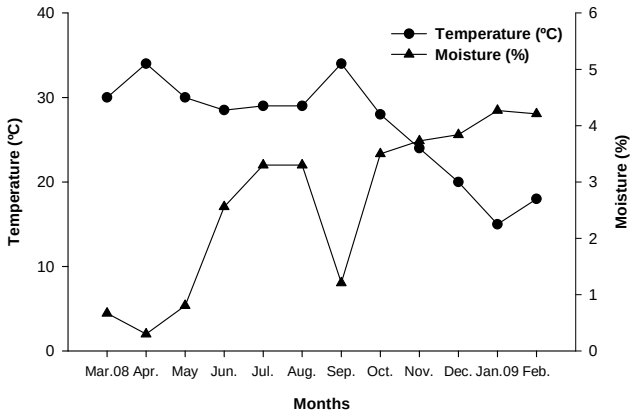
The moisture content of soil exhibited a wide range of variation (minimum 0.68% and maximum 3.79%) at this site. Increase in moisture content promotes the growth of fungi which is the chief food for termite, Collembola and Oribateid mites. Humidity was the most important factors determining distribution, 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 analysed. The correlation and regression between Apterygote and Pterygote with soil moisture and soil temperature was highly significant in this study.

The value of soil pH throughout the year from the sampling site remained acidic. The insectan population was maximum when the pH ranged between 7.4 to 7.7. According to Davis (1963) pH variation can not be separated from that of organic carbon and porosity of soil.

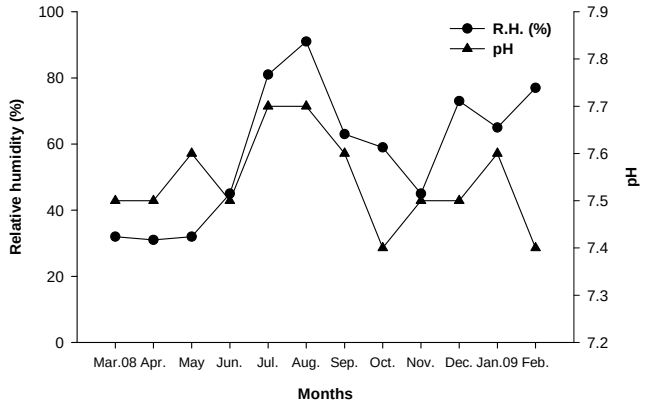
Therefore pH had very little or no direct effect on the population of soil microarthropods but it might contribute to the fluctuation of population by indirectly influencing vegetation and other physio-chemical properties of the soil.

The organic carbon content of the soil varied between 0.62% to 0.88% and exhibited a strong positive correlation with insectan population except Dipterans. This correlation should be under the influence of dry or moist conditions because soil moisture determines the density and type of vegetation, which in turn contributes the collection of organic matter in the soil. The organic matter is the source of food for the organism but it also controls the living space for the soil microorganism. The increase in population with the increased organic matter in soil has been reported in past byAlfred 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 7.8 to 11.2 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.



(a)Correlation between soil temperature and soil moisture at teak plantation



(b)Correlation between relative humidity and pH at teak plantation

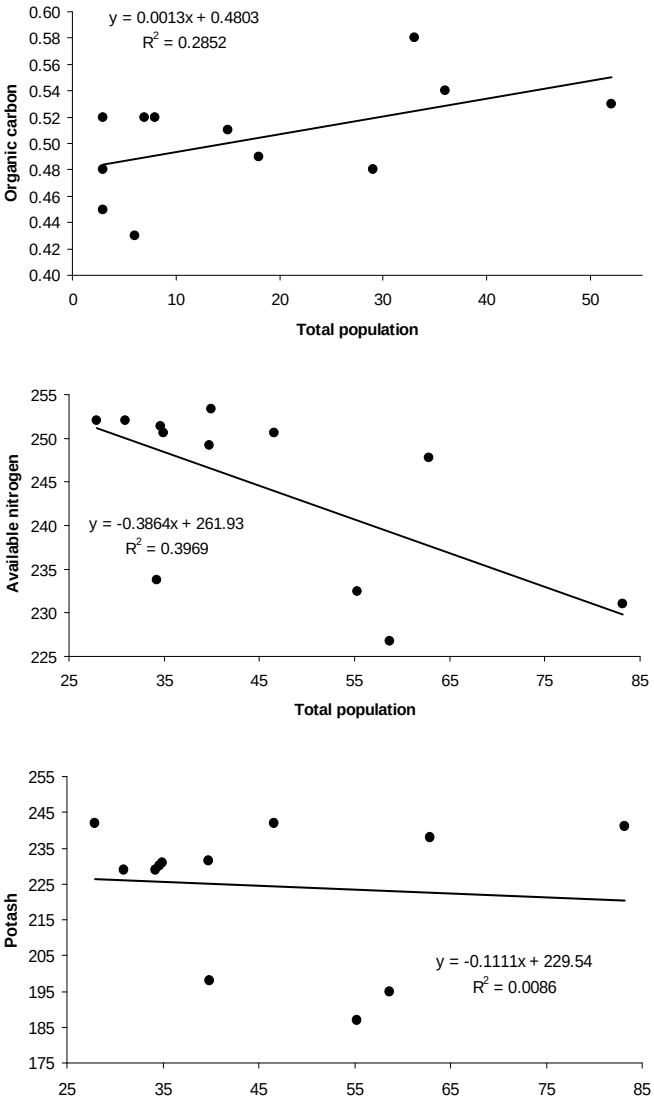
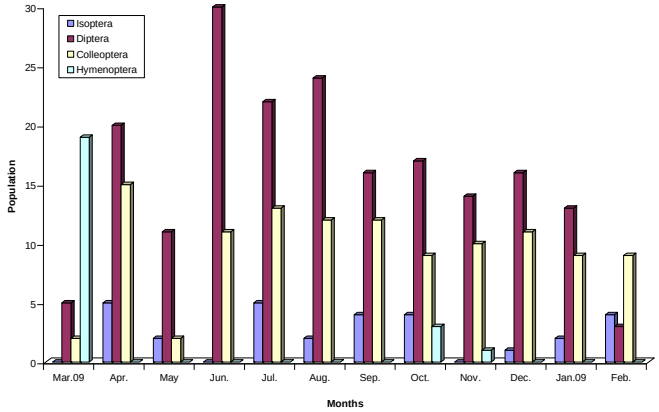


Fig. 1: Regression analysis of total population of insectan of mineral soils with (a)organic carbon, (b) available nitrogen and (c) potash at teak plantation



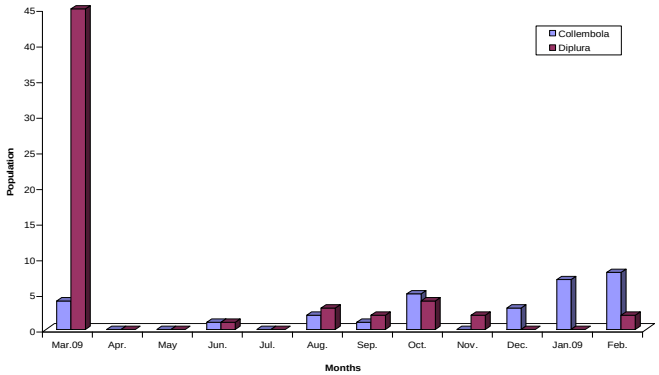


Fig. 2: Population fluctuation ofPterygoteand Apterygote insects from the site during 2009-10 at teak plantation.

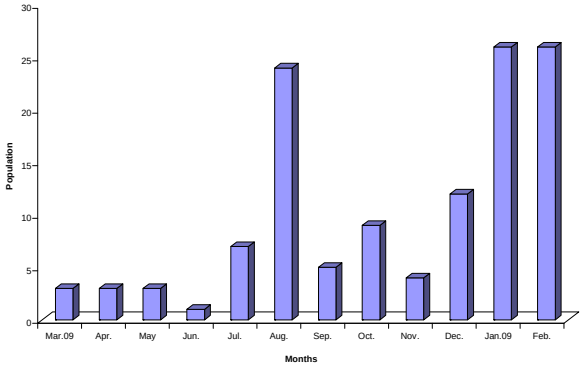


Fig. 3: Population fluctuation of Acari insects from the site during 2009-10 at teak plantation.

The concentration of available nitrogen in sampling site varied between 211.5 ppm to 278.0 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 Collembola coleopterans. Dipterans also high levels of cattle slurey are toxic for these organisms (Bloger and Curry 1980). In conclusion,it becomes clear from the present study that

edaphic factors play vital role in regulating the population density of soil micro arthropods.

REFERENCES

[1] Averbach, S.I. and Crossley, O.A. (1960): A sampling decree for soil microarthropods. *Acarologia*, 2: 279-287

[2] Banerjee S.(1976) Micro arthropods and nitrate content of *soil*.*ActaArachnol* 26(1):47-50

[3] BlogerT.and Curry F.P. (1980) effects of cattle slurry on soil arthropods in grassland.Pedobiologia 20;246-253

[4] Chaudhuri, D.K. and Roy S. (1972). An ecological study on Collembola of West Bengal, India, *Ric. Indian Museum India***,** 66(1-4); 81-101.

[5] Choi Won Ti, Moorhead D.L., Neher D.A. and RyooMeen Ti (2006). A modeling study of soil temperature and moisture effect on population dynamics of *ParonychiousKimi* (Collembolan)

[6] Darlong, V.T. and Alfred J.R.B. (1982). Differences in arthropods population structure in soils of forest and Thum sites of North East India. *Pedobiologia*, 23: 112-219

[7] Davis B.N.K. (1963): A study of micro arthropod communities in mineral soil near Korby Netherland. J. Animal Ecol. 32(1); 49-71.

[8] Dowdeswell, W.H. (1959): Practical Animal Ecology. *Methuen and Co. Ltd*. London.

[9] HaimiJari, LaamanenJarkko, PenttinenRitva and Raty Mika (2005). Impacts of elevated CO2 and temperature on the soil founa of boreal forests. Applied soil ecology, 30(2); 104-112.

[10] Jackson, R.M. (1966): Life in the soil William Dower and Sons Ltd. London &Beccles.

[11] Klironomos,J.N. and Kendrick,W.B.(1995) stimulative effects of arthropods on endomycorrhizas of sugar maple in the presence of decaying litter.*Funct.Ecol*.,9,528-530

[12] Lasebikan, B.A. (1973): The effect of clearing in the soil arthropod of a Nigerian Rain forest. Biotropica: 7(2); 84-85.

[13] Niwa, C.G., Robert W. Peck and Torolf R. Torgvsen (2001) Soil, litter and course woody debris habitats for arthropods in Eastern Oregon and Washington. Northwest Science; 75: 141-148.

[14] Rajagopal, D. (1983). TERMITES. Applied soil biology and Ecology.*Sharda Publishers*, Banglore, 183-225.

[15] Salt G. (1952): The arthropod population of the soil in some East African Pastures. Bull. Ent. Res. 43: 203-220.

[16] Stephan Hattenschwiler, Alexi V. Tiunov and Stefan Scheu (2005).Biodiversity and litter deposition in terrestrial ecosystem. *Ann.Rev.Evol.Syst.* 36; 191-218.

[17] Trehan, K.H. (1945): Some observation of the soil sauna of cotton fields at Lyallpah. Proc. Ind. Acad. Sci. 21(3); 191-201.

[18] Walkey, A. and Black I.A. (1934). An examination of the degtjreff method for determining soil organic matter and a proposed modification of the chromatic acid titration method. *Soil Sci*., 37: 29-38.

[19] Wardle, D.A. Nicholson, K.S., Bonner, K.I. and Yates, G.W. (1999). Effects of agricultural intensification on soil associated arthropod population dynamics community structure, diversity and temporal variability over a seven year period. Soil Biology and Bio Chemistry, 31; 1691-1706.

[20] William, P.M., Silva S. and Whiteford W.G. (1987). Diurnal activity patterns and vertical migration in desert, soil microarthropods. *Pedobiologia*, (3); 65-71.

[21] Wiwatwitaya D. and Takeda H.(2004) Seasonal changes in soil arthropod abundance in the dry evergreen forest of north-east Thailand ,with special reference to collembolan communities. *Ecological Research.*