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# Effect of Some Edaphic Factors on the Population Diversity of Soil Mesofauna in Grassland area of Northern Indian state of Uttar Pradesh (India)

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## Abstract

Soil mesofauna abundance and diversity are regulated by edaphic factors. The effects of some environmental factors on abundance and distribution of these soil mesofaunal population is known, but how scale influences spatial distribution is less well evaluated, particularly at the community level. However, given that many soil insects are pests or beneficial natural enemies, and that collectively they play a role in soil processes such as degradation, mineralization etc. The abundance of soil mesofauna is greatly affected by climate, intensive agriculture and different type of environmental factors (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 diversity of soil mesofaunal population 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 Soil mesofaunal communities are influenced by some selected factors which also influence above and below ground animals. Soil temperature, moisture and pH are the principal factors affecting the diversity and distribution of all the soil animal groups.

**Keywords:** Mesofauna, edaphic factors, Soil temperature, Organic Carbon

## INTRODUCTION:

Soil fauna is essential for ecosystem dynamics as it is involved in biogeochemical processes, promotes nutrient availability and affects the animal communities. There is increasing research interest and focus on the roles of soil mesofauna in above and belowground processes and their interactions (Johnson et al., 2013) there remains a considerable lack of knowledge on the abundance and distribution of soil insects at an individual and a community level. It is known that there is natural stochasticity in insect abundance over short timescales, linked to their high reproductive rate and environmental factors (Schowalter, 2011) such as temperature, moisture, food availability and soil texture (King, 1939) and that abundance and distributions can vary even between even closely related species (Benefer et al., 2012). Therefore, Mesofaunal population abundance and distribution are regulated by several biotic and abiotic factors and their interactions. Among abiotic factors, temperature and humidity stand out as the most important ones constraining abundance and distribution of mesofauna. Furthermore, it is well documented that abiotic factors, especially temperature, regulate the ecology of mesofaunal communities. The present study explores part of the effects of edaphic factors on mesofaunal abundance and provides remarkable insights on the influence and the direction of the impact that edaphic factors have on mesofaunal populations. There is a great diversity of studies included that goes across several insect taxa and ecosystems reflecting the magnitude of the effects of the physical environment on mesofaunal populations in grassland. Grassland ecosystems cover 30% to 40% of the earth's terrestrial surface, provide critical habitat for large numbers of species, and support extensive grazing economies on every continent except Antarctica (Coupland 1979, Samson and Knopf 1996). Grasslands that are used to support grazing activities are renewable natural systems, requiring management practices that capitalize on appropriate natural feedbacks and constraints (Fuhlendorf and Engle 2001). In the present study, an attempt has been made to study the effect edaphic factors on the population diversity of soil mesofauna in grassland area.

## MATERIAL AND METHODS:

In the present study, mineral soil samples were collected from two different depths of 0-5cm and 5-10 cm 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 soil mesofauna 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.

## RESULT AND DISCUSSION:

The diversity of soil fauna in grassland soils is very rich. In general, the mesofaunal population is the most abundant in terms of both number and biomass. As in all ecosystems, soil organisms are classified by width into macrofauna (greater than 2 mm diameter), mesofauna (between 100 mm and 2 mm diameter) and microfauna (less than 100 mm diameter). The work carried out in a stipulated period for the assessment of relationship of abiotic factors with soil mesofaunal population. The samples collected from the grassland yielded insects and mites. The total numbers of insects and mites show the irregular fluctuation during the sampling period. This site was under the supervision of land and garden department department of university, A.M.U. Aligarh. The total mesofaunal population comprises Pterygote, Apterygote and Acari. The population of pterygotes from this site comprised of Isoptera, Diptera, Coleoptera and Hymenoptera. There is either positive or negative correlation with the edaphic factors.

Tripathi G. at al (2007) 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 mesofaunal population still they were not collected in large numbers. Reasons we tried to analyze. The population of insects and Acari from the grassland 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 15˚ C to 32˚ C. Physical factors like temperature, moisture being interlinked are perhaps inseparable in natural conditions. Parwez H. et al. (2014) studied the impact of Co2 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 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 moisture content of soil exhibited a wide range of variation (minimum 0.49% and maximum 4.12%) 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 7.3 to 7.8. 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 mesofaunal population but it might contribute to the fluctuation of population by indirectly influencing vegetation and other physio-chemical properties of the soil. Similar findings were reported in our earlier studies (Sharma N. and Parwez H. 2015, 2017). The organic carbon content of the soil varied between 0.58% to 0.94% 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 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 6.9 to 13.2 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.

The concentration of available nitrogen in sampling site varied between 210.5 ppm to 284.0 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 diversity of soil mesofauna.

## CONCLUSION:

It is generally observed that the physical and chemical factors of the soil have direct or indirect effect on the population of soil mesofauna. It is well established that Collembolans and Diplurans are a strong pillars of decomposition community. The grassland site had greater pterygotan population also with the predominance of collembolans in one or two months. In this work, the assessment of the insectan population of the soil and also the interrelationship of the population with different edaphic factors revealed that no single factor is responsible for the mesofaunal population but all factors have cumulative effect.

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**Table1:** Pearson Correlation between mesofaunal population and edaphic factors during the sampling year.

| Soil Mesofauna / Edaphic factors | Pterygote | | Apterygote | | Acari | |
|---|---|---|---|---|---|---|
| | **0-5cm** | **5-10cm** | **0-5cm** | **5-10cm** | **0-5cm** | **5-10cm** |
| Soil Temperature | .240 | **.917**** | .389 | **.793**** | -.472 | .465 |
| Soil Moisture | .356 | .059 | .072 | .496 | .276 | **.776**** |
| Relative Humidity | -.139 | -.169 | -.107 | -.207 | -.529 | -.094 |
| pH | -.444 | -.264 | -.324 | .036 | -.271 | .000 |
| Organic Carbon | .436 | .226 | **.630*** | .137 | -.306 | -.133 |
| Organic Matter | .428 | .228 | **.620*** | .138 | -.309 | -.122 |
| Available Nitrogen | .032 | .155 | .081 | .395 | .098 | .174 |
| Phosphate | -.193 | -.254 | -.473 | .135 | -.168 | -.057 |
| Potassium | -.182 | .161 | -.124 | .107 | -.276 | -.077 |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

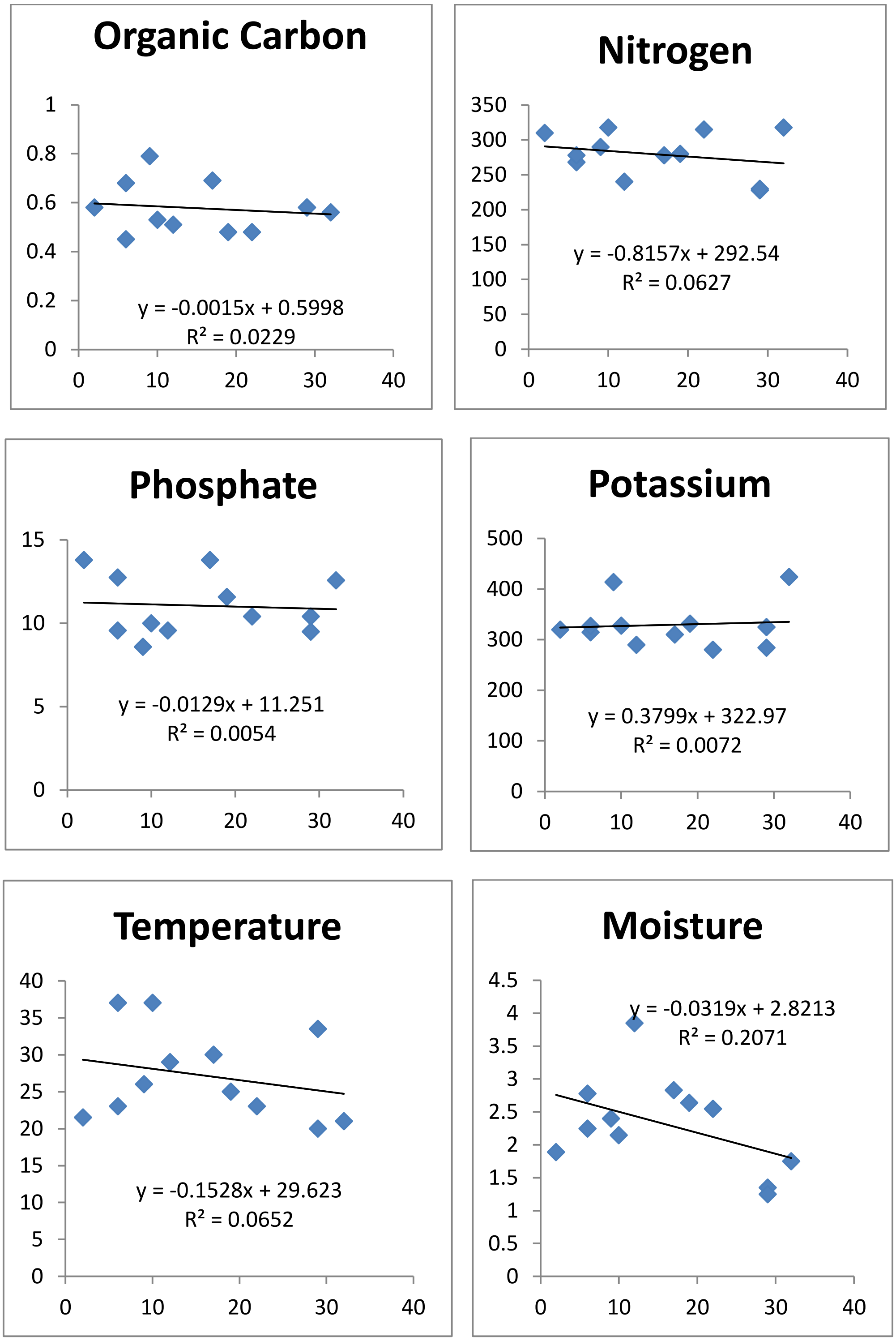


**Figure1:** Regression analysis of total population of soil mesofauna with edaphic factors at experimental site.

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