Biospectra : ISSN : 0973-7057, Vol. 15(1), March, 2020, pp. 359-364
An International Biannual Refereed Journal of Life Sciences

44(AS).
Animal Science

ISSN : 0973-7057

Int. Database Index: 663 www.mjl.clarivate.com

Importance of mesofauna in soil

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Received : 05th February, 2020; Revised : 22nd February, 2020

Abstract : Soil may be a large reservoir of varied organisms which together help in regulation of varied biogeochemical cycles. Soil biodiversity is comprised of the organisms that spend all or some of their life cycles within the soil or on its immediate surface (including surface litter and decaying logs). The soil mesofauna are a crucial a part of "> a part of terrestrial ecosystems and a connecting link between microfauna and macrofauna which together form an important part of soil decomposer community. They perform and regulate a major proportion of the organic matter transformations and nutrient fluxes in terrestrial ecosystems. The fluxes and flows are regulated to large extent by Soil mesofauna, being considered as 'Ecosystem webmasters'. The disturbance or perturbation of soils usually alters microarthropod numbers like tillage, fire, and pesticide application typically reduces populations but recovery could also be rapid and microarthropod groups respond differently.

Keywords : Acari, collembola, mesofauna, soil microarthropods

INTRODUCTION

The word Human itself has its roots within the Latin, Humus', the organic matter in soil.[1] Animal members of the soil biota are abundant and diverse. The array of species is extremely large, including representatives of all terrestrial phyla. Many groups of species are poorly understood taxonomically, and details of their explanation and biology are unknown. The easiest and most generally used system for classifying soil organisms is to group them by size (body width) into three main groups: macrobiota, mesobiota and microbiota.[2,3] Body width of fauna is also related to their microhabitats. The microfauna (protozoa, small nematodes) inhabit water films. The mesofauna inhabit air-filled pore spaces and are largely restricted to existing ones. The macrofauna, in contrast, have the power to make their own spaces, through their burrowing activities, and just like the megafauna, can have large influences on gross soil structure.[4-6] The vast range of body sizes among the soil fauna suggests that their effects on soil processes happen at a variety of spatial scales.[7,8] "Ecosystem engineers," earthworms, termites, or ants, alter the body of the soil itself, influencing rates of nutrient and energy flow. "Litter transformers," microarthropods, fragment decomposing litter and improve its availability to microbes. "Micro-food webs" include the microbial groups and their direct microfaunal predators (nematodes and protozoans). These three levels operate on different size, spatial, and time scales.

HABITAT, FUNCTION AND DISTRIBUTION OF MESOFUANA (MICROARTHROPODS)

A soil mesofauna taxon (group) also mentioned as microarthropods is an invertebrate group (aptera) found within terrestrial samples with the size ranging from 0.1-

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2mm which include organisms/orders like Acari, Collembolans, Proturans, Diplurans, Symphellids, Enchytriaeds etc. Large numbers of the microarthropod group (mainly mites and collembolans) are found in most sorts of soils. A square metre of forest floor may contain many thousands of people representing thousands of various species. Microarthropods have a big impact on the decomposition processes within the forest floor and are important reservoirs of biodiversity in forest ecosystems. Soil microarthropods are significant reservoirs of biodiversity but it's not clear exactly how diverse they'll be. Estimation of species richness may be a difficult problem for several sorts of soil organisms (fungi, bacteria, nematodes, for instance, also as micro arthropods). Unlike the macro arthropods, the mites and collembolans have little or no effect on soil structure. Their dimensions allow them to use existing spaces in soil structure thus are often also termed as, Interstitial animals. Even the massive, soft-bodied members of the mite group Prostigmata don't seem to make their own passageways. Some litter-feeding species do burrow into substrates like petioles of decaying leaves and make tunnels, but these haven't any direct effect on soil structure intrinsically. The microarthropods resemble the microfauna in this characteristic. Microarthropods also form a crucial set of linkages in food webs; many microarthropods prey on fungi and nematodes, thereby linking the microfauna and microbes with the mesofauna. Microarthropods successively are prey for macroarthropods like spiders, beetles, ants, and centipedes, thus bridging a connection to the macrofauna. Even a number of the smaller megafauna (toads, salamanders) feed on microarthropods, thus, it's essential to review soil as an ecosystem.

MESOFAUNA COMMUNITY AND THEIR ROLE IN SOIL ECOSYSTEM SURVIVAL

Generally, temperate forest floors with large accumulations of organic matter support high numbers, whereas tropical forests where the organic layer is thin contain lesser numbers of microarthropods.[10] Disturbance or perturbation of soils usually alters microarthropod numbers like tillage, fire, and pesticide application typically reduce populations but recovery could also be rapid and microarthropod groups respond differently. Soil mites usually outnumber collembolans but these become more abundant in some situations. In the springtime, forest leaf litter may develop large populations of "Snow fleas" (*Hypogastrura nivicola* and related species). Among the mites they themselves usually dominate but the fragile Prostigmata may develop large populations in cultivated soils with a surface crust of algae. Immediately following cultivation, numbers of Astigmatic mites have been seen to increase dramatically.[11] In addition, the mesofauna is mobile and migrates through different soil layers, passively transporting bacteria, fungi and their propagules within the gut or on the body surface to new microsites and substrates. Despite being minusculer compared to macrofauna species like earthworms and millipedes, which are the most bioturbators, the soil mesofauna may significantly contribute to forming the microbial habitat. Humus material (H layer) of forest ecosystems on acid soils may almost entirely contains fecal pellets of collembolans and enchytraeids. Micro- and mesofauna don't affect their food source solely by harvesting; selective grazing on certain microbial species can also change the community structure of the microflora. This alters abundance and activity of bacteria and fungi and modifies the pattern of organic matter decay.[12-14]

The soil mesofauna community in undisturbed habitats with special reference to Oribatid mites possesses large diversity of mesofauna compared to the disturbed ones.[15] While studying the results of acid rain on litter decomposition during a beech forest it had been reported that presence of mesofauna significantly reduced the facility of the acid rain to inhibit carbon mineralization.[16] Gamasid mites are good indicators of the soil quality as their high sensitivity to external impact combined with their importance for ecosystem functions make soil mesofauna extremely valuable for ecotoxicology.[17] The rainforests contain a huge kind of soil microarthropods.[18] The seasonal abundance of oribatid mites numbers are correlated positively with radiation on the day of collection.[19] The role of Orbatid mites within the decomposition of the cones of Scotch pine (*Pinus sylvestris*) is of prime importance and thus the orbatid mites are great decomposers compared to other groups of soil mesofauna.[20] The effects of summer warming on the whole population densities of soil-dwelling microartropods within the high arctic region has no significant effect of temperature elevation on orbatid mite populations while as there's negative impact on springtail numbers.[21]

The effects of manipulated soil microclimate on mesofaunal biomass and variety during a hotter, drier

summer, in contrast, experimental heating depress diversity and biomass in drier zone of the plots and variety within the moist zone but enhance biomass within the moist zone and both the biomass and thus the range are positively correlated with soil organic matter.[22] There's decline of soil mesofaunal biodiversity because of the appliance of pesticides as evident from the appliance of DDT in high-input grasslands showed a high density of microarthropods with a high fraction of thelytokous reproduction, associated with a decrease in genetic variation.[23]

The highly abundant and diverse mesofauna populations are capable of upper rates of litter fragmentation and thus the short term decreases of soil pH has no negative effect populations of collembolans.[24] While working on the impact of Collembola and Enchytraidae on soil surface roughness and properties, it had been observed that the surface roughness increased because of mesofaunal activity.[25] The role of soil microarthropods (Acari and Collembola) in organic matter decomposition and nutrient cycling during a forest ecosystem is critical and thus the tiny changes within the structure of soil microarthropod assemblages can have significant effects on the local mobilization of nutrients.[26] The influence of microarthropods on litter decomposition at three forested sites -two tropical and one temperate reveal that the microarthropod populations are considerably effective in litter decomposition which is minimal within the temperate region where the fauna tend to increase the decomposition rate only towards the highest of the year.

In contrast, the effect of fauna within the tropical regions are marked within months of the start of the start of experiment thus it become evident that the range of mesofauna is greater within the tropical regions.[27] The functional role of Collembola within the ecosystem is plant litter decomposition processes and in forming soil microstructure while as soil acidification, nitrogen supply, global global global climate change and intensive farming have negative impact on Collombolan diversity.[28] The mineral amendments on soil fauna in an acid breech forest floor show that nitrogenous amendment decrease the numbers of oribatid mites.[29] Most of the predatory mites – Gamasina or Mesostigmata are life style predators in soil and litter, on the soil surface or on plants and Mesostigmata are important predators of Nematoda, Collembola and bug larvae and should function bioindicators.[30] Soil microarthropods mainly Acari negatively answer altered soil-water availability in tall grass prairie ecosystems and are less abundant in irrigated plots and at the wetter lowland sites which confirm the importance of soil water content in affecting microarthropod densities and distributions in grasslands, and suggest complex, non-linear responses to changes in water availability.[31]

The long-term effects of compaction in arable land because of conventional soil tillage, has negative impact on collembolan number while as, the harvesting and tillage support increase of Collembola in conservation tillage. the stableness analysis of soil Oribatid mite communities from environmentally stressed habitat and relatively well preserved habitat with the attitude of consistency as a primary criteria of stability reveal that concluded that oribatid community from preserved habitat are more stable than from environmentally stressed habitat.[32] The effects of constant temperature versus diurnally fluctuating temperature and uniform versus varying moisture, on the population densities and species richness of Collembola and Mesostigmata in coniferous forest humus and birch leaf litter are well understood by the actual fact thatat fluctuating moisture and temperature regime, Collembola are most abundant, and species richness of Collembola remain higher, whereas Mesostigmata are more numerous at constant temperature.[33]

The possible host habitat specialization in two major groups of soil arthropods, the oribatid and mesostigmatid mites, under three tree species viz., *Eucalyptus pilularis*, *Eucalyptus propinqua* and *Allocasaurina torulosa* show differences between tree species are insufficient to vary species composition of mites.[34] The disturbance of vegetation and soil resulted by tropical rainforest fragmentation are the most factor affecting the range of soil mesofauna and thus the soil condition with more soil organic matter, total N and P, higher pH value and lower soil bulk density become more favorable to the soil mesofauna while because the species richness, abundance and sort of soil mesofauna in fragmented forests are above those in continuous forest, but the similarity of species composition in fragmented forest to the continual forest is minimal.[35] In case of dynamics of springtail and mite populations, there is no evidence for regulation of springtail numbers by mites or for regulation of mite numbers by macroarthropods.[36] Correlations between Collembola, total C and N are usually weak under field conditions and omnivory is probably the prevailing feeding strategy in

Collembola.[37] The relationships between Collembola, Soil chemistry and humus types in forest stands reveal that the Collembola seem to be linked closer to the body of humus than to its chemical parameters.[38] The relative abundance of Collembola and three suborders of mites (Oribatida, Mesostigmata and Prostigmata) during decomposition are greater in old litter than in fresh litter.[39] Organic matter removal and vegetation control generally cause an enormous decrease in collembolan populations; while compaction didn't significantly affect collembolan populations.[40] The groundwater level is also one of the main environmental factors influencing the composition of collembolan and oribatid mite assemblages. The responses of soil microarthropods to experimental short-term manipulates of soil moisture show that drought decrease microarthropod species richness. As the Oribatid mites and Collembola respond differently to the irrigation treatments that the latter community show species evenness and variety within the frequently irrigated plots while because the former community within the infrequently irrigated ones. The population abundance of Collembola and Acari remainlow during drought conditions and therefore the humidity is that the most vital factor determining distribution, abundance, and survival of soil Collembola in tropical forest. And high predation and low accumulation of organic matter cause low population abundance of Collembolan within the tropical habitat.

The variations within the population density of soil invertebrates are controlled by the particular soil ecological conditions. Dominant mesofauna species are morphologically and physiologically adapted for living near the soil surface. The future effects of varied regimes of repeated fertilization on fine roots, mycorrhizae, and soil mesofauna in young stands of shore pine (*Pinus contorta Dougl*. var. latifolia Engelm.) and interior spruce white spruce (Moench) Voss, Engelmann spruce Parry, and their present hybrids) show that fine root attributes and mesofauna respond differently to repeated fertilization regimes at the pine and spruce study sites. Phenanthrene affect the population dynamics of mesofauna and soil biological functioning counting on exposure duration, sort of community, or both. The impacts of invertebrate soil micro- and mesofauna (grazers and predators) on plant productivity and microbial biomass indicate that soil fauna help to manage ecosystem production, especially in nutrient-limited ecosystems.

Soil mesofauna act because the Potential Biological indicators of success in reclaimed soils for recolonization and therefore the mesofaunal densities are greater in natural soils than in reclaimed soils and community structure differ between natural and reclaimed soils.The effects of soil mesofauna and microclimate on nitrogen dynamics in leaf litter decomposition along an elevation gradient give conclusion that the rapid accumulation of N in lower elevation sites may result within the retention of mobile N in soils and therefore the effects of soil mesofauna on N dynamics could also be intimately associated with microclimate (warm and humid) and faunal diversity along the elevation gradient. The stable- isotope labeling and probing of recent photosynthates into respired CO_2, soil microbes and soil mesofauna employing a xylem and phloem stem-injection technique on Sitka spruce (Picea sitchensis) reveal that the Stem injection of huge trees with 13^oC-enriched compounds may be a successful tool to trace C-translocation belowground. In particular, the significant 13^oC enrichment of CO_2 and enchytraeids near the base of the tree and the significant 13^oC enrichment of phosphor-lipid fatty-acid (PLFAs) up to 20 m away indicate that mature Sitka skpruce (*Picea sitchensis*) have the capacity to support soil communities over large distances.

The meso-fauna foraging on seagrass pollen may serve in marine zoophilous pollination and aid within the pollination of *T. testudinum* when visiting female flowers. The diversity of acari and collembola along a pollution gradient in soils of a Pre-pyrenean forest ecosystem around a steel mill reveal that the density of acari and collembola significantly decrease with the increase in concentration of Cr, Mn, Zn, Cd and Pb. Mites appear to be more sensitive to heavy metal pollution than springtails. From the review of literature it's quite evident that the soil mesofauna are a crucial a part of terrestrial ecosystems and a connecting link between microfauna and macrofauna which together form an important a part of soil decomposer community.

CONCLUSION

Soil mesofauna are ready to use the prevailing pore space in soil, cavities or channels. They constitute important reservoirs of biodiversity and are reflectors of ecosystem metabolism. Furthermore, the soil mesofauna regulate plant productivity and microbial biomass and are key organisms to manage ecosystem production, especially in nutrient-limited ecosystems.

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