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Soil arthropods diversity in agricultural and horticultural ecosystem of mid hills of Meghalaya

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Abstract
An experiment was conducted at ICAR-NEH, NBPGR research farm and experimental farm of the College of Post-Graduate Studies in Agricultural Sciences (CPGS-AS), CAU, Meghalaya with a view to determine the Soil arthropods diversity in Agricultural and Horticultural ecosystem of mid hills of Meghalaya. The results revealed that the Agricultural ecosystem recorded higher soil arthropods population of 1987 individuals as compared to Horticultural ecosystem with 1500 individuals. It was also recorded that Soil arthropods belonging to 5 different Classes under 31 Families and 37 Genus constituted the fauna of the arthropods whereby Class Entognatha recorded the highest number of individuals. The highest number of individuals recorded under Macro and Micro arthropods was Order Araneae and Order Entomobryomorpha respectively.

Keywords: Biodiversity, macro arthropods, micro arthropods, entognatha

Introduction
Soil is a dynamic natural body which is composed of minerals and organic materials along with living forms in which plant grows and dies. It is abode for millions of living organisms and midway to interact with the large number of organisms in environments. The functions and structures of soil are very much essential for biosphere, and yet most difficult and least known form. The main environmental functions of soil include nutrient cycling, storage of nutrient, water maintenance and regulation. For healthy plant growth, a good soil structure is needed to allow air flow and water into the soil. Soil biota indicate the complete community presence in the soil system despite the fact, biodiversity can vary from soil to soil between various plant species. The most dominant group in terms of numbers and biomass is conferred by microorganisms, nematodes and micro arthropods (Collembolans and Mites). Soil organisms occupy 0.5% of absolute soil capacity; and out of these 5-15% is characterized by micro-organisms (bacteria, protozoa etc.) and macro-organisms (termites, earthworms, ants etc.) and 85-95% characterized by plant roots. As per estimate, it consist large areas of mites, nematode, earthworms and arthropods [1]. Biological inquisition of soil arthropods is most necessary to figure out the pattern of distribution of these animals, nutrient cycling and soil formation. Soil organism provides soil nutrients and the various minerals required for the growth and development of the plants. Acarina (mites) and Collembolans (springtails) are found most diverse among arthropods in the soil and the predominant macro arthropods are Coleopterans and Hymenoptera etc. Millipedes, Centipedes, Mites, Spiders and Annelids etc. come under soil dwelling arthropods [2]. Micro arthropods population study reported that the soil mites and collembolans occurs more in all types of soils. Soil mites and collembolans are the essential part of the soil. Researchers paved the intensive studies of soil mites and other soil micro arthropods in India [3]. Soil arthropod communities are highly diverse and critical for ecosystem functioning and play a crucial role in an ecosystem and act as predators, pollinators, parasitoids, herbivores, decomposers and also known as ecosystem engineer and litter transformers. Arthropods can be used as biological indicators for agroecosytem integrity [4]. The burrowing arthropods such as subterranean insects like termites make tunnels and galleries; and nest forming ants improve soil porosity and results in adequate aeration and water holding capacity below the ground level. Arthropods feces form the soil aggregates and humus, which stabilize the soil physically and increase the nutrients storing capacity. Biodiversity is important for sustainability of life on the earth. It provides stability to soil against disturbance and stress of the ecosystem [5].

North East India is a geographically hotspot and "gateway" to diverse flora and fauna. Meghalaya is a part of north eastern Himalayas which is rich in biomes of the world high in rare species. North Eastern state of India, especially Meghalaya is considered as a rich in biodiversity due to its unique geographical location and distinct climatic condition. Therefore, keeping in view of these considerations, present investigations was taken on soil arthropod biodiversity.

Materials and Methods

To determine the Soil arthropods diversity in Agricultural and Horticultural ecosystem of mid hills of Meghalaya, the experiments were conducted at ICAR-NEH, NBPGR Research farm, Umiam, Ri-bhoi district, Shillong (Meghalaya) and Experimental farm of the College of Post-Graduate Studies in Agricultural Sciences (CPGS-AS), Umiam, Ri-Bhoi district. The sample collection was carried out in (Agri and Horti ecosystem) of an area about (10 × 10) m^2, 100 m^2 each. The experiment was started during July 2019 and continued up to February 2020. To develop the method of sampling in arthropods communities, collection were made using different methods viz., Hand picking, Pitfall trap and Rubbish trap were employed for collecting Macro arthropods. During the period of our study soil arthropods collection was done by Pitfall trap and Rubbish trap for soil Macro arthropods while Berlese funnel and Flotation methods was used for the collection of soil Micro arthropods. The plot was divided into 100 quadrates measuring 10m × 10m (100 m^2). In case of Micro arthropods extraction was done by using Floatation methods and Berlese funnel. The most common and important soil arthropods species were identified to the lowest possible taxon. Identification was done based on established taxonomic keys and literature. Cataloguing and documentation was done using images and photographs. Unidentified specimen was sent to AAU, Jorhat, NBAIR, Bangalore, RPCAU, and BHU, Varanasi.

Results and Discussion

Diversity of soil arthropods recorded in Agricultural and Horticultural ecosystem during the study are illustrated in Table 1. Altogether, five Classes of soil arthropods were collected viz., Entognatha, Arachnida, Insecta, Crustaceans and Chilopoda during the study period. Out of these, highest numbers of individuals were recorded from Entognatha Class with 1448 individuals followed by Arachnida with 899, Insecta 764, Crustaceans 240 and the least was recorded by Chilopoda with 133 individual. As shown in Fig. 1 total of 3487 individuals were collected from Agricultural and Horticultural ecosystems, out of which Agricultural ecosystem recorded the highest individuals of 1987 compared with Horticultural ecosystem which recorded only 1500 individuals. In the Agricultural ecosystem, highest number of individuals was recorded from Entognatha Class (858) followed by Insecta (558), Arachinida (372), Crustaceans (138) and the least was Chilopoda (63). Similarly, in Horticultural ecosystem out of 1500 individuals the maximum individuals were recorded from Entognatha Class followed by Arachinida, Insecta, Crustaceans and Chilopoda respectively. Soil arthropods collection comparisons were done with the different sampling methods where the pitfall trapping method was found to be a suitable sampling method for the collection of soil arthropods (Micro and Macro arthropods). The present finding is in close conformity with Eni *et al*. [8] reported that the 4 Classes, 5 Order and 9 Genera which incorporates Chilopoda, Diplopoda, Arachnida, Insecta and Collembolan from the soil to a profundity of 10cm. They found the most abundance as Collembolan and least as Diplopoda. Nongmaithem [9] reported that soil arthropods revealed the presence of 18 Orders belonging to 5 Classes viz., Insecta, Myriapoda, Arachnida and Crusatceans. Soil arthropods were grouped into 3 broad division viz., Collembola, Acarina and other arthropods. Similarly, Angurana *et al*. [10] collected a total of 1033 individuals of soil arthropods of which 707 individuals were from Agricultural field and 326 individuals from Non- Agricultural field. Collembolan was the most dominant while the least were Coleoptera and Hymenoptera. Timothy *et al.* [11] also found that the richness of species like Coleoptera (Carabidae and Staphylinidae) and Araneae was obtained by placing many traps in sampling area. Unique species were also reported. In the current study, Flotation methods and Low cost Berlese funnel (designed by SCP, CPGS-AS) was used as active and passive extraction methods with special reference to soil Micro arthropods. Berlese funnel collected less number of soil litter arthropods as compared to Pitfall trap and Hand sorting which is in conformity with the finding of Nsengimana *et al*. [6]. Results are similar with the findings of Lakly and Crossley [7] who observed that Flotation methods does not depend upon the arthropods mobility (passive procedure) whereas Tulgreen method depends upon the migration of soil arthropods from sample as locomotive arthropods move down in response to heat and humidity changes and is considered as active procedure. Tulgreen method is more variable as compared to Floatation method.

Conclusion

Soil arthropods are prime concern of soil mesofauna and macrofauna in all types of soil. Soil living organisms or soil arthropods upholds as they dissolve in biological material, food series, increase soil formation and supervise the soil community populace along with crop contagion. Soil arthropods recover the potency of porosity of soil and also use as an agro ecosystem purity indicator. Thus, soil arthropods are higher for the region that of varied climatic conditions especially in north eastern regions. Five soil arthropods Classes were recorded. Class Entognatha recorded the highest individuals and Class Chilopoda with lowest individuals, pitfall trapping method found out to be the best method for the soil arthropods collection. Collembolan was the most dominant while least was Coleoptera and Hymenoptera.

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Table 1: Soil arthropods observed in Agricultural and Horticultural ecosystem

Class	Order	Total	Grand Total
Entognatha	Entomobryomorpha	701	1448
	Poduromorpha	485	
	Symphypleona	164	
	Diplura	98	
Arachnida	Araneae	522	899
	Trombidiformes	98	
	Mesostigmata	75	
	Prostigmata	107	
	Oribatidae	97	
Insecta	Dermaptera	38	764
	Isoptera	187	
	Coleoptera	475	
	Orthoptera	67	
Chilopoda	Scutegeromorpha	88	133
	Scolopendromorpha	45	
Crustacean	Malacostraca	240	240
Grand Total		**3487**	

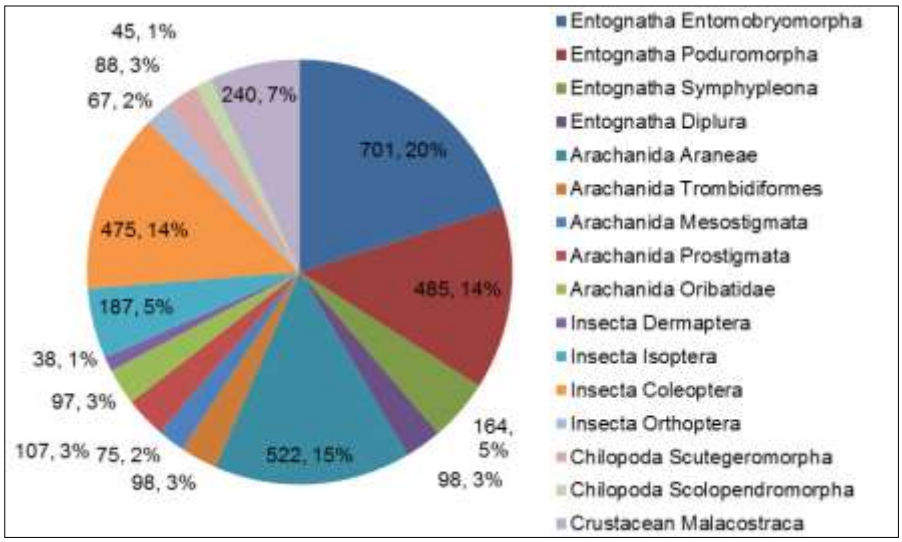

Fig 1: Graphical representation of soil arthropods recorded in Agri - Horti ecosystems

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