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ARTHROPODS: HABITAT, FEATURES OF LIFE

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Abstract

Soil arthropods are a group of soil-inhabited arthropods belonging to the classes of Crustacea, Arachnida, Myriapoda, and Insecta. They are generally characterized by the features, namely a hard chitinous exoskeleton, segmentation, multiple jointed appendages, and an open circulatory system. Orchards are complex ecosystems in which plants have adjacent associations with different living constituents. Consequently, the fundamental modification in the community of plants has an impact on the population of arthropods Mango and litchi are essential groups of fruit crops with highly nutritious value farming, on the other hand, is considered to reduce the effects of conventional agricultural practices on the environment and especially halt the decline of biodiversity in the agricultural landscape

keywords: Arthropods, Habitat,

INTRODUCTION

Soil arthropods are a group of soil-inhabited arthropods belonging to the classes of Crustacea, Arachnida, Myriapoda, and Insecta (Eisenbeis and Wichard, 1987). They are generally characterized by the features, namely a hard chitinous exoskeleton, segmentation, multiple jointed appendages, and an open circulatory system. These are involved in many processes such as organic matter translocation, breaking and decomposition, nutrient cycling, soil structure formation, water regulation and consequently play important roles in maintaining soil quality and health and providing ecosystem services (Menta and Remelli, 2020). High biodiversity is perceived as synonymous with ecosystem health. Diverse communities are believed to have increased stability, increased productivity and resistance to invasion and other disturbances. In any ecosystem, determination of diversity, richness, evenness, and abundance of fauna is required for ecological studies, habitat management, and conservation programs (Nahmani et al., 2005). Agricultural landscape, habitat type, farming system, landscape composition and connectivity all contribute to explaining species biodiversity and richness (Leksono, 2017).

ARTHROPOD COMPOSITION COMPARING

Orchards are complex ecosystems in which plants have adjacent associations with different living constituents. Consequently, the fundamental modification in the community of plants has an impact on the population of arthropods (Ramzan et al., 2021). Mango and litchi are essential groups of fruit crops with highly nutritious value (Lauricella et al., 2017; Zhao et al., 2020). Organic farming, on the other hand, is considered to reduce the effects of conventional agricultural practices on the environment and especially halt the decline of biodiversity in the agricultural landscape (Boutin et al., 2009). The vegetable field is usually intensified. Since the intensification of production systems implies simplification, and consequent biodiversity losses leading to the reductions in ecosystem services, the use of arthropod biodiversity and dynamics can be a reliable indicator of system diversity, covering a wide range of ecological functions in the agro-ecosystem. Arthropods help in the mineralization of some nutrients in the bacteria and fungi and release nutrients in plant-available forms, increase soil fertility by changing the physical properties of soil and many of these also compete with the root and foliage-feeders and protect plants from pest attack thereby increasing the production of the crops. Soil arthropod's diversity is very much determined by the vegetation above it. However, very few studies have only been done on the soil different habitats with different vegetation types. Given that arthropods play a major role in nutrient cycling, community interactions and food webs (Losey and Vaughan, 2006), knowledge of arthropods' composition in different habitats are essential. The present study was done to address the diversity indices of arthropods and their abundances in different habitats by using pitfall traps. The objective was to determine which of the five habitats consist of the best overall population numbers of as many taxa as possible. The sampling method commonly used for measuring soil arthropods in different habitats is pitfall trapping. The fundamental design of a pitfall trap consists of a container buried into the

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ground with the top flush with the soil surface (Hohbein and Conway, 2018). In comparison to other collection methods, it has been considered the most ideal method for sampling soil arthropods (Sabu and Shiju, 2010).

ARTHROPODS (PHYLUM ARTHROPODA)

The most conspicuous group of organisms living in the shelter of bryophytes are the arthropods (Bonnet et al. 1975; Kinchin 1990, 1992). McKenzie-Smith (1987) contended that animal densities among bryophytes often were greater than those we might expect simply on the basis of the greater surface area, implying that they provided more than just space. Yet, as Gerson (1969) so aptly pointed out, ecologists, both botanical and zoological, had dismissed the bryophyte habitat, as CloudsleyThompson (1962) put it, because "it is clear that moss does not form a biotope with a stable microclimate." Humph! To what were the ecologists comparing it? Not only do the bryophytes modify their internal climate relative to the ambient conditions, they also modify the soil conditions, permitting some of the arthropod species to survive there when the ambient atmospheric conditions are extreme and uninhabitable (Gerson 1969). Acting like a spongy insulator, they buffer soil temperatures and reduce water evaporation from the soil.

But they also can interfere with water reaching the soil in short spates or very light rainfall. They provide a humid environment when the sun dries the atmosphere. And some species act like a black box, absorbing heat with darkcolored leaves and reaching temperatures higher than those in the atmosphere. With these varying conditions, we might hypothesize that bryophytes can serve as a refuge at times while being inhospitable at others, and for some, provide a source of food.

The abundance of arthropods among bryophytes may in part relate to their concurrent venture onto land in the early Ordovician (Anissimov 2010). Once on land, they have invaded the three main strata: subterranean, forest floor debris, and arboreal (Grimmett 1926). Among these, we will generally not be concerned with the subterranean stratum as it is rarely a habitat for bryophytes. The stratum of forest floor debris reminds us that soil scientists often consider the moss layer as part of the soil, and most certainly Grimmett included it with the forest floor debris. Yanoviak et al. (2004) considered such habitats as epiphytic mosses to enhance species richness of the arboreal arthropods by increasing the available types of niches. The bryophytes provide a structural component to the arboreal habitat and function to buffer the moisture and protect against the wind. They furthermore provide a foraging location and a place to deposit eggs (Gerson 1982; André 1983; Nadkarni 1994; Kitching et al. 1997; Drozd et al. 2009)

Understanding microhabitat use and selection by terrestrial animals is critical to the conservation and management of plants and wildlife, especially threatened and unique species and communities. Local, fine-scale habitat heterogeneity allows for the spatial distribution of various microhabitats throughout a single, dominant habitat type. This heterogeneity provides differing resources that facilitate the nonrandom distribution of animals across the landscape and may help to avoid realized niche overlap (Bates et al., 2007; Ramey & Richardson, 2017). Microhabitat selection and use may be driven by individual species' life history requirements, environmental factors (e.g., plant cover and shade), biological pressures (e.g., competition), and ability to withstand climatic stressors. For terrestrial arthropods, selection of microhabitats often depends on a range of factors, including habitat structure (Landsman & Bowman, 2017; Miyashita & Takada, 2007), availability and evidence of available prey (De Omena & Romero, 2008; Johnson et al., 2011; Landsman et al., 2020; Morais-Filho & Romero, 2008), quality and quantity of floral resources (Ruttan et al., 2016), nesting material (Beiroz et al., 2016), sites for oviposition (Bergman, 1999), competition (Wittman et al., 2010), and survival rates for larvae (Albanese et al., 2008). Another component of habitat selection, perhaps the most critical for some invertebrate groups, is the functional separation of microhabitats based on fine-scale microclimates.

RESEARCH MYTHOLOGY

SAMPLING

Soil Sampling

The initial soil samples were collected at each of the site. After careful removal of the dry litter layer from the top, random soil samples of the size (10x10x10 cm) were collected from the (0-10 cm) layer with a sterilized steel auger (5 cm diameter), at least from three different stands of each tree species. The soil samples were then pooled, and sieved (2 mm mesh) to remove coarse stones and root fragments. It was air-dried for 72 hrs at room temperature and ground to pass through 80-mesh sieve (l80µm) and then used for chemical analyses.

Physio-Chemical Analysis of Soil

- **Soil Temperature and Moisture**

Principle: The temperature and moisture content of soil fluctuate with respect to the physical and chemical parameters, air temperature, relative humidity, rate of rainfall and the surface vegetation including plant canopy of the area.

Procedure: During each sampling the temperature of soil was recorded by inserting a 'soil thermometer' to a depth of 5 cm. The soil surface temperature was also measured at various sites. The prevailing moisture content of soil was measured immediately using an 'infrared torsion balance moisture meter' at 105oC.

- **Soil pH**

Principle: Soil acidity or pH is a measure of hydrogen ion (H+) activity in the soil solution defined as -log 10 of the [H+] concentration. The H+ activity in soil is a function of the parent material, time of weathering, vegetation, climate and topography. In addition to these, the season, soil organic matter and biological activity influence soil pH. Soil pH was measured in a 1:2.5 fresh soil-water suspension with a glass electrode (Jackson, 1962).

Procedure: 10 gram of air-dried soil sample was taken in a 50 ml beaker and 25 ml of distilled water was added to it. The suspension was stirred for 20 to 30 minutes using

magnetic stirrer. Then a digital pH meter was used to measure the pH of solution (µpH system 361- Systronics) after 1 h of standing for sedimentation.

- **Electrical Conductivity**

Principle: The electrical conductivity of soil is related to the total soluble cations or anions, which determines the soil salinity. As the Electrical Conductivity is a measure of soluble nutrients, it indicates nutrient availability for plants. Soil salinity greatly irifluences physical, chemical, biological properties and processes in soil. Soil Electrical Conductivity was measured in a 1:2.5 fresh soil-water suspension with a glass electrode (Jackson, 1962).

Procedure: 10' gram of air-dried soil sample was taken in a 50 ml beaker and 25 ml of distilled water was added to it. The suspension was stirred at regular intervals for 20 to 30 minutes using magnetic stirrer. Then the soil suspension was used for estimation of E.C. by a digital conductivity meter after 1 h of standing for sedimentation (Direct Reading Conductivity Meter 304 - Systronics).

- **Organic Carbon**

Soil organic matter consists of diverse components such as living organisms, slightly altered plant and animal organic residues, decomposing organic matter that vary much in their stability and susceptibility to further decomposition (Magdoff, 1992; Jackson, 1962).

Principle: The organic carbon content of dry soil samples was measured following Wakley and Black's rapid titration method (Jackson, 1962). A known amount of soil was digested with chromic acid (potassium dichromate and concentrated sulphuric acid) for oxidation of organic matter. The excess of potassium dichromate not reduced by soil organic matter, is then determined by titrating against standard ferrous ammonium sulphate solution.

DATA ANALYSIS

SPECIES COMPOSITION

The present study spread over a period of 17 months covering all the seasons sampled a total of 34,925 individual of epigeal arthropods sampled by pitfall trap method representing 19 taxa and 200 different species. Their distribution across the 17 months, four seasons , three habitats and four vegetations depicted that the predominant arthropod taxa were the Arachnida (including Acarina), Insecta – both Apterygota (including Collembola) and Pterygota (including Dermaptera and Coleoptera) and Myriapoda (Chilopoda and Diplopoda). Major taxa obtained during study period were Acarina, Aranae, Coleoptera, Diptera, Hymenoptera, Isoptera, Myriapods, Orthoptera, Thysanoptera and Thysanura. Minor taxa obtained were Blattodea, Dermaptera, Diplura, Embioptera, Hemiptera, Isopod, Neuroptera, Protura, Pseudoscorpiones, Scorpiones.

Barren Land (BL)

Only few taxa were obtained from this habitat. Hymneoptera found to be the dominant taxa which comprised of 58.05% of total arthropod population sampled through pit-fall trapping. Other taxa were Collembola (14.67%), Coleoptera (10.93%), Acarina (8.22%), Aranae (3.08%), Thysanura (2.15%), Isoptera (1.31%), Diplura (0.75%), and

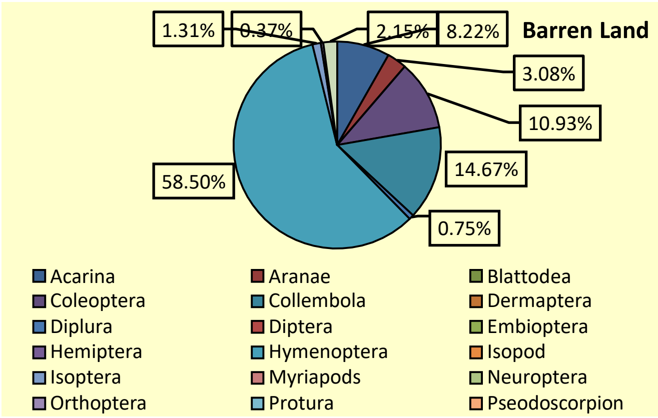

Figure 1: Species composition across Barren Land (BL)

Orthoptera (0.37%). Other groups such as Blattodea, Dermaptera, Diptera, Embioptera, Hemiptera, Isopod, Myriapods, Neuroptera, Protura, Pseudoscorpion, Scorpiones, Thysanoptera were absent in this habitat (6).

Un-restored Habitat:

Hymneoptera found to be the dominant taxa which comprised of 23.14% of total arthropod population sampled through pit-fall trapping. Other taxa sampled were Collembola (11.73%), Coleoptera (18%), Acarina (19%), Aranae (7.76%), Thysanura (1.19%), Isoptera (1.25%), Diptera (4.4%), Diplura (0.58%), and Orthoptera (3.93%). Other minor groups such as Blattodea (2.09%), Dermaptera (0.54%), Embioptera (0.39%), Hemiptera (0.89%), Isopod (0.91%), Myriapods (0.61%), Neuroptera (0.19%),

Protura (2.09%), Pseudoscorpion (0.88%), Scorpiones (0.41%), Thysanoptera (0.49%) in this habitat (7).

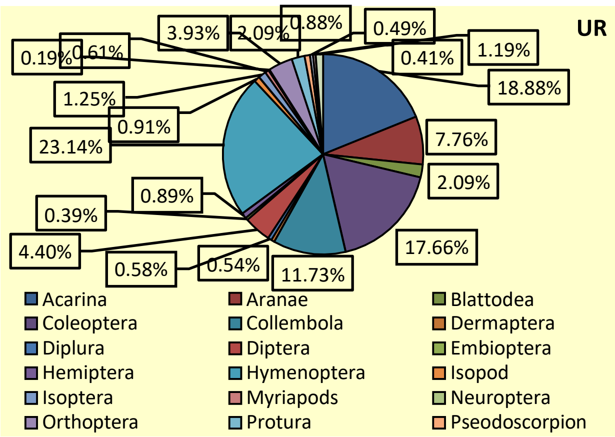

Figure 2: Species composition across Un-restored Habitat (UR)

The species composition across different vegetations in un-restored habitat are given below.

- **Acacia colei vegetation (AUR):**

Acarina found to be the dominant taxa which comprised of 18.55% of total arthropod population sampled through pit-fall trapping. Other taxa sampled were Collembola (15.05%), Coleoptera (17.40%), Hymenoptera (17.67%), Aranae (8.09%),Thysanura (0.71%), Isoptera (2.27%), Diptera (6.15%), Diplura (0.58%), and Orthoptera (5.16%). Other minor groups such as Blattodea (1.75%), Dermaptera (0.49%), Embioptera (0.49%), Hemiptera (0.22%), Isopod (0.22%), Myriapods (0.85%),Neuroptera (0.11%), Protura (1.75%), Pseudoscorpion (2.08%), Scorpiones (1.01%), Thysanoptera (0.49%) in this habitat (8).

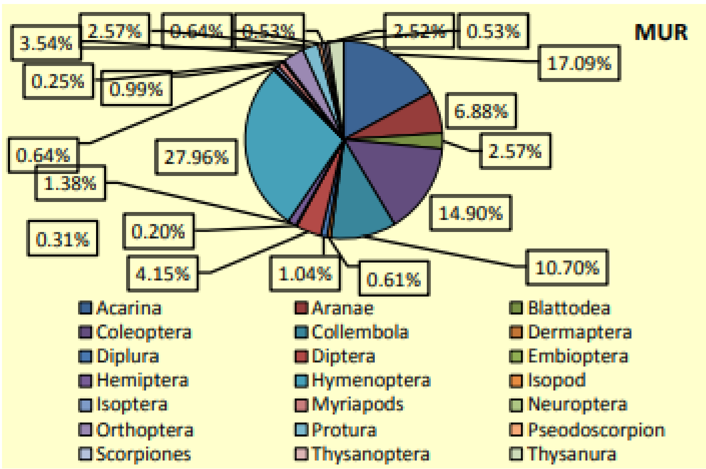

Figure 3 Species composition across Acacia colei of Un-restored Habitat (AUR)

- **Bambusa bambusa (BUR):**

Acarina found to be the dominant taxa which comprised of 18.55% of total arthropod population sampled through pit-fall trapping. Other taxa sampled were Collembola (15.05%), Coleoptera (17.40%), Hymenoptera (24%), Aranae (9%),Thysanura (0.71%), Isoptera (2.27%), Diptera (6.15%), Diplura (0.58%), and Orthoptera (5.16%). Other minor groups such as Blattodea (1.75%), Dermaptera (0.49%), Embioptera (0.49%), Hemiptera (0.22%), Isopod (0.22%), Myriapods (0.85%),Neuroptera (0.11%), Protura (1.75%), Pseudoscorpion (2.08%), Scorpiones (1.01%), Thysanoptera (0.49%) in this habitat (9).

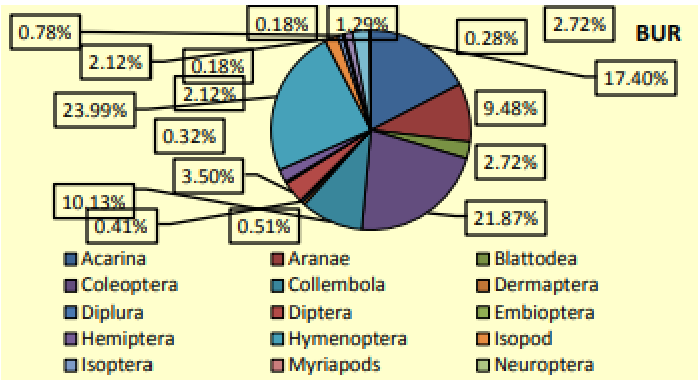

Figure 4 : Species composition across Bambusa bambusa of Un-restored Habitat (BUR)

CONCLUSION

Higher abundance, density and diversity of soil epigeic and edaphic arthropod taxa were observed in Restored habitat compared to that of un-restored and barren land. However, groups such as Orthoptera, Dictyoptera, Sminthuridae, were observed higher in un-restored habitat. Therefore the restored habitats with different vegetations can the used as habitats for conservation of the belowground arthropod including entomofaunal diversity. There were significant seasonal variations in the epigeic and edaphic arthropod and microarthropod species richness and abundances on one hand and their diversity on the other. north-east monsoon showed significant impact, and represented the period of highest number of species, maximum number of individuals sampled in the epigeic and edaphic arthropods. South-west monsoon was similar to winter in some aspects and due to its wet nature. Summer was the period when there were low number of species and lower abundances of arthropods and densities of microarthropods. Hymneoptera followed by Coleoptera were the predominant taxa found during the study period. Other epigeic arthropod were Acarina, Collembola, Araneae and miscellaneous group of arthropods such as Orthoptera, Isoptera, Thysanoptera, Dictyoptera, Dermaptera, Neuroptera, Embioptera, larvae, Diptera etc. Pedominat micro-arthropod (edaphic) taxa were Collembola and Acarina, and arthropod larvae. Acacia vegetation of both the habitats followed by mixed vegetation sheltered higher densities and diversity of species with higher dominance indices. Restored habitat.

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