Biological Forum — An International Journal, **2**(2): 70-72(2010) **ISSN : 0975-1130**

Effects of springtails community on plant-growth

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ABSTRACT : The soil is a reservoir of organisms ranging from beneficial to deleterious for plants. The interactions among these organisms are very important for plant growth and health. The majority of springtails feed on fungal hyphae or decaying plant material. In the soil, they may influence the growth of mycorrhizae and control fungal diseases of some plants. Therefore, the objective of this article discussed the role of springtails community on plant growth.

Keywords: Springtail, soil fertility.

INTRODUCTION

Collembola (commonly known as "springtails") are currently considered to be a monophyletic Class of the Phylum Arthropoda There are three main Orders of Collembola. Members of the Arthropleona (about 6500 species) have a more or less elongated body shape and range from highly active surface-dwelling species to those that live out all their lives in the depths of the soil. An example of this Order is Folsomia candida , which belongs to the Family Isotomidae. It is familiar to ecotoxicologists as one of a suite of "standard test soil organisms," which are used to assess the toxicity of new chemicals before they are released into the environment. The soil is a reservoir of organisms ranging from beneficial to deleterious for plants. The interactions among these organisms are very important for plant growth and health. The majority of springtails feed on fungal hyphae or decaying plant material. In the soil, they may influence the growth of mycorrhizae and control fungal diseases of some plants (Lubbock,1973). Therefore, the objective of this paper discussed the role of springtails community on plant growth.

COLLEMBOLAN DIVERSITY

Habitats with extreme climates such as deserts and polar regions support few species of *Collembola*, but sites with many niches have a diverse springtail fauna. *Collembola* seem to follow the general rule that diversity is inversely related to latitude; that is, there are more species in tropical than in temperate zones. In tropical rain forests, more than 130 species m-2 have been found in soil, leaf litter, and aboveground vegetation. In more temperate forests, diversity is lower, but it is not unusual to find more than 40 species in deciduous woodland. *Collembola* exhibit dominance patterns typical of most groups of terrestrial arthropods. The majority of individuals are usually represented by a small number of common species. In most populations, a large fraction of the species (usually >50%) is rare with dominance values of 1% (Axelsen *et al.*, 2000 and Stork *et al.*, 1993).

STUDY OF COLLEMBOLA BIODIVERSITY IN AGRA REGIONS

Some species of collembola found in agra regions are given in Table -1.

Table 1 : List of springtails (Collembola) of Agra regions.

Family	S1	S2	S3	S4	S5
Hypogastruridae					
Hypogastrura (*Ceratophysella*)					
H. (*C.*) *denticulata* Bagnall, 1941	-	+	+	+	+
H. (*C.*) *armata* Nicolet, 1842	-	+	-	+	-
H. (*H.*) *purpurescens* Lubbock, 1867	-	-	-	-	+
Isotomidae					
Folsomia penicula Bagnall, 1939	+	-	+	-	+
Folsomia quadrioculata Tullberg, 1971	+	-	-	-	-
Folsomia similis Bagnall, 1939	-	-	+	-	-
Folsomia candida Willem, 1902	+	+	+	+	+
Folsomia strenzkei Nosek, 1963	-	-	-	-	-
Isotoma viridis Bourlet, 1839	+	+	+	+	-
Entomobryidae					
Entomobrya sp.					

Family			**S1**	**S2**	**S3**	**S4**	**S5**
Entomobrya marginata Tullberg, 1871	+	+	+	-	+		
Entomobrya nivalis Linnaeus, 1758		-	-	-	-	-	
Entomobrya arborea Tullberg, 1871		-	-	-	-	-	
Entomobrya quinquelineata Börner, 1901	-	-	-	-	-		
Entomobrya puncteola Uzel, 1891		-	-	-	-	+	
Total species	5	5	6	4	6		

S1= SIKANDRA, S2= PALIWAL PARK, S3= VICTORIA GARDEN, S4= KEETHAM, S5= BICHPURI

ABUNDANCE

Collembola are extremely abundant in soil and leaf litter. In most terrestrial ecosystems they occur in high numbers, typically between 104 and 105 m^{-2}. Densities of springtails of more than 105 m^{-2} have been found in pine forests in India and Japan, moorland in England, and dry meadows in Norway. Collembola are particularly abundant in agricultural soils that are farmed "organically". In the rain forests, Collembola comprise about 20% of the total number of arthropods on tree trunks and 50% and 60% of the total from soil and leaf litter, respectively. However, because of their small size the contribution of Collembola to total soil animal biomass and respiration is low, typically between 1% and 5% in temperate ecosystems, but up to about 10% in some arctic sites and as much as 33% of total soil fauna respiration in ecosystems in early stages of succession. Typical values for the dry weight of springtails in temperate ecosystems are 0.15 gm 22 in deciduous woodland and 0.3 gm^{-2} in limestone grassland.

CHANGES IN SOIL STRUCTURE

Despite their relatively low biomass, springtails are extremely important in influencing the structure of some soils. For example, "alpine pitch rendzinas" on limestone are composed mainly of a deep black humus layer of 15 to 20 cm in depth that is formed almost entirely of Collembola feces. Most soils contain millions of collembolan fecal pellets m^{-2}, and these must be beneficial in slowly releasing essential nutrients to plant roots as the pellets are broken down by microbes (Messer *et al.*, 2000)

ROLE IN DECOMPOSITION

The main effect of Collembola on decomposition and "soil respiration" is through feeding on fungal hyphae. At certain densities of Collembola, grazing of mycorrhizae on roots can stimulate growth of the symbiont and improve plant growth. In other situations, Collembola may reduce disease by consuming pest fungi. Selective grazing by springtails may be an important factor limiting the distribution of certain species of basidiomycete fungi in the field. However, many of these effects are density-dependent, and too little information is available for quantifying accurately the specific contribution of Collembola to "indirect" or "catalytic" decomposition. Nevertheless, the influence of springtails on decomposition and nutrient availability must be significant in many ecosystems(Sabatini and Innocenti, 2001 and Hagvar, 2000).

SPRINGTAILS AND PLANT GROWTH

Very few people really understand how soils work. I'd like to give three illustrative examples of how soil arthropods, soil microbes and roots work together as a combined system in the real world. The first example is of onion production. Basically, the plant is incapable of taking up any phosphorus from the soil unless it has mycorrhizae on its roots. Mycorrhizae, literally meaning fungus roots, are thread like fungal bodies that interact with plant roots that pick up lots of phosphorous and other substances.

The growth of the plant depends upon the number of arthropods called springtails living in the soil. Springtails function by eating the tips of the mycorrhizae which stimulates the mycorrhizae to grow, dissolve more nutrients in the soil around it, and feed it to the plant. As the number of springtails in the soil increases, the plant grows faster until there are so many springtails that they eat all the mycorrhizae. Then growth of the onions drops to zero again. The second example of oak forests . When oak trees live on sandy soil they grow very slowly. They don't make many leaves so there's not much leaf litter at the end of the year. But the litter that does come down year after year piles up very thick. Most of the nutrients are in the litter layer, unused, not part of the biological growth of that ecosystem. On the other hand, oak trees that grow on clay soil grow very fast and have lots of leaves. But when the leaves hit the ground they decompose very rapidly and make a very thin litter layer. All the nutrients in that ecosystem are bound up into the tree growth itself. An oak tree puts lots of chemicals in its leaves called phenols (a mildly acidic toxin) that prevent caterpillars from destroying the trees. When the leaves die and become litter on the ground, the phenols are still in the leaf. When a millipede or an earthworm comes along and starts to *e at.*, that leaf, the PH changes and the phenols polymerize (combine with each other) forming a plastic rubbery mass that in turn kills the millipedes. In clay soils however, springtails are present and fill their bellies with inorganic clay particles. At night springtails migrate up to the litter layer and feed on fungi and leaf litter. The inorganic clay particles in the gut prevent the polymerization from taking place. As a result, the nutrients in the ecosystem cycle through the environment and leaf litter does not build up(Gange *et al.*, 2000). The point of the story is that the productivity of that entire forest ecosystem is basically the result of one little arthropod in that soil. Soil invertebrates are system catalysts. They regulate the rate of decomposition and the rate of nutrient cycling by breaking down litter and small organisms (like chewing) but don't chemically process nutrients in the soil. This is important because every chemical and physical property of soil is basically driven by the surface area to volume ratio of the particles that make it up. In essence soil invertebrates make nutrients andorganic components usable for other organisms (Hopkin,2003). Additionally, soil invertebrates mix organic and the inorganic components changing the microstructure of the soil, which in turn drives the complex processes of microbial succession (the process by which a plant or animal communities change over time). Invertebrates feed on the current microbial crop and their own feces provide for a new and different type of microbial community to develop (Gloria *et al.*, 2009). In fact, most organisms eat the manure or feces of the other things. As a result, the total nutrient content of a soil, whether tied up in organic matter or immobilized in inorganic phases in the mineral soil, are of secondary importance.

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