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Soil Arthropod Abundance and Formation of Sclerotium Grains in Fagus Forest, Akita, Japan

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Arthropods are the most abundant herbivores and detritivores in many terrestrial ecosystems (Seastedt and Tate, 1981) having roles as decomposers, microorganism feeders and also contributors to C and N mineralization (Holtkamp, 2008). Sclerotium grains as the resting bodies formed by fungal species on the other hand, are important forms of carbon storage in soils (Willets and Bullock, 1992). Their ability to withstand the low pH and heavy metal content in the soil environment as a symbiotic function to protect plant roots from toxic ions has become a subject of interest to soil scientists (Watanabe et.al, 2004). Although the importance of arthropods and sclerotium grains are highlighted, the correlations between the two are poorly understood. This study aims to describe the relationship between arthropods and sclerotium grains of Cenococcum geophilum and related species in the Fagus Forest soils.

Soil samples collected named B, S, and T sites for the Bottom (720 asl meters, gradient 5 degree), Slope (742 asl meters, gradient 40 degree), and Top (780 asl meters, gradient 1 degree). L, F, H, and A horizons of each of three repeat were collected within a 50x50 cm plot. Soil arthropods found in the L horizon were manually collected while the Berlese-Tullgren method was used for the remaining layers. Number of individuals was counted for species richness and abundance. Arthropod diversity was quantified using Shannon-Wiener Index (H’). Sclerotium grains in the A horizon were manually collected. Soil pH, C/N ratio, and moisture content were also analyzed.

Arthropod diversity was highest at the S (H’= 2.08), medium at the T (H’= 1.66), and lowest at the B (H’= 1.18). The number of arthropods species was highest at the T (34 species), then S (29 species) and then B (27 species). Mites (Acari: Cryptostigmata) and springtails (Collembola) were the most abundant species found in all sites, making up 44.34% and 29.06% of the total community respectively.

Results show that the abundance of mites reached the highest at the B (63.8%), followed by T (40.8%) then the S sites (28.4%). The abundant mites of B were accompanied by the lowest springtail abundance and sclerotium grain counts, while the lowest mite abundance of S sites was where the medium abundance of springtails and the most sclerotium grains were found.

Sclerotium grains found were blackish brown, 0.2 – 3.0 mm in diameter, 0.21 – 0.89 mg in weight, 1.9 – 5.1 in count per soil g, and had massive medulla. Within the S sites where the grains were mostly found, the pH ranged between 3.87 until 4.05. The total carbon content and C/N ratio and the soil moisture content of the S site were moderate compared to the T and the B site.

Among the three altitudes the S showed the most favorable condition for arthropod diversity and sclerotium grain. Although the main vegetation was Fagus crenata in all sites, the S sites had dense Sasa bamboo and grass as understory vegetation, while the B was mostly grass, and F. crenata filled the T sites. It is most likely that the S site serves as an ecotone between the T and the B sites.

Mites as predatory arthropods feed on springtails, which explain why abundant mites result in low springtail abundance. Fungivore springtails graze on fungi which result in the increase of hyphae production (Parkinson, et.al, 1978). As a result, more sclerotium grains were found where the springtails were abundant. Therefore, there has been an indication that mites and springtail abundance can be used as a potential indicator of sclerotium grains. Further research on fungi preferences of springtails and the laboratory-based sclerotium formation is our next interest.