Microhabitat Formation: Effects of Organic Matter Diversity and Quality on Soil Biota

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Abstract
Recovery of soil biota within the degraded soil plays important roles in soil health. However, in order to inhabit this particular soil, the biotas require organic matter as their microhabitat, which mostly lack in damaged soil. The objective of this research was to evaluate the effects of organic matter diversity and quality on soil biota as they form the essential food web providing nutrients for plants to use. The experiments were done by combining seven, four, or three species of organic matter with various litter quality (determined by its C:N ratio), i.e., <10, 20-40, >60. Inoculant was added in each treatment (eight combinations). Incubation was run for seven weeks, where samples were taken after one, two, four, and seven weeks. Soil biota enumerates consisted of bacteria, nematodes, collembolans, and mites. The results indicated that abundance and diversity of the soil biota were no difference in seven, four, and three combinations of species. However, they demonstrated clear pattern based on organic matter quality. It was suggested that quality of organic matter determined the soil biota abundance and diversity more strongly than organic matter diversity.

Keywords: collembolans, mites, nematodes, organic matter, soil health

Introduction

Soil biota play a vital role in soil health and ecosystem functioning (Porazinska et al. 2003). They contribute to nutrient cycling, organic matter decomposition, and the formation of soil structure. However, in degraded soils, the recovery of soil biota is often hindered by the lack of organic matter, which serves as their microhabitat (Sérgio et al. 2012). Therefore, understanding the effects of organic matter diversity and quality on soil biota is essential for successful soil restoration efforts. The objective of this research was to evaluate the effects of organic matter diversity and quality on soil biota as they form the essential food web providing nutrients for plants to use

Methods

In this study, seven, four, or three species of organic matter were combined with varying litter quality, determined by the carbon-to-nitrogen (C:N) ratio (<10, 20-40, >60) . Eight combinations of organic matter species were used, and an inoculant was added to each treatment. The incubation period lasted for seven weeks, with samples collected at one, two, four, and seven-week intervals. The soil biota enumerated in this study included bacteria, nematodes, collembolans, and mites. The enumerations of soil biota followed Carter and Gregorich (2008)

Results and Discussion

The results indicated that abundance and diversity of the soil biota were no difference in seven, four, and three combinations of species. However, they demonstrated clear pattern based on organic matter quality. The findings indicate that SOM diversity and quality have significant effects on microhabitat formation and subsequent soil biota dynamics. This results was coincide with Kuzyakov (2010) report. Higher levels of SOM diversity contribute to increased microhabitat heterogeneity, providing varied niches for different soil organisms. This heterogeneity leads to higher species diversity and functional complementarity, enhancing ecosystem stability and resilience (Caruso, Taormina, and Migliorini 2012).

SOM quality, determined by its chemical composition and decomposition rates, also influences microhabitat formation. High-quality organic matter, rich in nutrients and easily decomposable, supports a greater abundance and diversity of soil organisms. These microhabitats created by quality SOM offer favorable conditions for nutrient cycling, organic matter decomposition, and biological interactions.

Moreover, microhabitats influenced by SOM diversity and quality promote specific interactions between soil organisms. Certain microhabitats favor the presence of beneficial microorganisms that enhance plant growth, suppress pathogens, and improve nutrient availability. Other microhabitats may support invertebrates involved in the breakdown of organic matter that facilitate nutrient uptake by plants.

It was suggested that quality of organic matter determined the soil biota abundance and diversity more strongly than organic matter diversity.

Conclusion

Microhabitat formation is strongly influenced by soil organic matter diversity and quality. The diversity of SOM provides varied microhabitats, while the quality of SOM determines the abundance, and nematode composition.

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