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REVIEW

Aboveground insect herbivory shapes plant–soil feedback and ecosystem resilience

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Abstract
The interaction between plants and their surrounding soil ecosystems is complex, with plant–soil feedback acting as legacy effects from previous plants, influencing subsequent plant growth and insect interactions. Recent studies have shown that experiments focusing on individual factors in isolation do not accurately predict the outcomes of these complex interactions. Aboveground herbivores impact the development of root exudates and their surrounding microbiome, suggesting that herbivory indirectly shapes belowground biotic communities. Such impact of insect herbivory on plant–soil feedback is a crucial area of ecological research. Most studies focus on root-associated organisms and their influence on foliar herbivorous insects, and little attention has been given to the reverse interaction-how foliar herbivory affects the soil environment and PSF. This study explores the bidirectional influence of herbivory and PSF, revealing that aboveground insect herbivory can significantly alter plant–soil feedback mechanisms, influencing not only plant performance but also the broader community structure. A holistic approach that integrates soil microbial complexity with insect herbivory is needed to better predict community-level outcomes and enhance plant protection strategies. Our study thus highlighted the need for a community-based perspective when studying interactions among plants, insects and soil microorganisms.

Keywords Root exudates · Rhizosphere microbes · Subsequent plants · Feedback phase · Plant–insect interaction · Above- and belowground

Introduction

The relationship between plants and soil is fundamental to terrestrial ecosystems, where plants serve as essential components, interacting with both micro- and macro-organisms including above- and belowground. Plants act as host and vital source of carbon and nutrients for various organisms, including herbivores, plant-associated microorganisms and plant-feeding nematodes. Such interactions lead to alterations in the plant's morphology, physiology and molecular traits, influencing the attraction, behaviour, performance and abundance of other biota inhabiting it concurrently or subsequently (Van der Putten et al. 2001; Sharma et al. 2021). This influences not only the plant health but also the soil in which it grows, thereby affecting the performance of subsequently growing plants, a phenomenon, referred to as 'plant–soil feedback' (PSF) (Van der Putten et al. 2013). These plant-mediated interactions have profound implications on both, the plant and its associated community (Biere and Goverse 2016). Previous studies highlight the crucial role of PSF in shaping plant communities and invasions, emphasizing the mechanism of how PSF vary in different environmental conditions (Bever et al. 1997; Smith-Ramesh and Reynolds 2017). PSF are shaped by various key feedback pathways which can influence plant performance as well as ecosystem processes. Among these, three central mechanisms are commonly recognized, namely litter inputs,

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