

Arbuscular mycorrhizal fungi are ubiquitous in nature and associate with the roots of about 75% of all vascular plants. The association is considered to be mutualistic, because the mycorrhiza donates mineral nutrients to the plant in return for a supply of organic carbon. Both of these features mean that a mycorrhizal plant may represent a very different food source for an insect herbivore, compared with a non-mycorrhizal individual. Mycorrhizal effects on plants that could be of importance to insects include altered nutritional quality, chemistry or simple physical features such as overall size. Our knowledge of how mycorrhizas can affect phytophagous insects is restricted, but here I will give an outline of the interactions that have been found and will attempt to produce a synthesis of these patterns. I will address the mechanisms by which these interactions occur and will place the work in a multitrophic context by considering higher trophic levels as well.

7.14.4. Effects of belowground and aboveground organisms on plant floral traits and seed set

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In animal-pollinated plants, fitness is influenced by floral traits that function as advertisement and reward for pollinators. It is increasingly recognized that belowground and aboveground communities are highly interdependent and studies on how belowground organisms affect flowering traits and seed set may lead to a more integrative view of the functioning of terrestrial ecosystems. In a three-factorial common garden experiment we investigated single and combined effects of root herbivores, leaf herbivores and decomposers on floral traits and seed set of wild mustard (*Sinapis arvensis*). Reduced nutrient availability through leaf herbivory affected primarily floral traits that could be important for pollinator attraction. Improved nutrient supply through decomposer activity was invested in seed production but did not affect floral traits. Our results suggest that *S. arvensis* faced no strong selection pressure from pollen limitation. Ultimately, this study may lead to a more detailed understanding of how belowground and aboveground plant-animal interactions shaped the evolution of plant species.

7.14.5. Linking above and belowground multitrophic communities: consequences for diversity and ecosystem functioning

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Aboveground and soil dwelling communities are spatially separated. Plants exist both aboveground and in the soil and as primary producers they obviously influence both compartments. Evidence is now accumulating that organisms living above- and belowground can also influence each other via the plant. Most of this evidence is based on single interactions using one host plant and one aboveground and belowground organism. Using artificial grassland communities consisting of plant, soil, and aboveground communities, we will show how in a complex system above- and belowground communities can influence each others dynamics. Soil community composition influenced plant diversity and ecosystem functioning. Moreover, aboveground plant primary and secondary chemistry changed depending on soil community composition, resulting in reduced herbivore populations, but increased performance of the natural enemy of the herbivore, leading to an aboveground trophic cascade mediated by belowground organisms.

7.14.6. Nutrient competition may cause spatially structured herbivory on lupines at Mount St. Helens.

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A 3 yr nutrient addition experiment on primary successional substrates at Mount St. Helens, USA, demonstrated N limitation of most community members, but P limitation of *Lupinus lepidus*, the N-fixing, dominant colonist. P addition increased the proportion of lupin seeds filled (yr 1) and % cover (yr 3). Forb % cover also increased by yr 3 in P plots, suggesting N-P co-limitation of the community. Removing neighbors around focal plants increased

lupin relative growth (RGR), survivorship, and the RGR response to P fertilization. *L. lepidus* is subject to intense herbivory by lepidopteran larvae in low density patches that is absent in the high density patches studied here. Larvae raised in captivity typically have higher RGR on leaves from low density patches, which are usually higher in N and P. However, larval RGR and gross growth efficiency increased with leaf P content but not leaf N. In glasshouse, P fertilization increased leaf N and P and larval RGR. In the field, larvae placed on plants 1 yr after neighbor removal consumed more leaf surface area. We hypothesize that P limitation of lupin under competitive conditions excludes herbivores from high density patches.

7.14.7. Above- and belowground pathogens: driving the evolution of plant sexual reproduction?

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A popular but largely unproven hypothesis on why sexual reproduction is so widespread is that the production of variable offspring provides better protection against rapidly evolving pathogens. Scarce empirical tests of this hypothesis in plants have focused on the effects of aboveground pathogens. Increasing awareness that belowground pathogens can play an important role in shaping plant diversity prompts us to consider the potential role of soil pathogens. Do these pathogens pose selection pressures that are strong and specific enough to shape genetic variation within plant populations, and to drive the evolutionary maintenance of plant sexual reproduction? And how do their effects compare to or interact with those of aboveground pathogens attacking the same plant species? I will discuss existing views on this, and will outline a strategy to address the issue empirically using dandelions as a model system - a species that has sexual as well as asexual forms and that is attacked by both aboveground and belowground pathogens.

7.15.1. Human impact, ecosystem management and ecosystem conservation in protected areas

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The earth has always been under transformation by natural forces, but today it is being transformed by human action. The human imprint on the earth's landscape is profound: natural ecosystems are being transformed into highly altered systems. Even in protected areas, some ecosystems have been seriously degraded or destroyed. The consequences are: loss of biodiversity at all levels of organization, habitat destruction, extinction and endangerment of species. This is particularly serious in areas with a long history of intense use by humans and at the same time with high level of biodiversity. Among these areas those located in Mediterranean region are very significant. Here there are many hot spots of biodiversity. We urge that, particularly on protected areas, ecosystem management be conservative. In this areas the core of ecosystem management should be ecosystem protection and restoration. Therefore, where it is necessary to use natural resources we must carry out ecosystem management strategies which ensure to maintain their ecological integrity. Sustainable resource use is necessary to ensure the future of life on the earth.

7.15.2. National Parks Kopaonik and Tara (Serbia) - management and nature conservation challenge

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Two out of five National Parks in Serbia, Tara and Kopaonik Mts were enounced in the same year and are placed into the same law category, but they did not have the same destiny. The long-term negative influence on Kopaonik culminated in building of a huge hotel complex and ski paths at the ecologically most important and floristically richest area of the mountain. Consequences of direct and indirect negative influence, destruction, degradation and change of natural structure of phytocenoses led to serious disturbance of stability of ecosystems. The only chance for stopping this process and recovery of the area is the strict application of ecological principles and extremely sustainable use of natural resources on Kopaonik. On Tara Mt, due to controlled use of resources, there are some spacious very well preserved forest complexes, the main asset of which are the relict biocenoses and species. The state of ecosystems, conservation