

Abstract

There is a considerable evidence of both cooperation and synergism between groups of organisms concentrated around mycorrhiza rather than the rhizosphere of plants being inhabited by a very diverse population of competing organisms. A huge increase has taken place in the detailed understanding of the microbial environment surrounding plant root systems and of the processes involved in the establishment of the mycorrhiza symbiosis. It seems that if the interaction between microbes and plants is of particular interest to the development of a sustainable agriculture, the relationship is carefully choreographed through complex signaling systems. This development has also allowed a more holistic approach to the investigation of mycorrhiza and the possibility for optimizing the beneficial aspects of the symbiosis. Much of our detailed knowledge of the interaction between arbuscular mycorrhizal fungi (AMF), bacteria, and plants comes from legumes, members of the Fabaceae, which form symbiotic relationships with both AMF and nitrogen fixing "rhizobia." The three groups of organisms establish a tripartite interaction that may also involve additional endophytic partners. There is considerable similarity in the development of the symbiosis between the contrasting microbial symbionts – fungi and bacteria – and the host legume. Although there is no competition for infection sites between AMF and rhizobia, there can be resources from the host plant. The benefits from mycorrhiza in the tripartite interaction are enhanced when the host plant is colonized early, especially from an intact extraradical mycelium (ERM). Such AMF colonization can also stimulate more rapid formation of root nodules by rhizobia. An increased rate of photosynthesis or greater green leaf area can be triggered in the host plant in response to AMF colonization, which enhances the available carbon resources within the tripartite symbiosis. The interactions between AMF and other bacteria is less well understood but some of the species that are found in close association with AMF have been shown to enhance the formation of mycorrhiza on receptive hosts and most of the "mycorrhiza helper bacteria" have some beneficial effects on the development of the mycorrhizal host plant. The interactions with soil fauna, particularly grazing arthropods, do not suggest that AMF or their host plants are adversely affected by these activities.

Keywords: Soil biota; colonization mechanisms; chemical signaling; tripartite symbiosis; Fabaceae; rhizobia; mycorrhizal helper bacteria; agronomic practices