Mycorrhizal Symbiosis and Evolution of Myco-Heterotrophy in Plants

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Mycorrhizal symbiosis is one of essential interactions for majority of vascular plants and many moss species are also known to have similar interactions with glomeromycotan fungi. In this symbiotic system, plants provide carbon sources to fungi whereas fungi support absorption of inorganic nutrients from roots of plants. In some plant-mycorrhizal fungi interactions, however, plants depend on their carbon sources to fungi completely. This nutritional form is called myco-heterotrophy and only about 450 spp. of plants with this form were known in the world. Some myco-heterotrophic plants have associations with mycorrhizal fungi of other plants and draw carbon sources from trees through fungi while others depend on saprophytic fungi and obtain carbon sources from fungi directly.

Myco-heterotrophic plants show two characteristic features on fungal relationships. One is specificity on fungal partnership. Most myco-heterotrophic monotropoids and orchids show extreme specificity to their mycorrhizal fungi. Some of arbuscular mycorrhizal fungi-dependent plants also highly specialized to their fungal partners. The other is fungal partner change during the evolution of myco-heterotrophic species. Most species of myco-heterotrophic orchids depend on basidiomycotan fungi other than anamorphic *Rhizoctonia* known as "orchid fungi".

In some myco-heterotrophic lineages, fungal partner changes were precedential to the losses of photosynthetic ability and mixotrophic plants which obtain carbon sources both from own photosynthesis and from fungal provision evolved as intermediate states to the complete myco-heterotrophy. Mixotrophic plants provide suitable systems to study the evolution of myco-heterotrophy and accompanied events with the evolution (partner changes and specialization to particular fungi) Ongoing studies about plant-fungi relationships in a mixotrophic orchid and a annual gentian will be presented.