

The evolution of mycoheterotrophy in Neottieae

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Mycoheterotrophy, the nutrition based on carbon from mycorrhizal fungi, is how all orchids start their lives during the germination of their reserve-less seeds. Whereas most of them then develop leaves and become photosynthetic, some species arisen independently remain achlorophyllous and continue to feed mycoheterotrophically for their whole lifespan. Others use both photosynthetic and mycorrhizal carbon sources, a nutrition called mixotrophy. Mycoheterotrophy at adulthood has evolved several times in different orchids lineages, such as the well-studied tribe Neottieae. This group of terrestrial Epidendroideae encompasses six genera with species showing the three nutrition types described above: autotrophy, mycoheterotrophy and mixotrophy. The phylogenetical relationships between the genera has however remained unclear for long. Here we present a robust phylogenetical framework as well as newly sequenced plastidial genomes of Neottieae spp. We suggest a reconstruction of the evolutionary history of mycoheterotrophy in this group and the associated changes in chloroplast functioning. Our results reveal a continuum in plastidial genome degradation, which does not always match the level of mycoheterotrophy, suggesting asynchronous metabolic and genomic evolutions towards mycoheterotrophy in Neottieae.