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Influence of Mycorrhizal Fungi on Orchid Distribution and Population Dynamics

Marc Selosse*

Department of Plant Taxonomy and Nature Conservation, University of Gdańsk, Gdańsk, Poland

(Corresponding author: Marc Seolosse)

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DESCRIPTION

In some areas of their natural range, more than 50% of native orchids in North America are classified as vulnerable or endangered. Propagation is a crucial component in orchid conservation. Each stage of the orchid's existence is dependent on certain fungi to some extent, and there exists a complicated symbiotic relationship between them and mycorrhizal fungi. Early on, mycorrhizal fungi provide all of the nutrients, including carbon that orchids need. While the interaction with symbiotic fungi is essential, the life cycle of an orchid also depends on specific environments and pollinators. Since pollinators, fungi, and orchids are frequently used as indicators of the health of the environment as a whole, it is important to comprehend their biology, ecology, and ecosystem needs in order to create successful procedures for orchid preservation and propagation.

For life to exist on Earth, symbiotic relationships are essential. 10% of all plant species in the world are orchids. Orchids are good examples for researching symbiotic relationships since they develop symbiotic relationships with both fungus and pollinators that can be either mutually advantageous or predatory. For effective orchid conservation, it's critical to investigate how environmental factors, mycorrhizal fungi distribution, and abundance affect the distribution and flowering of orchids.

Numerous ecological variables, including the emergence of holobionts, which are crucial for colonisation and the development of ecological communities, have an impact on the distribution and population dynamics of orchids. Mycorrhizal cheating in photosynthetic orchids is becoming more common. Orchid Mycorrhizal Fungi (OMF) is essential for seed germination, seedling establishment, reproduction, and the survival of many orchid species. As a result, changes in the OMF's composition and quantity can have a significant impact on the distribution and fitness of orchids. Because of the insights it can offer into the interactions and coexistence patterns among species, network analysis is a crucial technique for the study of interactions between plants, microorganisms, and the environment.

In nature, symbioses are common and have an impact on both individual plants and populations. Depending on the life history stage, fungi provide all or part of the carbon and other necessary elements for orchids. Therefore, the presence of orchid mycorrhizal fungus is necessary for the survival of orchid populations. Recent research suggests a connection between orchid density and dormancy, which cause apparent density disparities, and OMF abundance. When OMF were plentiful, orchids were more numerous, less likely to go dormant, and more likely to reappear. The difference between OMFs and endophytic fungi, as well as the purpose of non-mycorrhizal endophytes in orchid roots, both require further study.

Abiotic and biotic factors limit the distribution and abundance of orchid populations. At the large landscape scale, these factors include latitude, macroclimate, area size, and evolutionary history. At the local landscape scale, they are soil properties, light conditions, substrate types, degree of disturbance, pollinating insects, and seed production and dispersal. The effects of altitude, soil moisture, and pH may also be felt at both scales. Depending on the spatiotemporal scale under consideration, these elements may have different effects.

OMF play a crucial role in seed distribution and germination, the establishment of new seedlings, and the soil niche partitioning of their lifelong host orchids, despite the fact that orchids contain dust-like seeds that typically lack nutrition. Microhabitats rich in OMF typically promote increased seed germination and seedling establishment in natural habitats, and more orchids tend to develop in regions with richer OMF distribution. Therefore, modifications in the OMF's composition, abundance, and evenness may have a significant impact on the suitability of orchids, which in turn alters their distribution and community.

During nutritional dormancy, most orchids encounter carbon constraints. It is believed that the local availability of suitable fungi is related to the orchids' ability to emerge from dormancy during this period, during which they require fungi to deliver nutrition. Therefore, OMF availability may influence the dormancy process, thereby influencing the population features and reproductive success, which may then change the apparent density of orchid populations. The introduction of OMF in areas devoid of orchids but close to existing orchid populations can be successful, according to OMF inoculation trials. As a result, OMF abundance may also speed up seed germination and protocorm development.

It's interesting to note that there appears to be some correlation between the abundance of OMF and the distribution of adult orchids, indicating that the location of adult orchids influences the diversity and abundance of OMF to some extent. Furthermore, numerous studies show that autotrophic orchids provide nutrition to fungi. Therefore, we cannot completely rule out the notion that the density of autotrophic orchids is to blame for the abundance of OMFs.

CONCLUSION

The spatiotemporal variation in OMF may play a more significant role in defining the distribution and population dynamics of orchids than the distribution, quantity, and identity of OMF. As more orchid species coexist in the natural environment, the high spatiotemporal turnover rate of OMF may also lessen resource rivalry through niche separation. Numerous studies on the coexistence of terrestrial orchids that combine spatial point pattern analysis and OMF phylogenetic analysis support this. According to these studies, coexisting orchid species have distinct OMF communities with low overlap at fine spatial scales, and individual orchid species frequently occur as high-density clusters with strong local dominance. Therefore, the spatial distribution and interactions of the related OMF may operate as a mediator in the co-occurrence of terrestrial orchids seen in nature. The link between OMF and the spatial distribution of epiphytic orchids on various phorophytes has, however, received relatively little attention. Because approximately 70% of orchids are epiphytic, the scarcity of such studies limits our understanding of how OMF affect orchid distribution and population dynamics. Further research on the variables influencing OMF quantity and its effects on orchid individuals and populations is also necessary.