Impact Summary

Title: Facultative mycorrhization in a fern (Struthiopteris spicant L. Weiss) is bound to light intensity

Audience: Academic research funders and grant evaluation panels (SNF, ERC, Horizon Europe)

Reference: Guillen-Otero et al. (2024), BMC Plant Biology

A strong impact summary might be the final push that puts you in front of any other proposal to receive that grant. In this document I used an accessible tone and a broad integrative vision to demonstrate to funders and evaluation committees the current and future implications of a peer-reviewed research. I translated experimental findings into scientific significance, conceptual advance and future research direction.

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RESEARCH Open Access

Facultative mycorrhization in a fern (*Struthiopteris spicant* L. Weiss) is bound to light intensity

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Abstract

Background The establishment of mycorrhizal relationships between a fungus and a plant typically enhances nutrient and water uptake for the latter while securing a carbon source for the fungus. However, under a particular set of environmental conditions, such as low availability of light and abundant nutrients in the soil, the resources invested in the maintenance of the fungi surpass the benefits obtained by the host. In those cases, facultative mycorrhizal plants are capable of surviving without symbiosis. Facultative mycorrhization in ferns has been overlooked until now. The present study measured the response of *Struthiopteris spicant* L. Weiss, and its root-associated fungi to different levels of light and nutrient availability in terms of growth, mycorrhizal presence, and leaf nutrient content. This fern species exhibits a great tolerance to variable light, nutrient, and pH conditions, and it has been found with and without mycorrhizae. We conducted a greenhouse experiment with 80 specimens of *S. spicant* and three factors (Light, Phosphorus, and Nitrogen) resulting in eight treatments.

Results We found a significant influence of the factor light on fungal community composition, plant biomass, and nutrient accumulation. Departing from a lack of colonization at the initial stage, plants showed a remarkable increment of more than 80% in the arbuscular mycorrhizal fungi (AMF) richness and abundance in their roots when grown under high light conditions, compared with the ones in low light. We also observed an upward trend of C:P and C:N ratios and the above- and belowground biomass production when AMF abundance increased. Furthermore, the compositional analysis of the whole fungal communities associated with *S. spicant* roots revealed clear differences among low-light and high-light treatments.

Conclusions This study is the first to investigate the importance of light and nutrient availability in determining fern-AMF relationships. We confirmed that *Struthiopteris spicant* is a facultative mycorrhizal plant. The composition and diversity of AMF found in the roots of this fern are strongly influenced by light and less by nutrient conditions. Our study shows that ferns respond very sensitively to changes in environmental factors, leading to shifts in the associated mycorrhizal communities.

Keywords *Struthiopteris spicant*, Facultative mycorrhizal plant, mycorrhizal status, fern, arbuscular mycorrhizal fungi, ITS, Greenhouse experiment, Light, Nutrients

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SCIENTIFIC GAP

Facultative mycorrhizal plants can live with or without mycorrhizae depending on environmental conditions. This phenomenon, described in angiosperms, has not been experimentally demonstrated in ferns. Yet, many ferns act as pioneer species and often establish in nutrient-poor, toxic, or disturbed areas where suitable fungal partners might be absent. It is still unknown whether certain fern species can regulate mycorrhizal associations in response to different habitat factors.

BREAKTHROUGH CONTRIBUTION

This study provides the first experimental evidence of facultative mycorrhization in *Struthiopteris spicant* (deer fern). Under controlled settings, its association with mycorrhizal fungi was driven by light rather than nutrients. High light conditions corresponded with a significant increase in the richness and abundance of arbuscular mycorrhizal fungi. These findings suggest that the development of mycorrhizal symbiosis in this fern species is regulated by the carbon availability (the plant's photosynthetic output).

VALUE CREATED

This new evidence challenges the assumption that fern-fungus relationships are nutrient-dependent, revealing an environmental regulation angle. The variation in the abundance and composition of mycorrhizal communities within a single fern species demonstrates that *S. spicant* can change its interactions with root-associated fungi depending on photosynthetic balance. This conceptual advance

To read the full summary, click **here**.