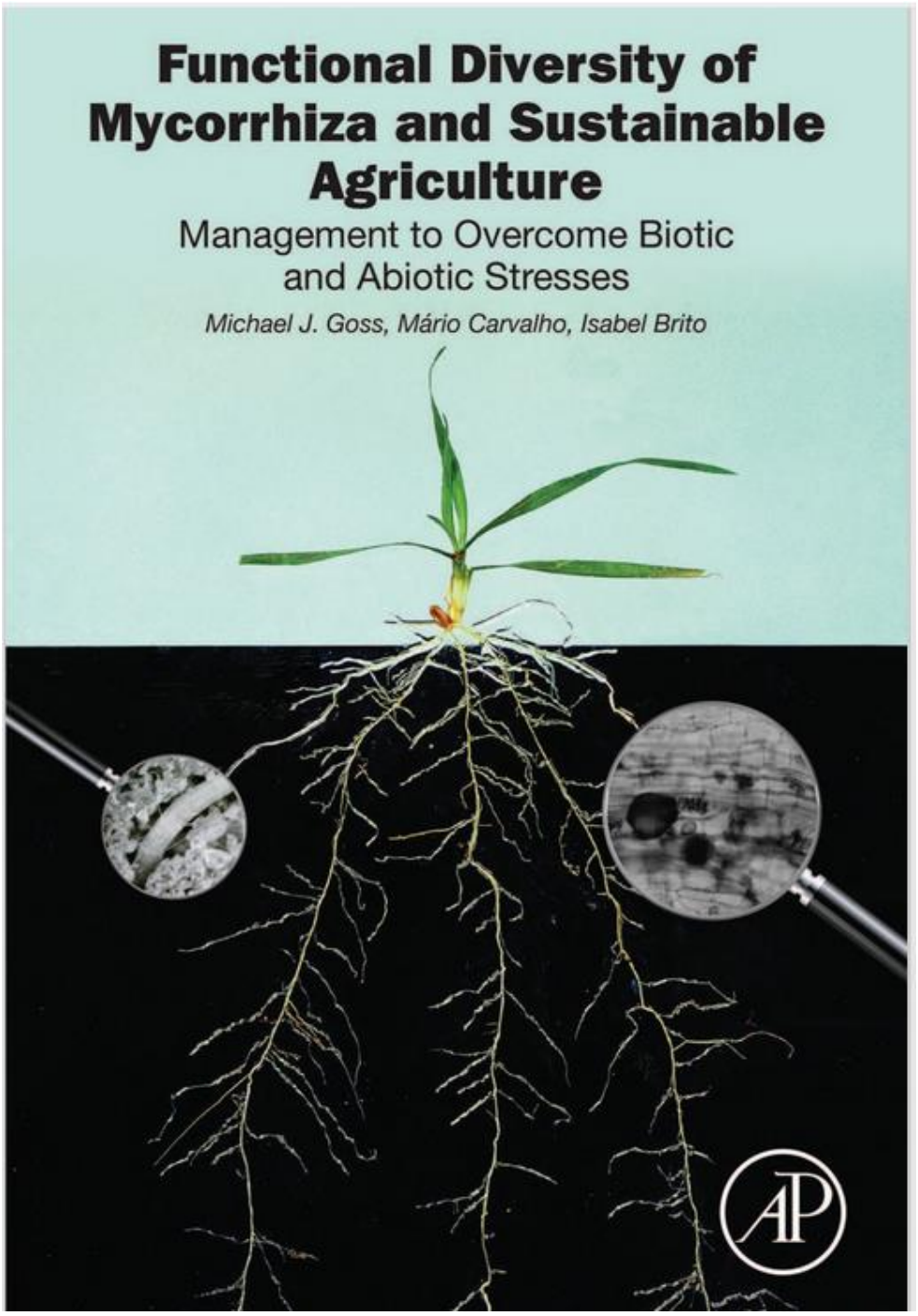
Functional Diversity of Mycorrhiza and Sustainable Agriculture
Management to Overcome Biotic and Abiotic Stresses
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Academic Press is an imprint of Elsevier
125 London Wall, London EC2Y 5AS, United Kingdom
525 B Street, Suite 1800, San Diego, CA 92101-4495, United States
50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom

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British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
A catalog record for this book is available from the Library of Congress

ISBN: 978-0-12-804244-1

For Information on all Academic Press publications
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Publisher: Nikki Levy
Acquisition Editor: Nancy Maragioglio
Editorial Project Manager: Billie Jean Fernandez
Production Project Manager: Lisa Jones
Cover Designer: Mark Rogers

Typeset by MPS Limited, Chennai, India

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ACADEMIC PRESS

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Chapter 5 – Impacts on Host Plants of Interactions Between AMF and Other Soil Organisms in the Rhizosphere*

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https://doi.org/10.1016/B978-0-12-804244-1.00005-8

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; Fabeacea; rhizobia; mycorrhizal helper bacteria; agronomic practices

* With Luís Alho and Sabaruddin Kadir.