Journal of Plant Growth Regulation
https://doi.org/10.1007/s00344-021-10392-5

Arbuscular Mycorrhizal Fungi in Conferring Tolerance to Biotic Stresses in Plants

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Received: 4 January 2021 / Accepted: 7 May 2021

Abstract

Mycorrhiza is a symbiotic association between the roots of plants with fungi. Among the various types of mycorrhizal fungi, arbuscular mycorrhizal fungi (AMF) are the most prominent as they are obligate symbionts with a wide host range, and they play a major role in shaping ecosystems and associated productivity. Approximately 71% of vascular plant species are able to form symbiotic association with AMF. AMF primarily rely on the host for photosynthates but give much more in return for the well-being of the host plant. Most importantly they are able to improve tolerance of host plants against various biotic stresses, such as—bacterial, fungal, viral, nematode phytopathogens and herbivores. The underlying mechanism includes—competition for nutrients, space, and host photosynthates, rhizosphere alteration and host defense induction. The effectiveness of an AM association in conferring biotic stress tolerance is context dependent, affected by various biotic and abiotic factors. This review describes various mechanisms involved in AMF mediated biotic stress tolerance in plant and the biotic and abiotic factors which influences the performance of AM association.

Keywords Arbuscular mycorrhizal fungi · Symbiosis · Defense · Biotic stress

Abbreviations

AMF	Arbuscular mycorrhizal fungi
AM	Arbuscular mycorrhiza
PPN	Plant pathogenic nematodes
MAMP	Microbe associated molecular patterns
MTI	MAMP triggered immunity
ETI	Effector triggered immunity
PGPR	Plant growth promoting rhizobacteria

Introduction

Instead of considering plants as single living autonomous entities, a much suitable term would be to suggest them as holobionts consisting of the host plant and associated microorganisms. These microorganisms maintain a connection to the plant employing various biotic interactions, of which mutually beneficial interactions or symbiosis holds a special case scenario in terms of the benefits exerted to its stakeholder organisms. A widely occurring symbiotic association of plant roots with fungi is termed as "mycorrhiza". Plants exhibit a diverse array of symbiotic associations with microorganisms, but the AM association is considered very important as it plays a key role in shaping both agricultural and natural ecosystems and their associated productivity (Bonfante and Genre 2010). Due to their key role in various ecosystems, AMF has been recognized as a keystone taxon in microbial communities (Powell and Rillig 2018). AMF belongs to the subphylum Glomeromycotina of the phylum Mucoromycota (Spatafora et al. 2016).

Approximately, 71% of all vascular plant species are able to establish an AM symbiosis (Fernández et al. 2019). AMF, which establish symbiotic associations with terrestrial plants, are obligate symbionts as they cannot complete their life cycle without a host plant (Sugiura et al. 2020). In the

Handling Editor: Rhonda Peavy.

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Published online: 23 May 2021