The Role of Arbuscular Mycorrhizal Symbiosis in Plant Adaptation to Drought Stress

著者	CHEN Baodong
journal or publication title	Journal of Integrated Field Science
volume	15
page range	68-68
year	2018-10
URL	http://hdl.handle.net/10097/00124009

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It has been well demonstrated that arbuscular mycorrhizal (AM) symbiosis can improve plant drought tolerance. To reveal the relative importance of mycorrhizal fungi and root hairs in plant water relations, a bald root barley (brb) and its wild type (wt), were grown with or without inoculation of the AM fungus, *Rhizophagus intraradices* under well-watered or drought conditions, and plant physiological traits relevant to stress resistance were recorded. The experimental results indicated that AM fungi could almost compensate for the absence of root hairs under drought-stressed conditions. Moreover, our results confirmed that AM fungi could enhance plant drought tolerance by improving P uptake and plant-water relations, which subsequently promoted plant photosynthetic performance and growth, while root hairs presumably contributed to the improvement of plant growth and photosynthetic capacity through an increase of shoot P concentration.

In the following study, we cloned two full-length aquaporin genes, namely *GintAQPF1* and *GintAQPF2*, by rapid amplification of cDNA 5'- and 3'-ends from an AM fungus, *Glomus intraradices*. The expression of the two genes in arbuscule-enriched cortical cells and extraradical mycelia of maize roots was enhanced significantly under drought stress. Aquaporin localization, activities and water permeability were examined by heterologous expression in yeast. *GintAQPF1* and *GintAQPF2* are the first two functional aquaporin genes from AM fungus. Our data strongly support potential water transport via AM fungus to host plants.

In a split-root experiment, we further investigated the interactions between host plant and AM fungus under drought stress. Although mycorrhizal inoculation in either one or both compartments systemically decreased abscisic acid (ABA) content in the whole root system subjected to systemic or local drought stress, we observed local and/or systemic AM effects on root physiological traits and the expression of the functional genes in both roots and AM fungus *R. intraradices*. Interestingly, the simultaneous increase in the expression of plant genes encoding D-myo-inositol-3-phosphate synthase (IPS) and 14-3-3-like protein GF14 (14-3GF), which were responsible for ABA signal transduction, was found to be involved in the activation of 14-3-3 protein and aquaporins (GintAQPF1 and GintAQPF2) in *R. intraradices*. These findings suggest that co-expression of *IPS* and *14-3GF* is responsible for the crosstalk between maize plant and *R. intraradices* under drought stress.

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