

Phosphate Regulation of Arbuscular Mycorrhiza Symbiosis in Rice

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Abstract : Arbuscular mycorrhiza (AM) is a mutualistic symbiosis between plant roots and Glomeromycotina fungi, which is activated under low but inhibited by high phosphate. The effect of phosphate on AM development has been observed for many years, but mechanisms regulating it under contrasting phosphate levels remain unknown. Based on previous observations that promoters of several AM functional genes contain PHR binding motifs, we hypothesized that PHR2, a master regulator of phosphate starvation response in rice, was recruited to regulate AM symbiosis development. We observed a drastic reduction in root colonization and significant AM transcriptome modulation in *phr2*. PHR2 targets genes required for root colonization and AM signaling. The role of PHR2 in improving root colonization, mycorrhizal phosphate uptake, and growth response was confirmed in field soil. In conclusion, rice PHR2, which is considered a master regulator of phosphate starvation responses, acts as a positive regulator of AM symbiosis between Glomeromycotina fungi and rice roots. PHR2 directly targets the transcription of plant strigolactone and AM genes involved in the establishment of this symbiosis. Our work facilitates an understanding of ways to enhance AMF propagule populations introduced in field soils (as a biofertilizer) in order to restore the natural plant-AMF networks disrupted by modern agricultural practices. We show that PHR2 is required for AM-mediated improvement of rice yield in low phosphate paddy field soil. Thus, our work contributes knowledge for rational application of AM in sustainable agriculture. Our data provide important insights into the regulation of AM by the plant phosphate status, which has a broad significance in agriculture and terrestrial ecosystems.

Keywords : biofertilizer, phosphate, mycorrhiza, rice, sustainable, symbiosis

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