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Take-all disease is systemically reduced in roots of mycorrhizal barley plants

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Abstract

The systemic effect of root colonization by the arbuscular mycorrhizal fungus *Glomus mosseae* on infection of barley by *Gaeumannomyces graminis* var. *tritici* (Ggt) was studied. In split-root systems of barley one side was inoculated with *G. mosseae* and the other side was inoculated with Ggt.

Root infection by Ggt was systemically reduced when barley plants showed high degrees of mycorrhizal root colonization, whereas a low mycorrhizal root colonization exhibited no effect on Ggt infection. Our results show a clear systemic bioprotectional effect depending on the degree of root colonization by the mycorrhizal fungus. At a higher mycorrhizal colonization rate the concentration of salicylic acid (SA) was increased in roots colonized by the mycorrhizal fungus but no systemic increase of SA could be measured in non-mycorrhizal roots of mycorrhizal plants, indicating that the systemic bioprotectional effect against Ggt is not mediated by salicylic acid.

Keywords: Arbuscular mycorrhiza; Barley; Bioprotection; *Gaeumannomyces graminis*; Salicylic acid; Systemic resistance

1. Introduction

Arbuscular mycorrhizal fungi (AMF) colonize roots of most plant species. AMF and plants live in a symbiotic relationship where both partners derive benefits from the association. Mycorrhizal plants show an improved nutrient status, mainly phosphorus (P), whereas the AMF is provided by the plant with carbohydrates (Smith and Read, 1997).

Mycorrhizal root colonization also provides a bioprotectional effect against a broad range of soil-borne fungal pathogens (Dehne, 1982; Singh et al., 2000; St-Arnaud and Vujanovic, 2006). Take-all disease, which is caused by *Gaeumannomyces graminis* var. *tritici* (Ggt), is the most important root disease of cereal plants such as wheat, barley and rye (Asher and Shipton, 1981; Hornby et al., 1998; Cook, 2003), however, only few reports are available on a bioprotectional effect of AMF on Ggt. It has been reported that root colonization by AMF locally reduces lesions caused by Ggt in wheat roots (Graham and Menge, 1982) and enhances the shoot and root growth of plants colonized by Ggt compared to non-mycorrhizal Ggt-colonized wheat plants (Graham and Menge, 1982; Ksiezniak et al., 2001).

Some data on a local bioprotectional effect of mycorrhizal root colonization against soil-borne fungal pathogens have been reported (Dehne, 1982; Singh et al., 2000; St-Arnaud and Vujanovic, 2006), however, only scarce data are available on a systemic bioprotective effect of mycorrhizal root colonization. In two reports with *Phytophthora parasitica* and tomato the development of a systemic resistance through root colonization by AMF has been suggested (Cordier et al., 1998; Pozo et al., 2002). Although a systemic resistance towards Ggt has been reported with sterile red fungus, a basidiomycete, which is known to suppress infection of wheat roots by Ggt (Aberra et al., 1998), no data are available yet on a systemic bioprotective effect of mycorrhizal colonization against take-all disease caused by Ggt.

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