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ORIGINAL PAPER

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Root exudates of mycorrhizal tomato plants exhibit a different effect on microconidia germination of *Fusarium oxysporum* f. sp. *lycopersici* than root exudates from non-mycorrhizal tomato plants

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Abstract The effect of root exudates from mycorrhizal and non-mycorrhizal tomato plants on microconidia germination of the tomato pathogen *Fusarium oxysporum* f. sp. *lycopersici* was tested. Microconidia germination was enhanced in the presence of root exudates from mycorrhizal tomato plants. The more tomato plants were colonized by the arbuscular mycorrhizal fungus *Glomus mosseae*, the more microconidia germination was increased, indicating that alterations of the exudation pattern depended on the degree of root AM colonization. Moreover, alterations of the exudation pattern of mycorrhizal plants are not only local, but also systemic. Testing the exudates from plants with a high and a low P level revealed that the alterations of the root exudates from mycorrhizal plants, resulting in a changed effect on microconidia germination, are not due to an improved P status of mycorrhizal plants.

Keywords Arbuscular mycorrhiza · Glomales · Fusarium oxysporum · Microconidia · Tomato · Root exudates

Introduction

Arbuscular mycorrhizal fungi (AMF) are symbiotic soil fungi that colonize roots of about 80% of vascular plants. The mycorrhizal symbiosis enhances the growth and survival of numerous plant species (Smith and Read 1997). The establishment of the highly complex mycorrhizal association requires a continuous exchange of signals between the host roots and AMF, which affects the whole metabolism of the host (Smith and Read 1997).

It is reasonable to speculate that changes in the metabolism of the mycorrhizal host plant also result in a changed root exudation, which, in consequence, exhibits a different bioactive effect on organisms around the root (Vierheilig and Piché 2002; Vierheilig 2004a). In in vitro conditions, the first evidence of an altered root exudation of mycorrhizal plants has been provided with exudates from cucumber plants. Root exudates of mycorrhizal cucumber plants showed a reduced stimulatory effect on AM hyphal growth and an inhibitory effect on root colonization by AMF (Pinior et al. 1999; Vierheilig et al. 2003). Moreover, a changed exudation pattern of mycorrhizal plants has been suggested to be at least partially involved in the altered susceptibility of mycorrhizal plants towards soil-borne microorganisms (Vierheilig and Piché 2002; Vierheilig 2004a) such as fungi, bacteria, and nematodes. In in vitro studies, root exudates from mycorrhizal strawberry plants reduced the sporulation of *Phytophthora fragariae* (Norman and Hooker 2000) and root exudates from mycorrhizal potato plants increased hatching of nematodes (Ryan and Jones 2004).

Recently, it has been shown that root exudates collected from non-mycorrhizal tomato roots exhibit a higher attracting effect on zoospores of *Phytophthora parasitica* than root exudates from mycorrhizal tomato roots (Lioussanne et al. 2003). An inverse effect was observed with the chemotactic response of plant-growth-promoting bacteria. Root exudates from mycorrhizal tomato plants showed a higher attractional effect on plant-growth-promoting bacteria, such as *Azobacter chroococum* and *Pseudomonas fluorescens*, compared to root exudates from non-mycorrhizal tomato plants (Sood 2003).

Although there are some data on the effect of root exudates from mycorrhizal plants on symbiotic and pathogenic soil microorganisms, nothing is known yet on the effect of root exudates from mycorrhizal plants on the microconidia germination of the tomato pathogen *Fusarium oxysporum* f. sp. *lycopersici* (*Fol*).

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