

# The effect of fungicides on vesicular-arbuscular mycorrhizal symbiosis

## II. The effects on area of interface and efficiency of P uptake and transfer to plant

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### SUMMARY

Two experiments were conducted under controlled environmental conditions to determine the effects of the three fungicides, Benlate®, Aliette® and Ridomil®, on efficiency of P uptake from the soil and transfer across the living plant-fungal interface of onion plants (*Allium cepa* L.) associated with *Glomus* sp. 'City Beach' (WUM 16). P applied to the soil did not apparently increase the rate of transfer (flux) of P to the plant via the fungal partner of the mycorrhiza.

Benlate reduced P inflow and transfer across the interface in one of the experiments. The rate of P uptake per m living external hyphae was not affected but, as development of living external hyphae in the soil was reduced, the contribution of the fungus to P uptake was small. Aliette reduced growth of both shoots and roots, but apparently increased the accumulation of P in the tissues compared with controls. Ridomil reduced P inflow per m of root and P uptake per m living external hyphae, but had no effect on the rate of P transfer across the interface. This led to a reduction in the overall contribution of the fungus to P nutrition.

Key words: P inflow, P flux, *Allium cepa*, *Glomus* sp. 'City Beach', fungicide.

### INTRODUCTION

Assessment of the effects of fungicides on the function of mycorrhizas is important in the context of development of agricultural and horticultural management practices that maximize the contributions of the fungi to plant nutrition and growth while minimizing the effects of fungal plant pathogens. In a previous paper we reported the effects of three fungicides, Benlate, Aliette and Ridomil, on vesicular-arbuscular mycorrhizal (VAM) colonization of the roots of *Allium cepa* L. and on the interactions between colonization, P uptake and plant growth (Sukarno, Smith & Scott, 1993). In agreement with previous work (e.g. Hale & Sanders, 1982; Fitter, 1985; West, Fitter & Watkinson, 1993), Benlate appeared to act only on the fungus, reducing per cent colonization and consequently uptake of P,

and plant growth. In contrast, Aliette, and to a lesser extent, Ridomil, exerted effects on the plant as well as on the fungus.

In this paper we extend the analysis of the effects of fungicides to a more detailed assessment of mycorrhizal colonization and the function of the symbiosis, including the development and efficiency of the external hyphae in taking up P from the soil, the area of interface between plant and fungus, and the rate of P uptake and transfer to the plant. These processes are all essential for the functioning of the symbiosis in terms of P nutrition and hence plant growth (Jakobsen, Abbott & Robson, 1992a, b; Smith *et al.*, 1994; Smith & Gianinazzi-Pearson, 1988) and it is important to understand how they are influenced by fungicides. P inflow (rate of P uptake per unit length of root per unit time) and flux (rate of P transfer from fungus to plant per unit area of interface per unit time) are parameters that can be used to assess the efficiency of the VAM symbiosis with respect to P uptake. Environmental and chemical factors, such as the action of fungicides upon

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