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Arbuscular Mycorrhizal Fungi Increase Pharmaceutically Active Compounds in Valerian Roots

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ABSTRACT

Root colonization by symbiotic arbuscular mycorrhizal fungi (AMF) improves mainly the phosphorus (P) acquisition but additionally alters a range of biological and chemical parameters in plants. In the present study the effect of root colonization by AMF on pharmaceutically active compounds in valerian (*Valeriana officinalis* L., Valerianaceae) such as sesquiterpenic acids and essential oils was determined.
KEYWORDS: *Valeriana officinalis*, Valerianaceae, arbuscular mycorrhizal fungi, sesquiterpenic acids, essential oil, pharmaceutical active compounds

INTRODUCTION

The arbuscular mycorrhizal (AM) symbiosis is a widespread association between plants and fungi. The plant supplies the fungus with carbohydrates while the fungus efficiently transfers phosphorus (P) to the plant. Besides an influence on the biomass and fitness, the secondary metabolism of plants can be altered. In traditional remedies the underground parts of *Valeriana officinalis* are used because of their sedative and tranquillizing activity mainly due to sesquiterpenic acids and the essential oil. In the present study we show the effects of three different AMF on the sesquiterpenic acids and the essential oil concentrations of two *in-vitro* propagated valerian genotypes.

MATERIALS AND METHODS

1.1. Biological material and experimental setup

Seeds of *Valeriana officinalis* were *in-vitro* propagated on modified MS medium (Murashige and Skoog, 1962) containing 30 g/l sucrose, 100 mg/l *myo*-inositol, 3 g/l Gelrite and supplemented with 20 µM BAP. The acclimatized plantlets were transferred into pots containing an autoclaved substrate mixture of sand/soil/expanded clay (1/1/1; v/v/v). The experiment was conducted in the greenhouse for 6 months, included 5 replicates/treatment and two genotypes. The treatments were: **C** (control plants without AMF/without P), **S** (plants with Symbivit®/without P), **M** (plants with *Glomus mosseae*/without P), **I** (plants with *G. intraradices*/without P) and **P** (plants without AMF/with P). The degree of mycorrhization was estimated after staining according to the gridline intersection method (Giovannetti and Mosse, 1980).

1.2. Analysis and Statistics

Analyses were carried out on coarse roots. Sesquiterpenic acids were analyzed by HPLC (Bos et al., 1996). The essential oil was extracted by micro-distillation with Fenchone as internal standard and analyzed by GC/MS and GC/FID. Phosphorus was analyzed according to the ammonium-vanadate-molybdate method (Gericke and Kurmies, 1952). Statistics were performed with multiple comparisions by Tukey`s-b test in SPSS.

RESULTS AND DISCUSSION

In both valerian genotypes AMF-treated roots were successfully colonized (average 65%). All AM plants showed increased sesquiterpenic acid concentrations compared to the control (Fig. 1A), however, a positive effect on the essential oil concentration was only observed for Symbivit (a mixture of 6 different *Glomus* species) in genotype 1 (Fig. 1B). The P concentrations were significantly increased by all AMF and P-treated plants, but non-mycorrhizal/P supplied plants did not increase their level of pharmaceutically active compounds. Thus, these enhancements are rather fungus- than P-mediated. In summary, depending on the inoculum, the AM symbiosis can have a clear positive effect on pharmaceutically active compounds in valerian.

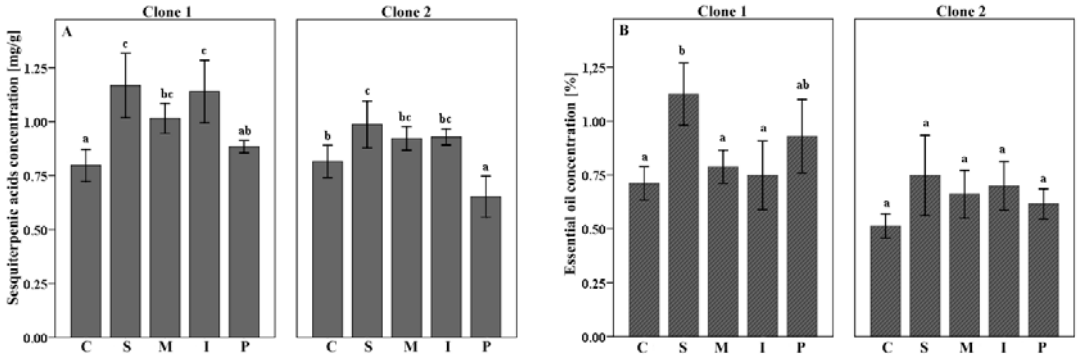

Figure 1. Sesquiterpenic acids in mg/g DW (A) and essential oil concentrations in % (B) of *V. officinalis* coarse roots (mean ± SEM). Different letters within one clone and compound denote significant difference ($P < 0.05$).

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REFERENCES

Bos, R., Woerdenbag, H.J., Hendriks, H., Zwaving, J.H., De Smet, P.A.G.M., Tittel, G., Wikström, H.V., Scheffer, J.J.S. 1996. Analytical aspects of phytotherapeutic valerian preparations. Phytochem Anal 7: 143-151.

Gericke S., Kurmies B. 1952. Die kolorimetrische Phosphorsäurebestimmung mit Ammonium-Vanadat-Molybdat und ihre Anwendung in der Pflanzenanalyse. Z Pflanzenernähr Düng Bodenkd 59: 235-247.

Giovannetti, M., Mosse, B. 1980. An evaluation of techniques for measuring vesicular-arbuscular mycorrhizal infection in roots. New Phytol 84: 489-500.

Murashige, T., Skoog, F. 1962. A revised medium for rapid growth and bio assays with tobacco tissue cultures. Physiol Plant 15: 473-497.