

Auxin-regulation of hyphal elongation and spore germination in arbuscular mycorrhizal fungus, *Gigaspora margarita*

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ABSTRACT

Hormonal effects of auxins, IAA, 2,4-D and NAA, on spore germination and hyphal elongation of arbuscular mycorrhiza, *Gigaspora margarita*, were investigated on agar plate in order to unveil the function of auxin in growth regulation of mycorrhizal fungi. All three auxins enhanced spore germination and hyphal elongation at 10^{-9} M concentration. However, at higher concentrations over 10^{-5} M, these auxins strongly inhibited spore germination and hyphal elongation. These dose-response relationships were identical to that of plant root elongation. Aromatic amino acids, phenylalanine and tyrosine, showed little effects at $10^{-7} \sim 10^{-3}$ M, whereas tryptophan strongly inhibited them at 10^{-3} M. The effective concentration range of auxin was consistent with the reported endogenous level of IAA in plant roots and also with IAA level in rhizosphere. These results indicate the possible function of auxin to regulate spore germination and hyphal elongation of mycorrhizal fungus *Gigaspora margarita*.

KEY WORDS: auxin, *Gigaspora*, hyphal elongation, IAA, mycorrhiza, spore germination

INTRODUCTION

Mycorrhizal fungi play a role in symbiotic roots by interacting with root surface. Although industrially propagated spores of *Gigaspora* are practically used in a farm, controlling mechanism of germination and hyphal elongation of this fungus remains to be unveiled. Auxin, one of the most fundamental plant hormone, exists in soil and many microorganisms produce auxin (Frankenberger-Jr 1995), mainly indole-3-acetic acid (IAA) from tryptophan (TRP). Moreover, IAA produced by plant shoots flows down to root tip, and IAA may diffuse, at least partially, into soil via apoplast space by the exporter proteins of IAA (references in review Tanimoto 2005). Thus, IAA may play a signaling role (Ludwig-Müller and Güther, 2007; Fitze *et al.* 2005.) in symbiotic space of the soil. However, the growth-regulating effect of auxin on the mycorrhizal fungus itself is not clear. We examined auxin effect *in vitro* on spore germination and hyphal elongation of arbuscular mycorrhiza and found the clear dose-response curve.

MATERIALS AND METHODS

Spores of *Gigaspora margarita* Becker & Hall were isolated from VA-Mycorrhiza Material (Serakinkon) purchased from Central Glass Co. Ltd. Tokyo. Spores were aseptically cultured on 1.5% agar plate, with or without auxins and amino acids. Germination and hyphal elongation

were traced by microscope and recorded by Motic Images 2000, Shimazu Co. Ltd. Tokyo.

RESULTS AND DISCUSSION

Figure one shows a typical dose response curve of hyphal elongation affected by IAA concentration. Hyphal length was measured after 10 days incubation on 1.5% agar plate with or without IAA. Nano molar concentration of IAA promoted but micro molar IAA strongly inhibited the elongation. Spore germination was also enhanced by nano molar IAA but was inhibited at micro molar level as reported in *Glomus fistulosum* (Glyndler *et al.*, 1998). Two synthetic auxins, 2,4-D and NAA, showed similar effects on spore germination and hyphal elongation. These concentration-dependent promotion and inhibition curves were similar to those of root elongation. Aromatic amino acids, tyrosine and phenylalanine showed no significant effects, whereas TRP a precursor of IAA, strongly inhibited the elongation. Such a dose-response curve is consistent with well known curve of vascular plant. While externally applied TRP promotes elongation of stem segments of pea (Tanimoto *et al.*, 1967), it strongly suppresses the elongation of roots (Tanimoto unpublished data). Inhibitory effect of tryptophan was also the same as the inhibition of root elongation. These results show the growth regulating function of auxins and its precursor TRP for spore germination and hyphal elongation of mycorrhiza, in addition to the hyphal branching factor, strigolactones (Akiyama 2006).

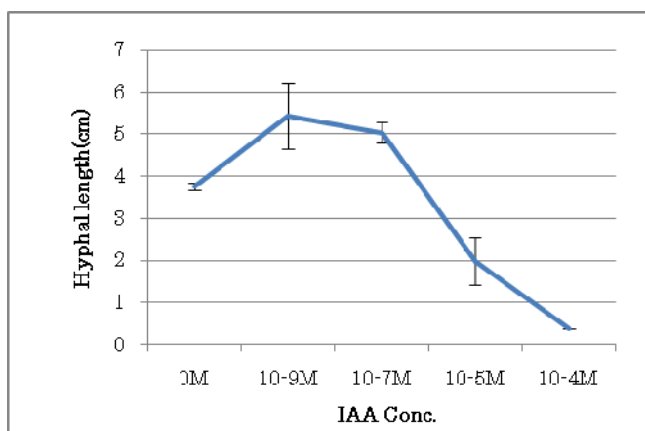


Figure 1. Concentration-dependent regulation of hyphal elongation by IAA after 10 days incubation on agar plate.

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