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## Toxic Effects of Phthalate Esters in Tobacco Root Exudates on Seed Germination and Seedling Growth

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### ABSTRACT

Autotoxicity is among the major reasons that are causing continuous cropping obstacle. It is a toxic influence of chemicals released from one plant species on the germination and growth of individuals of the same species. Here, in order to analyze the autotoxicity of tobacco root exudates, root exudates were collected from tobacco plants cultivated in both cultural solution and natural soil. Through ultra-performance liquid chromatography coupled with triple-quadrupole tandem mass spectrometry main autotoxic chemical substances in the root exudates were identified. Further, the autotoxic effects of the suspected autotoxins on seed germination (including germination rate, germination potential, germination index and vigor index) and seedling growth were also analyzed. As a result, dibutyl phthalate (or diisobutyl phthalate), dioctyl phthalate and diisooctyl phthalate were identified in tobacco root exudates. It was observed high concentration (greater than 0.5 mmol L<sup>-1</sup>) of each produced phthalate esters caused the significant ( $P < 0.05$ ) inhibition of tobacco seed germination and seedling growth as well through autotoxic effect. Finally, our findings also reveal that phthalate esters such as dibutyl phthalate, diisobutyl phthalate and diisooctyl phthalate in tobacco root exudates may play an important role in tobacco autotoxicity.

**Key Words:** autotoxicity, autotoxins, germination characteristics, root exudation, tobacco seedling

### INTRODUCTION

Tobacco (*Nicotiana tabacum* L., family Solanaceae), is not only an important cash crop in many countries, but also serves as a key model organism for the advancement of plant biology (Otsu *et al.*, 2004; Zhang *et al.*, 2013). Because a substantial amount of arable land in China has been lost to urban expansion and new infrastructure, continuous tobacco cropping has become widespread in recent years (Jia *et al.*, 2011). Continuous

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