

# Potassium limitation promotes the Sweetgum-*Clitopilus* symbiosis

long peng<sup>1</sup>, Xiaoliang Shan<sup>1</sup>, Yuzhan Yang<sup>1</sup>, Yuchen Wang<sup>1</sup>, Irina Druzhinina<sup>2</sup>, Xueyu Pan<sup>1</sup>, Wei Jin<sup>1</sup>, Xinghua He<sup>1</sup>, Xinyu Wang<sup>1</sup>, Xiaoguo Zhang<sup>1</sup>, Francis Martin<sup>3</sup>, and Zhilin Yuan<sup>1</sup>

<sup>1</sup>Research Institute of Subtropical Forestry Chinese Academy of Forestry

<sup>2</sup>Nanjing Agricultural University

<sup>3</sup>INRA Nancy

December 12, 2020

## Abstract

Several species of soil free-living saprotrophs can sometimes establish biotrophic symbiosis with plants, but the basic biology of this association remains largely unknown. Here, we investigate the symbiotic interaction between a common soil saprotroph, *Clitopilus hobsonii* (Agaricomycetes), and the American sweetgum (*Liquidambar styraciflua*). Notably, the colonized root cortical cells contain numerous microsclerotia-like structures. Fungal colonization led to increased plant growth and facilitated potassium uptake, particularly under potassium limitation (0.05 mM K<sup>+</sup>). The expression of plant genes related to potassium uptake is not altered during symbiosis, whereas the transcripts of three fungal genes encoding ACU, HAK, and SKC involved in K<sup>+</sup> nutrition is found in colonized roots. We confirmed the K<sup>+</sup> influx activities by expressing the ChACU and ChSKC genes into a yeast K<sup>+</sup>-uptake-defective mutant. Upregulation of the ChACU under 0.05 mM K<sup>+</sup> and no K<sup>+</sup> conditions was demonstrated in planta and in vitro compared to normal condition (5 mM K<sup>+</sup>). In addition, colonized plants displayed a larger accumulation of soluble sugars under 0.05 mM K<sup>+</sup>. The present study highlights that potassium limitation promotes this novel tree-fungus symbiosis mainly through a reciprocal transfer of additional carbon and potassium to both partners, and the role of dual soil saprotroph/symbiotroph in tree nutrition.

## Hosted file

Manuscript.pdf available at <https://authorea.com/users/382493/articles/498394-potassium-limitation-promotes-the-sweetgum-clitopilus-symbiosis>







