SCIENCES & BIOENGINEERING SCIENCES

The Research Groups
Plant molecular genetics and biotechnology & Microbiology

have the honor to invite you to the public defence of the PhD thesis of

Yang Zhang

to obtain the degree of Doctor of Bioengineering Sciences

Title of the PhD thesis:

Exploration of arbuscular mycorrhiza to improve rice growth and production with focus on zinc transport and translocation routes

Supervisor:
Prof. dr. Joske Ruytinx

The defence will take place on

Friday, June 13, 2025 at 5 p.m.

The defence can be followed through a live stream: bit.ly/4mJqd4o

Members of the jury

Prof. dr. ir. Geert Angenon (VUB, chair)
Prof. dr. ir. Frits Heinrich (VUB)
Prof. dr. Yue Gao (VUB)
Prof. dr. Sofie Goormachtig (UGent)
Prof. dr. Daniel Wipf (Université de Bourgogne, FR)

Curriculum vitae

Yang Zhang obtained her bachelor's degree in Environmental Science with honors from Henan University. Then she gained her master's degree in soil microbiology engineering from the Institute of Urban Environment, Chinese Academy of Sciences, People's Republic of China. She pursued her PhD degree in Plant Genetics and Microbiology research groups at Vrije Universiteit Brussel to explore the arbuscular mycorrhizal fungi impact rice production and grain Zn content, both in Zn deficient and polluted soils, by altering zinc transport and translocation routes. She loves nature and wants to do more research to improve our agriculture in an eco-friendly way.

Abstract of the PhD research

Rice is a lifeline for over half the world's population, but its growth is increasingly threatened by zinc imbalances in soils. In some regions, soils lack enough zinc—a nutrient vital for plant growth—leading to stunted crops and low or minor quality yields. In others, industrial pollution or overuse of fertilizers has left soils with toxic levels of zinc, poisoning plants. Farmers often face a lose-lose situation: adding zinc fertilizers can be costly and ineffective, while ignoring deficiencies worsens food insecurity. To address this, we turned to nature's solution: arbuscular mycorrhizal fungi (AMF)— soil microbes that form partnerships with plant roots to boost their resilience.
In this PhD thesis, we tested whether AMF could help rice grow in three soil types: zinc-deficient, zinc-fertilized, and zinc-polluted. Furthermore, we assessed the influence of AMF colonization on zinc transport routes within rice. We tested the impact of different AMF species and stability of the response across distinct rice varieties. The results were striking. In polluted soils, where untreated rice plants struggled to survive, adding AMF revived growth and increased grain yields. AMF acted like a "nutrient traffic controller", reducing harmful zinc buildup in leaves and grains while maintaining the plant's uptake of other critical nutrients. This balancing act could lower the risk of toxic zinc build-up in shoots and grains. Overall, AMF reduced rice variety specific responses of zinc transporters involved in root-to-shoot translocation and detoxification suggesting they largely define nutrient homeostasis in their host plant. Moreover, AMF interact with anti-oxidative stress response of rice host plants and support growth in absence of functional colonization, regardless of the AMF species applied. This suggests that AMF do not just help plants to cope stress by balancing nutrient supply but change their strategy for survival.
AMF inoculants are affordable and already used in eco-friendly farming. By adopting AMF, communities grappling with polluted soils (common near mining areas or industrial zones) or nutrient-poor fields, we could grow healthier rice without heavy reliance on chemical fertilizers. This approach not only safeguards food supplies but also protects soils and waterways from further pollution. Our work underscores the power of harnessing natural partnerships to solve human challenges. In a warming world with degrading soils, innovations like AMF could pave the way for sustainable agriculture that feeds people without harming the planet.