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THE EFFECTS OF TRICHODERMA HARZIANUM ON THE GRAVITY RESPONSE AND OXIDATIVE STRESS OF ARABIDOPSIS THALIANA FOR SPACE AGRICULTURE

Abstract

If humanity is to be an interplanetary species, then we must determine how to grow food for off-planet human space exploration. The Artemis missions and future missions to mars will require food sustainability resources to nourish and feed our astronauts living in deep space. However, plants in space are subject to multiple abiotic factors, such as microgravity and oxidative stress, which can greatly hinder growth. On earth, one way to improve stress resilience in plants is through the introduction of a beneficial root fungus such as *Trichoderma harzianum*. Up until now, no previous research has been conducted on the effect of the plant-microbe interaction on gravitropic response or other space flight related phenotypes. Our preliminary research has shown increased vegetative growth and final yield in the oxidatively stressed tomato plants grown in the presence of *Trichoderma* compared to the unstressed controls. The effect on growth promotion could have profound practical implications for plant growth management in space exploration where plants are constantly exposed to oxidative stress, such as high-light and extreme temperatures. Previous studies on fungal volatiles have shown using a split plate assay that a wide range of *Trichoderma* species could enhance the overall biomass, root production, and chlorophyll content of *A. thaliana*. This strongly suggests volatile organic compounds produced by the fungus influence overall plant health. To test if these volatile organic compounds influence gravitropic response, gravity assays analyzing root tip angles and response times will be conducted with split plates of *A. thaliana* and *T. harzianum*. Concurrent assays will also be performed to monitor changes while stimulating the oxidative stress response via hydrogen peroxide treatment. While there is a plethora of mechanisms the reactive oxygen species could be utilizing for growth promotion, the precise mechanism(s) in the plant-microbe symbiotic relationship remains to be discovered. This growth promotion activated through environmental oxidative stress could arise from the effects of the *T. harzianum*'s volatile organic compounds on plant gene expression. Quantitative assessment of the transcriptional response to these assays will help pinpoint the molecular and cellular mechanisms behind this phenomenon. The results of this study will support the first plant-fungi NASA space flight experiment, Project TASTIE (Trichoderma Associated Space Tomato Inoculation Experiment), set for the International Space Station in 2023.