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The Effects of Arbuscular Mycorrhizal Fungi on Secondary Metabolites in Potato Crops from Strip Cropping Soils

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Background

Arbuscular mycorrhiza fungi (AMF) are obligate root symbionts found in soils worldwide that date back 450 million years (Remy et al., 1994) in mutualistic symbiosis with an estimated 80% of land plants with beneficial traits for their host plant, including protection from abiotic stresses and pests and pathogens (Smith et al., 2010). Using AMF to guard against pests and diseases has been shown to be effective in several plant species (Cameron et al., 2013; Jung et al., 2012; Malik et al., 2018, 2018; Seminara et al., 2021).

Objective

The purpose of this study is to determine the effects of incorporating additional arbuscular mycorrhizal fungi (AMF) into soils with different crop diversity histories (strip cropping and monocropping) on the potato plant secondary metabolome and occurrence of herbivorous insects and pathogens. **Two questions will be addressed by this study are as follows:**

- 1. How does additional AMF affect potato crops' planted in strip cropping and monocropping soils in a field environment?
- 2. What effect does the addition of AMF in strip cropping and monocropping soils have on the occurrence of herbivorous insects and pathogens on potato plants?
- 3. What effect will neighbouring pests and pathogens – green peach aphids, Colorado potato beetles, and potato late blight– from long-term potato crops in both strip cropping and monocropping fields have on newly planted potato crops when AMF is added?

Hypothesis

- 1. Intercropping soils with added AMF leads to more interactions with biodiversity in intercropping soils, eventually higher yield weight, root weight, and yield abundance.
- 2. *a. Field Experiment*: Intercropping potato crops with additional AMF is less attractive for pests and diseases due to enhanced direct defences.
- 2. *b. Laboratory Experiment*: Leaves from plants with additional AMF are more production of secondary metabolites due to mycorrhizal-induced resistance.
- 3. Green-peach aphids, Colorado potato beetles, and potato late blight disease are less abundant in newly planted crops with additional AMF for both monocropping and strip cropping soils than soils without additional AMF.

Method

In the laboratory and field experiments, potato plants (Fontane variety) are given additional 1mL of an AMF solution provided by Koppert Biological Systems.

Laboratory experiment: Potato crops will be analysed with an LC-MS analysis machine to determine what secondary metabolites are affected by the added AMF and green peach aphids from either intercropping and monocropping soils.

Field experiment:

1. Potato crops planted in pots with either soils from intercropping or monocropping fields.
2. Weekly surveys are conducted to determine the number of incoming insects and the affected plant qualities.
3. Neighboring strip cropping fields are also surveyed.

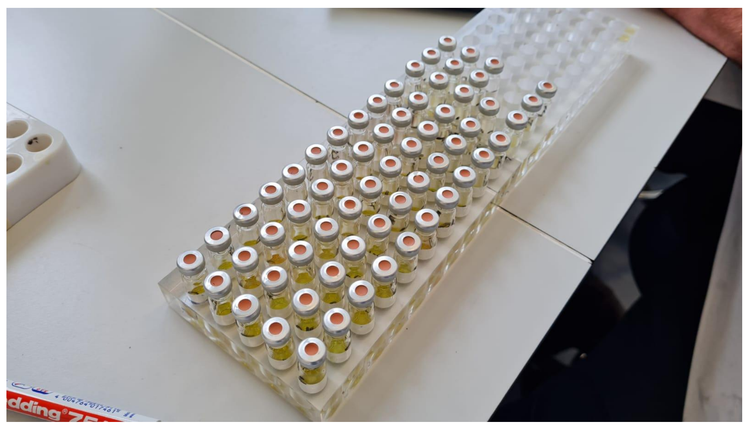

Figure 1. Potato leaf samples with additional AMF and infested with aphids for LC-MS Analysis for secondary metabolites

Figure 2. AMF solution measured for treated potato crops (left), potato crops used in the field experiment (right)

Acknowledgements

This study would not have been possible without the assistance of Drs. Laura Riggi, Karen Kloth, Dirk van Appeldorn, Roland Mumm, Jeroen van Arkel, and Bert Schipper. Thank you to the students and staff of the FSE chair group for allowing the field experiment to take place. The assistance of Ainul Sri Rejeki and Onikepe Akangbe in preparing for the experiment is deeply appreciated.

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