Trees for the enhancement of mycorrhizal functioning in low-input ETH maize cropping systems.

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Food System Challenge: Food Security

In Malawi, a majority of the population relies on subsistence farming.

A lack of capital leads to soil nutrient mining without adequate nutrient inputs.

Declining soil fertility \rightarrow declining crop yields \rightarrow declining food security.

Goal: Rejuvenate and maintain soil fertility while achieving sustainable yields!

Arbuscular Mycorrhizal Fungi (AMF)

- Plant symbionts
- Colonize plant roots
- Rely on carbon supply of host plant
- Improve nutrient access for host plants as a result of
 - a. Enhanced soil structure
 - b. Nets of fungal filaments (mycelia) increase the hosts' root system

Common Mycorrhizal Networks (CMN)

- Mycelia of different host plants interconnected
 - Potential for interplant nutrient exchange



Smallholder farmers' maize field in Malawi.



Malawian's staple food 'nsima' with beans.

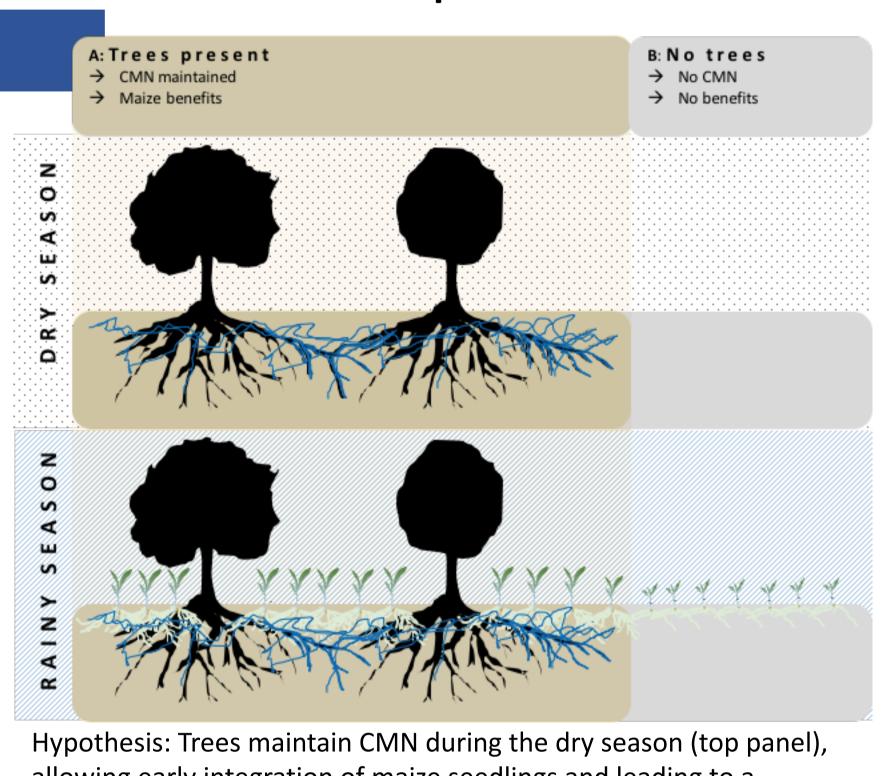
Background

Arbuscular mycorrhizal fungi can interlink plant individuals of the same or different species and contribute to improved plant mineral nutrition in the short-term and soil fertility over the longer-term.

Trees can play an important role in maintaining the vitality and thus infectivity of AMF mycelia from one cropping season to the next.

Crop seedlings may get a nutritional head start by tapping into the preexisting mycelia maintained by the trees and immediately become connected into a functional CMN.

We will assess how agroforestry trees via AMF influence nutrient uptake and biomass production of maize in Malawian smallholder farms.



allowing early integration of maize seedlings and leading to a nutritional head start with begin of the rainy season (bottom panel).



Faidherbia trees in smallholder farmers' fields in Malawi

Experiments

Isolated Tree Survey

Do single standing mango and faidherbia trees

- a. Maintain AMF abundance during the dry season?
- b. Improve soil structure and nutrients?
- c. Increase maize root colonization by AMF?

Distance from trunk Aerial view: (not to scale) **×**1 m **×**4 m **×** 10 m × 15 m

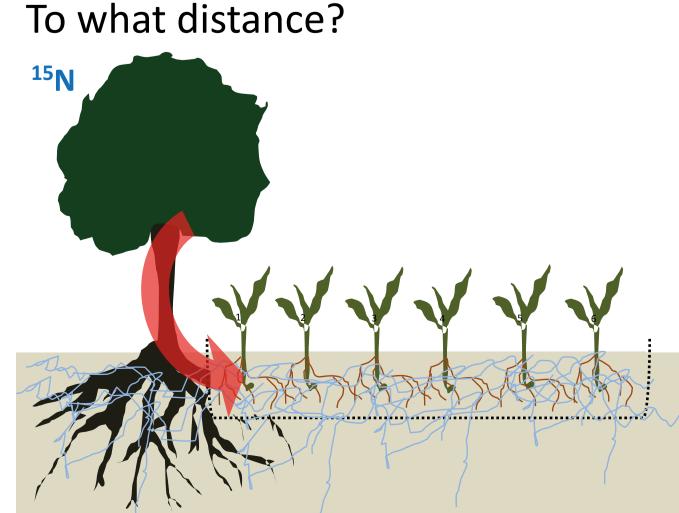
Samples were collected along a gradient away from single standing trees.

Mango tree in Malawian smallholder farmers' fields.

CMN Field Experiment

Does a tree to maize nutrient transfer occur in farmers' fields?

Is it relevant to maize performance?



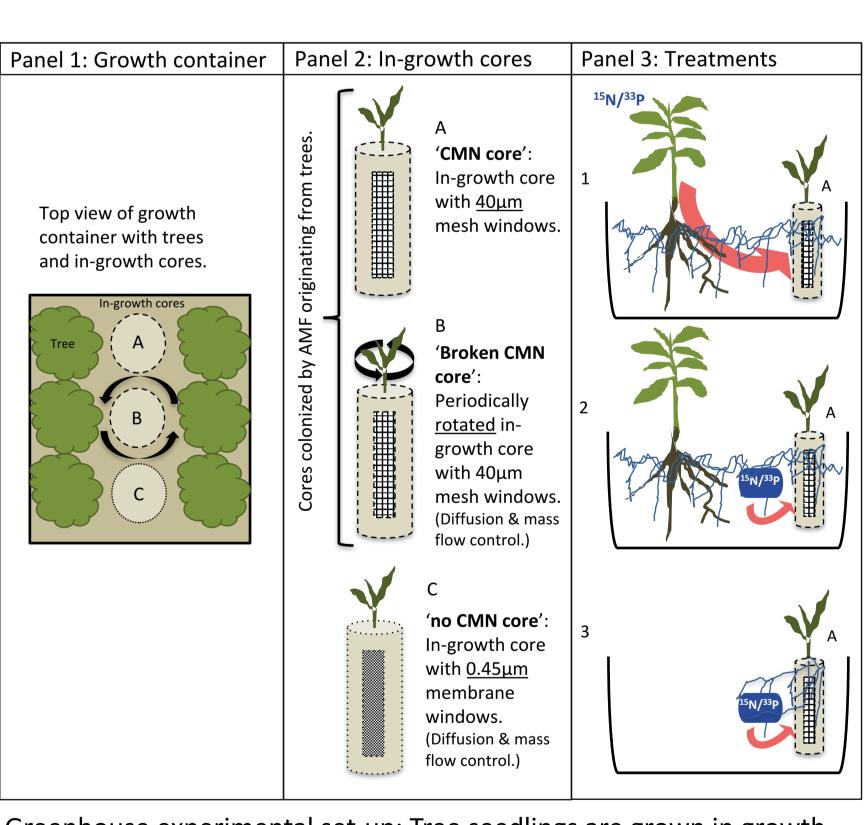
CMN field experimental set-up: Nitrogen will be traced from single standing trees to maize seedlings grown in root-exclusion compartments.



Installation of the root-exclusion compartment (1m x 6m, 0.5m deep). 40 µm mesh restricts root growth but allows passage of CMN.

Greenhouse experiment

Can nutrients be transferred from trees to maize via CMN? Do trees increase AMF-facilitated nutrient access of maize?



Greenhouse experimental set-up: Tree seedlings are grown in growth containers around three in-growth cores (panel 1). In-growth cores (panel 2) vary in design to test CMN functioning (A) and to control for diffusion and mass flow of nutrients (B & C). Treatments (panel 3) include testing tree-to-maize nutrient transfer (1), and soil-to-maize nutrient transfer in the presence (2) and absence (3) of tree-facilitated AMF.





in-growth cores.

Ultimate Goal

Improve soil fertility

- Improved yields
- Improved livelihoods of smallholder farmers

