

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

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 → declining crop yields → 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)

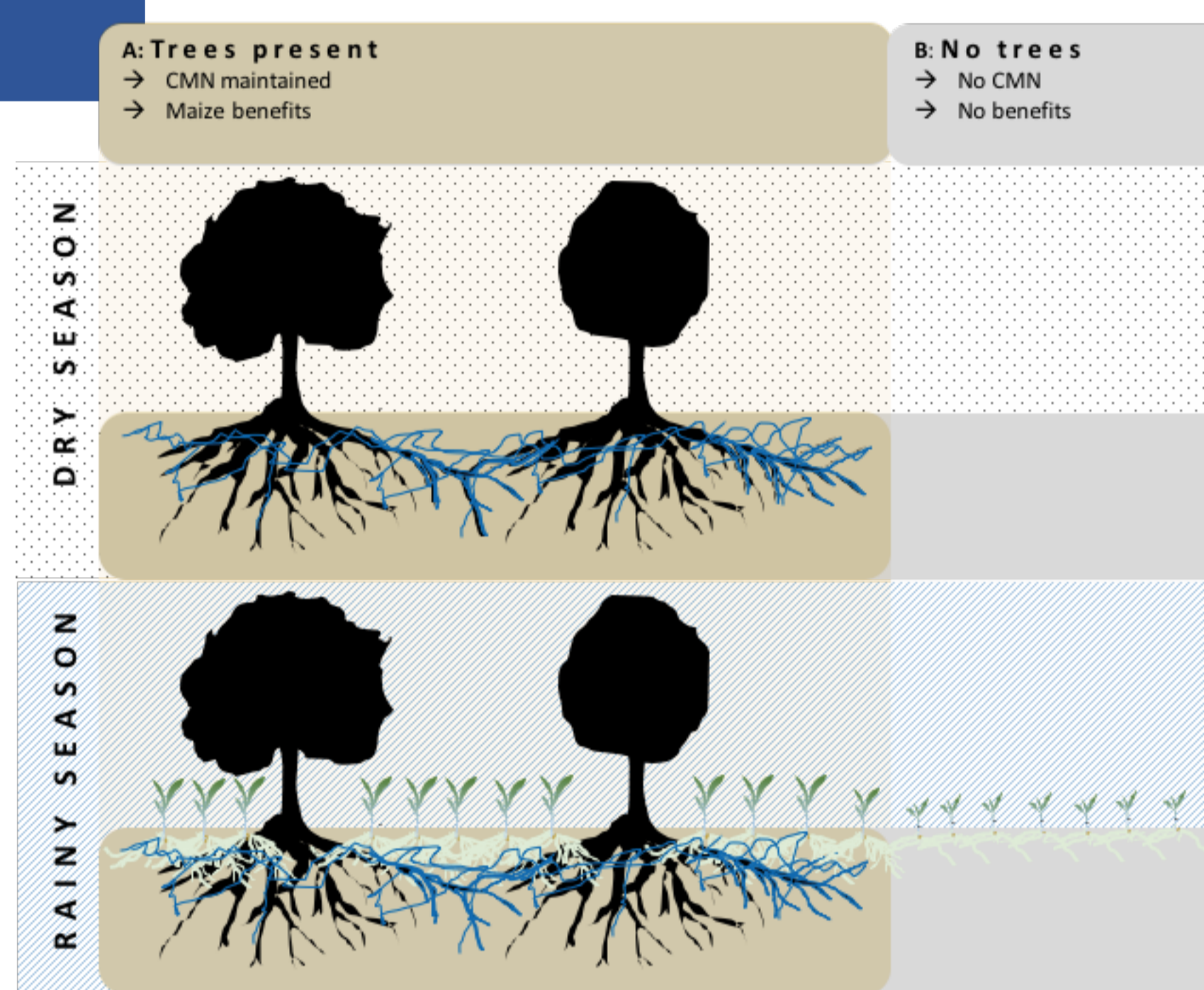
- Mycelia of different host plants interconnected
 - Potential for interplant nutrient exchange



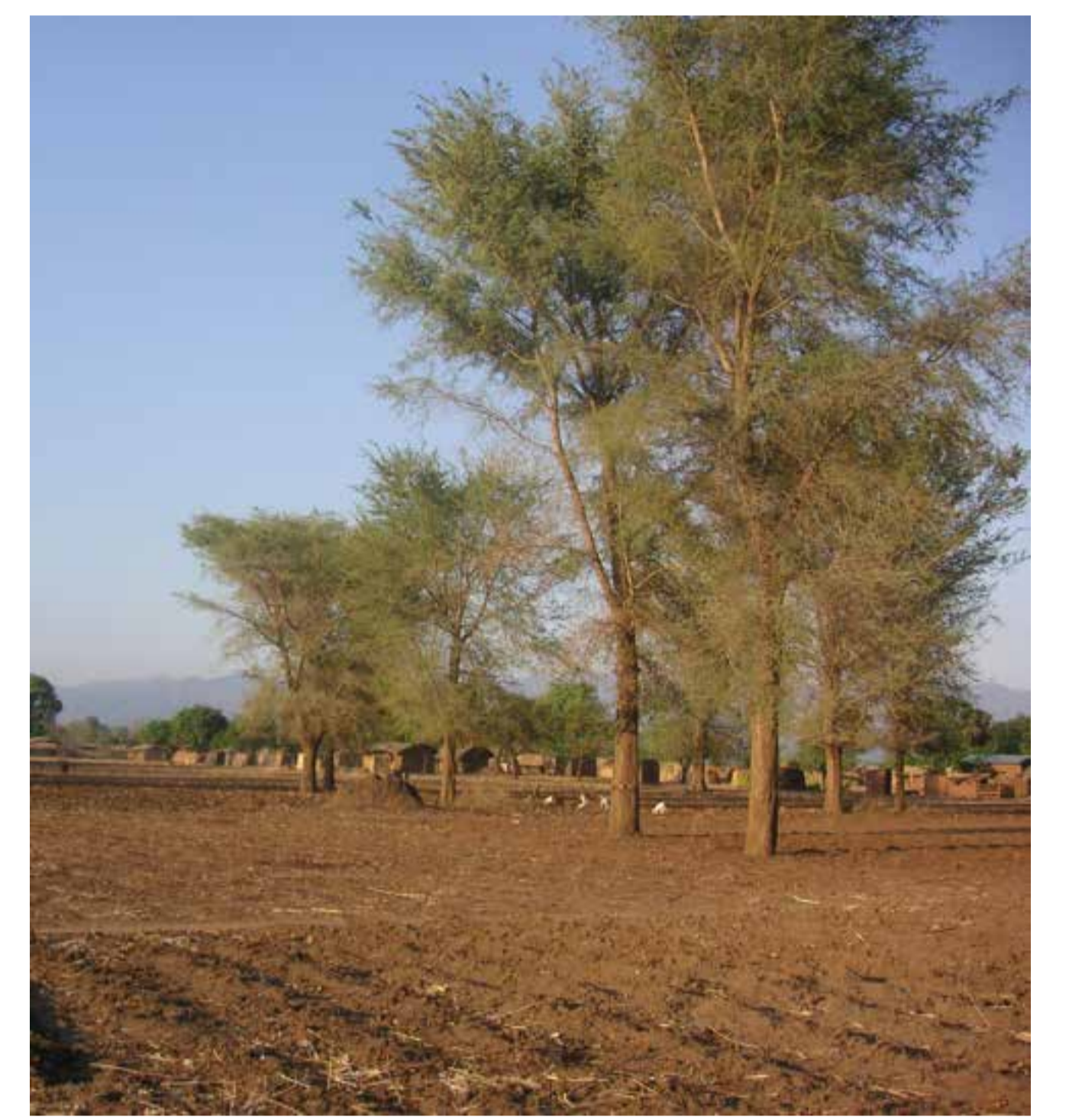
Smallholder farmers' maize field in Malawi.



Malawian's staple food 'nsima' with beans.



Hypothesis: Trees maintain CMN during the dry season (top panel), 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.

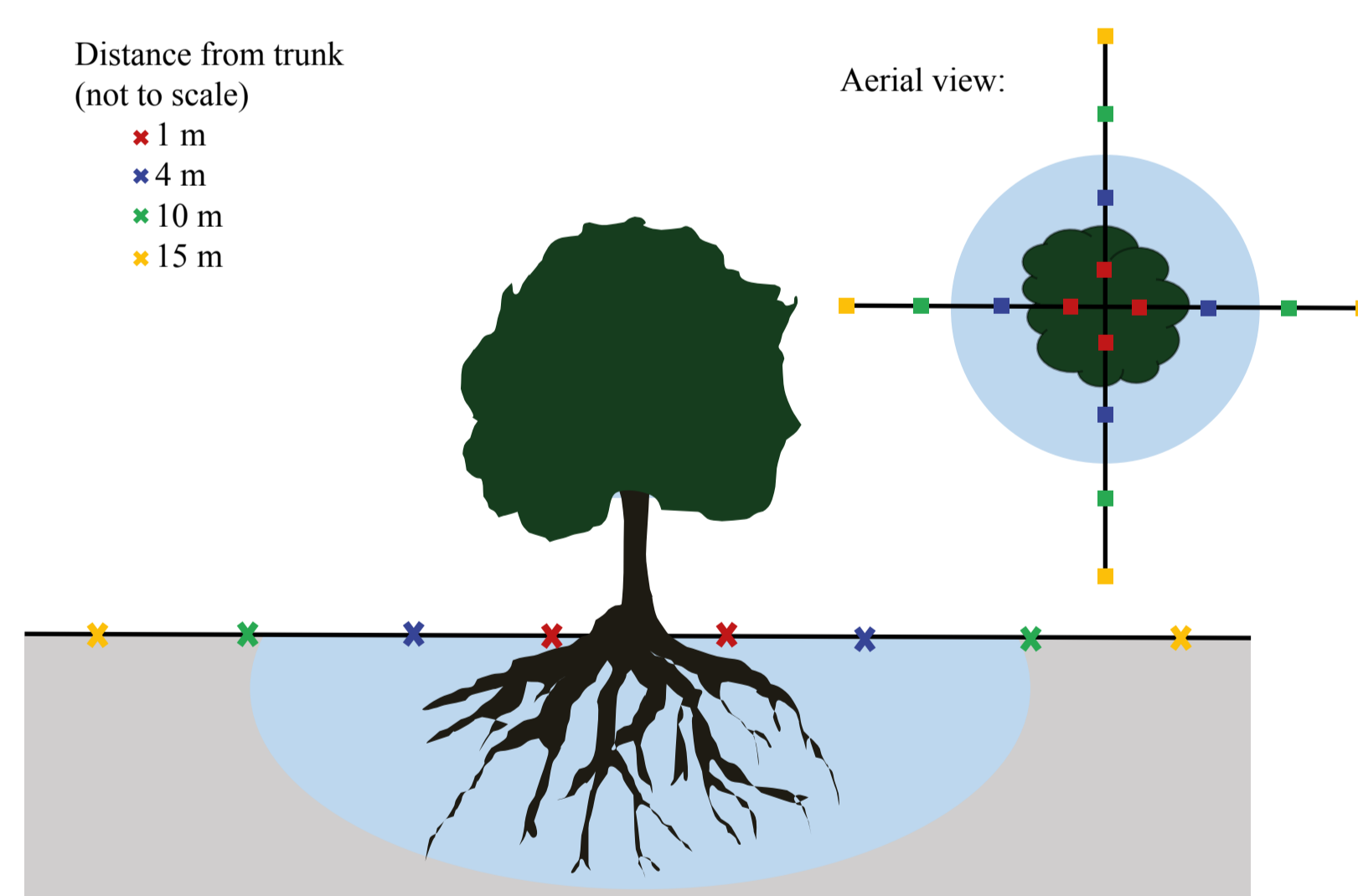
Experiments

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?



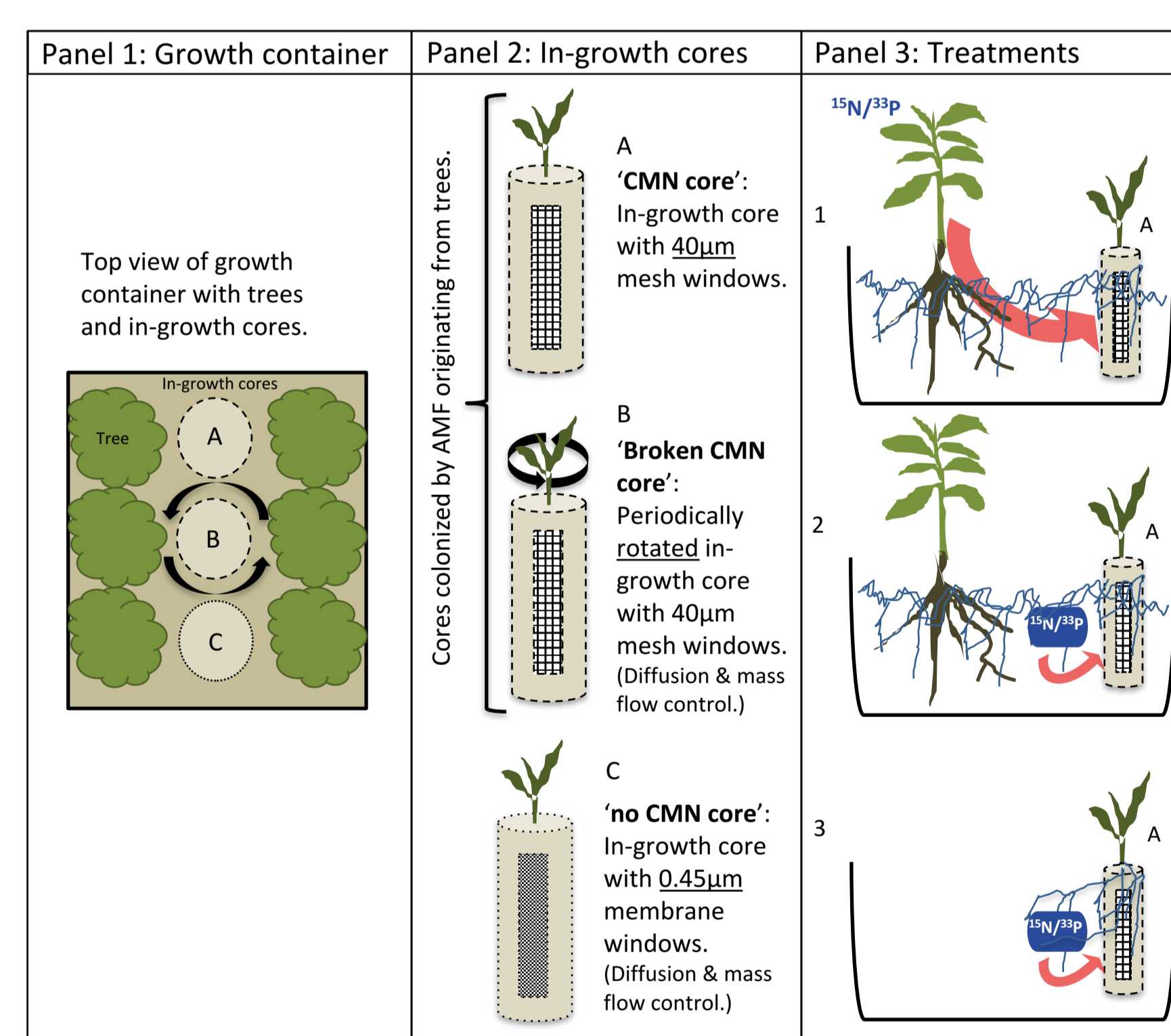
Mango tree in Malawian smallholder farmers' fields.



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

Greenhouse experiment

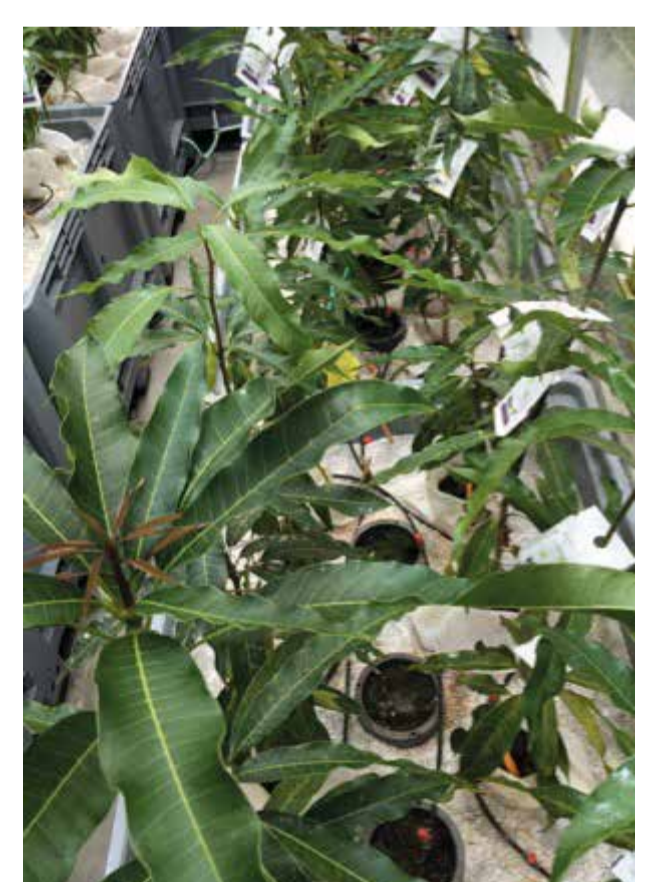
Can nutrients be transferred from trees to maize via CMN?
Do trees increase AMF-facilitated nutrient access of maize?



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.



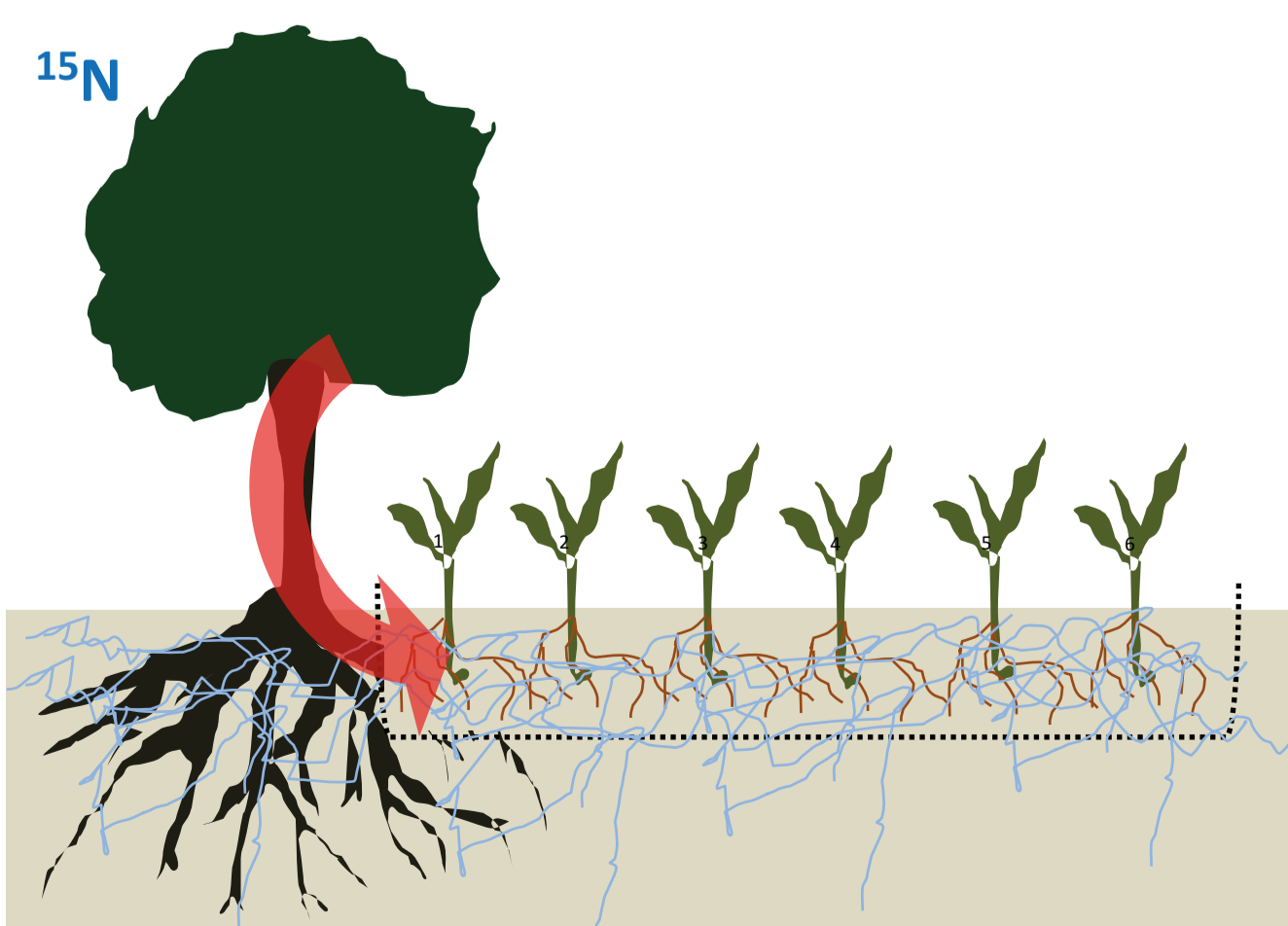
Faidherbia seedlings around in-growth cores.



Mango seedlings around in-growth cores.

CMN Field Experiment

Does a tree to maize nutrient transfer occur in farmers' fields?
Is it relevant to maize performance?
To what distance?



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.

Ultimate Goal

Improve soil fertility management strategies:

- Improved yields
- Improved food security
- Improved livelihoods of smallholder farmers

Malawian smallholder farmer family eating 'nsima' with beans.

