Why a genetic improvement program on mycorrhizal fungi could significantly improve yields of the food security crop cassava

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Abstract

The effects of mycorrhizal fungi on plant growth and phosphate acquisition have been known for decades and yet they have never lived up to their potential in full-scale agriculture. In this poster we show that they can indeed be used to increase food production and we present **three fundamental reasons** why genetic improvement of mycorrhizal fungi, combined with new technologies to biotechnologically improve the fungi should lead to greater food production and why such an improvement program is warranted:

Reason 1:
Genetic differences in mycorrhizal fungi cause differences in plant growth

The green revolution was largely fuelled by plant breeding. Genetically different plant varieties have different traits. We cross these varieties to produce better varieties. A fundamental basis for breeding is that differential growth of varieties has a genetic basis. Here we show that gentically different mycorrhizal fungi (all from one small field) differentially affect how plants grow (Fig. 1). This means that their effect on plant growth has a genetic basis. **This is a pre-requisit for a breeding program to improve mycorrhizal fungi.**

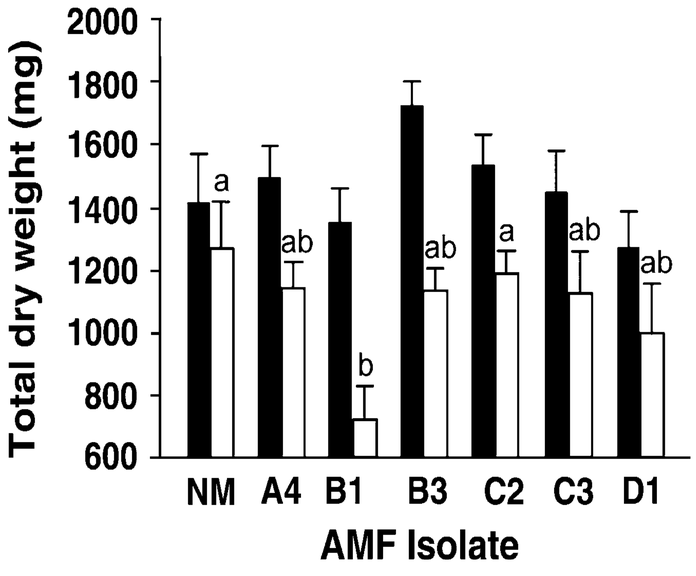

Figure 1. Two plant species inoculated with genetically different fungi grow differently.

Reason 2:
Cassava production is significantly increased by using *in vitro* produced mycorrhizal fungi

Our experiments in the field in Colombia show that cassava yields can easily be increased by about 20% using biotechnologically in-vitro produced mycorrhizal fungi (Ceballos et al. 2013).

See oral presentation 03-16 on Wednesday!!!

Figure 2. Students tend the cassava plants in Colombia.

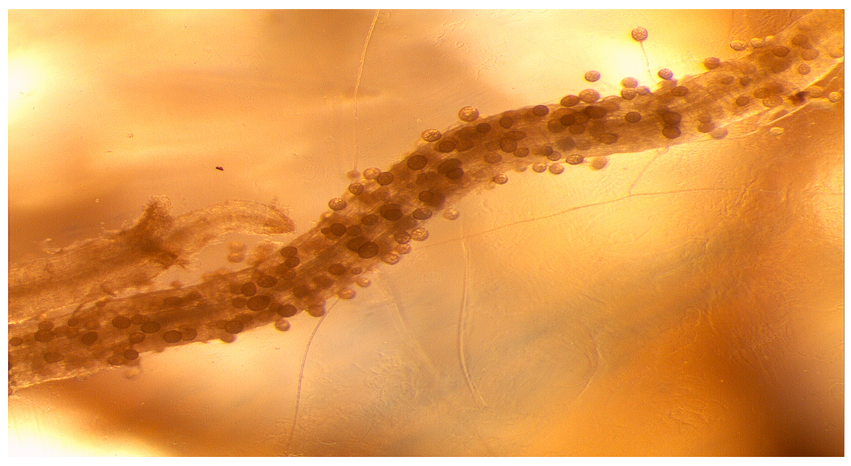

Figure 3. The cassava crop is inoculated with mycorrhizal fungus in a sterile gel carrier.

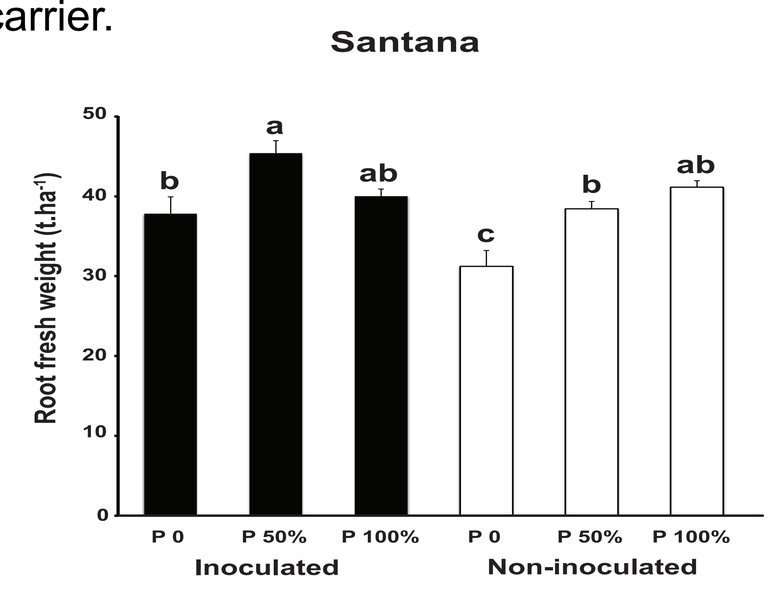

Figure 4. Inoculation with mycorrhizal fungi results in a significant yield increase at only 50% of the phosphate fertilizer normally used by Colombian farmers.

Reason 3:
Manipulating the genetics of mycorrhizal fungi greatly improves plant growth

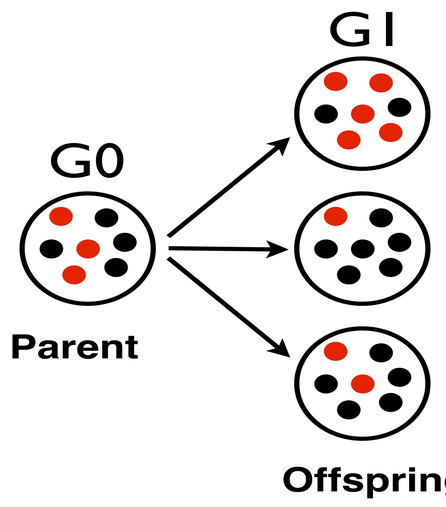

Figure 5. Mycorrhizal fungi have an unusual genetic system where they contain genetically different nuclei. When the fungus produces new spores clonally, the new spores are genetically different to the parent fungus and from each other.

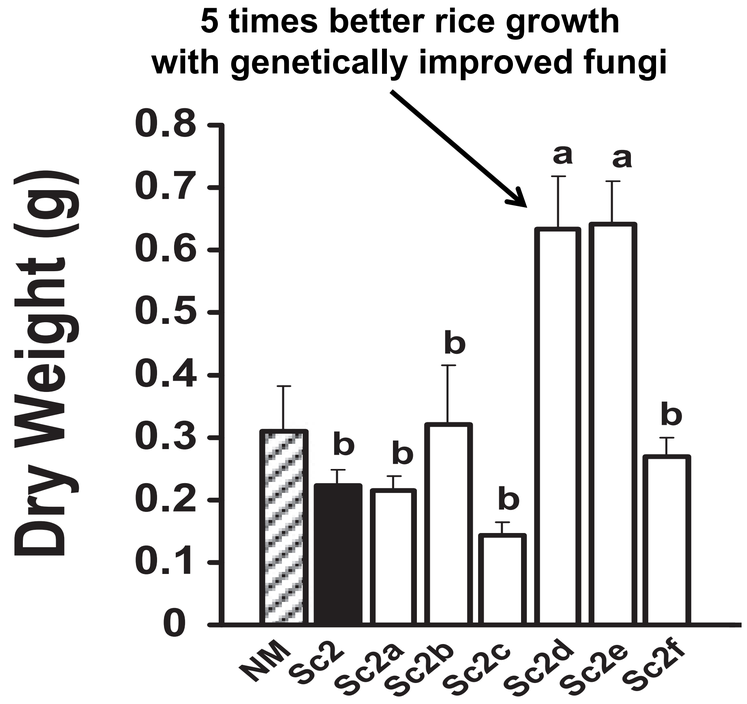

Figure 5. When we put those genetically different fungi onto rice we can increase rice growth by up to 5 times just by changing the genetics of the fungus. This shows that genetically improving these fungi by breeding is certainly warranted.

Conclusions

For the three reasons presented above, there is a strong rationale to undertake a genetic improvement program to improve cassava production and that of other globally important crops.