Mycorrhiza and Carbohydrate Relations in Sorghum and Shortleaf Pine (*Pinus echinata* Mill.)

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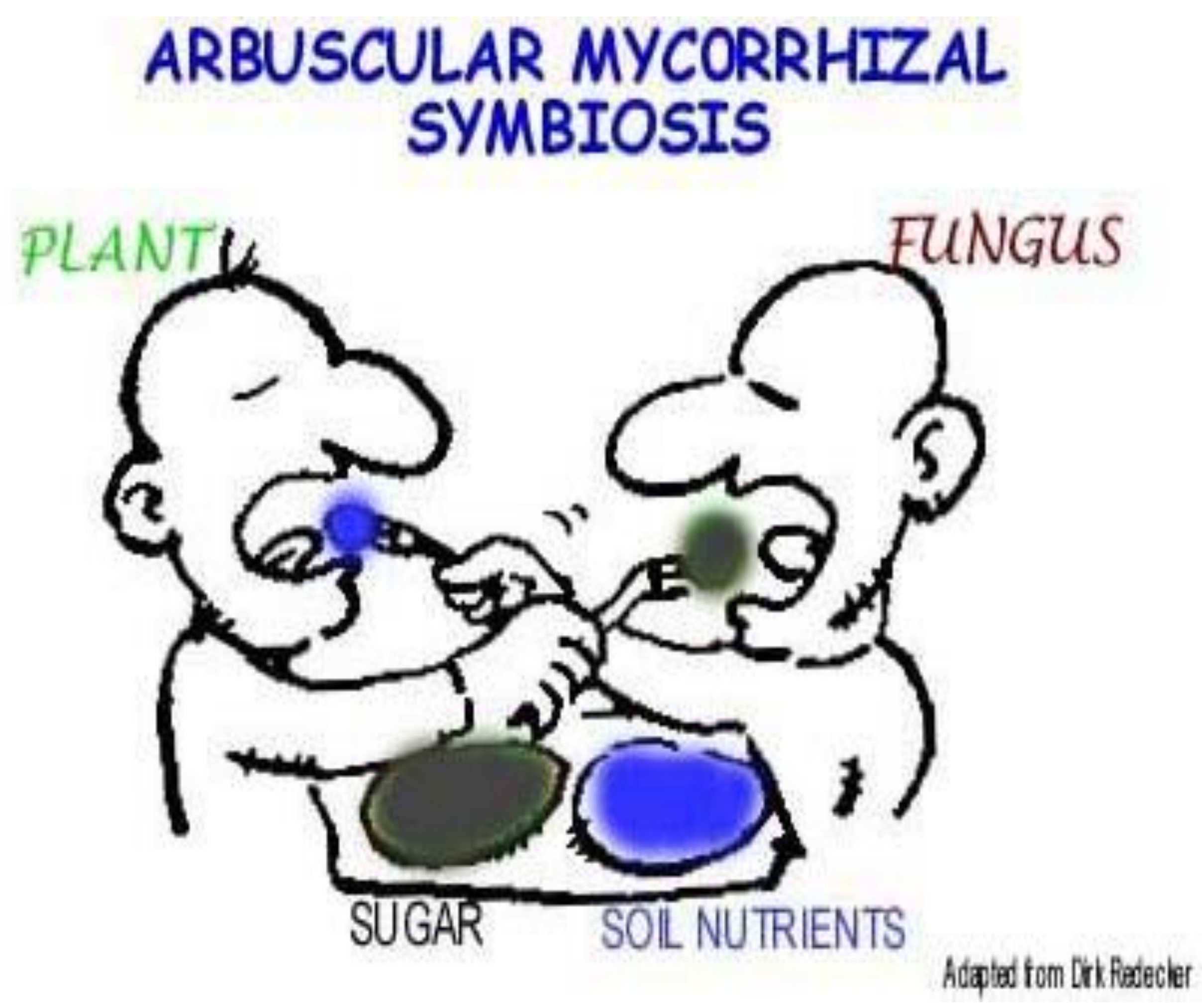
Introduction

A symbiotic relationship exists between roots of agronomic crops, like sorghum, and soil fungi; it is known as "mycorrhizae". It is a natural process whereby both parties benefit without causing harm to each other. The interaction produces a "fungus-root" mass which helps the plant absorb more nutrients and water from the soil by increasing the surface area of the root. The fungus in turn benefits from the sugar that sorghum provides through photosynthesis. Mycorrhizal fungi dwell in the soil and infect plant roots seeking sugar and other metabolites which they cannot produce by themselves. Plant roots allow such infection to occur because they are also looking for mineral nutrients which the fungal hyphae can abstract from the larger soil volume. Therefore the symbiosis is mutually beneficial to both parties. Although this part of the association has been studied extensively, researchers are not certain as to which metabolite(s) is (are) responsible for initiating the symbiosis. This study looked at carbohydrate levels in roots of shortleaf pine (*Pinus echinata*) and grain sorghum (*Sorghum vulgaris*) that were inoculated with either *Pisolithius tinctorius* or a mix culture of vesicular arbuscular mycorrhizae, respectively.

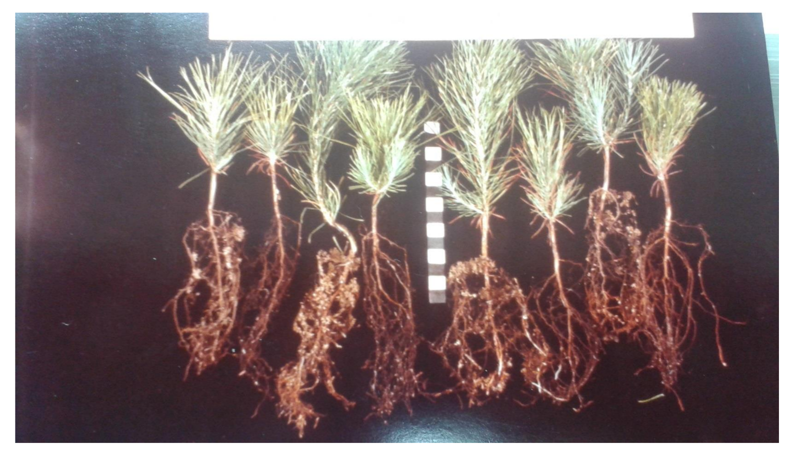


Objectives

1. Inoculate sorghum and shortleaf pine seeds with appropriate fungus and grow the plants in greenhouse .
2. Harvest roots and extract carbohydrates with appropriate solution
3. Assay for carbohydrates following established procedures.
4. Compare levels of carbohydrate between inoculated and non-inoculated plants.

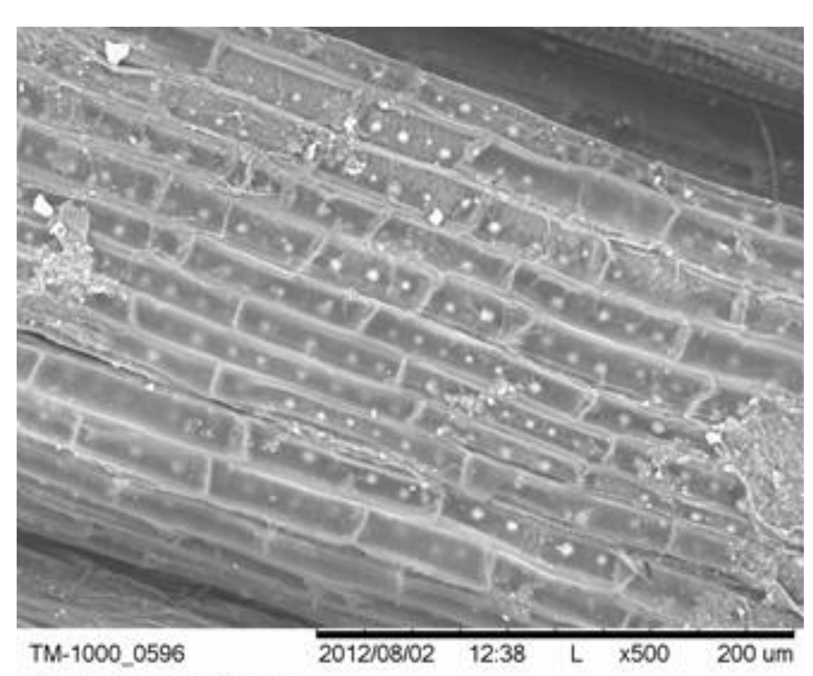
Materials and methods

Mycorrhizal (right) and non-mycorrhizal (left) sorghum.



Mycorrhizal and non-mycorrhizal shortleaf pine seedlings

Inoculated (red) and non-inoculated sorghum roots



Electron microgram of sorghum roots showing fungal penetration of cortical cells.

Results and Discussion

Table 1. Concentrations of sugars in mycorrhizal and non-mycorrhizal shortleaf pine and sorghum roots.

Sugar	Shortleaf Pine	Sorghum
Fructose	Concentration (mg/g)	
Mycorrhizal	13.1	0.7
Non-mycorrhizal	13.4	3.2*
Glucose		
Mycorrhizal 16.0	0.8	
Non-mycorrhizal	15.0	2.3*
Sucrose		
Mycorrhizal	32.9*	0.1*
Non-Mycorrhizal	31.3	0.03

Results in Table 1 indicate that glucose and sucrose were present at higher concentrations in mycorrhizal shortleaf pine roots while fructose and glucose were higher in non-mycorrhizal sorghum roots. Both shortleaf pine and sorghum roots indicated higher sucrose levels in mycorrhizal roots compared to non-mycorrhizal roots. These differences were significantly higher for all three sugars in sorghum but only for sucrose in shortleaf pine roots. The fact that the amount of sucrose found in mycorrhizal sorghum and shortleaf pine roots could indicate that this particular sugar plays a significant role in root-fungus symbiosis Increase root mass has been observed as a result of mycorrhizal inoculation. Greater root mass results could mean increased nutrient absorption. It could also mean more exudate production and release into the rhizosphere, which intern stimulates the growth of rhizosphere microflora, among them mycorrhizal fungi. Increased root and fungal growth may enhance ectomycorrhizal symbiosis. Previous studies have shown that mycorrhizal plants have greater top growth than non-mycorrhizal plants, which gives them advantage for increased photosynthesis.

Conclusions

- Mycorrhizal fungi help the host plant in the absorption and translocation of nutrients and water.
- The fungus provide the host plant with growth hormones: auxins, cytokinins, gibberellins, and growth regulators: vitamins.
- The symbiont benefits from sugars synthesized by the host plant.

Literature Cited

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