

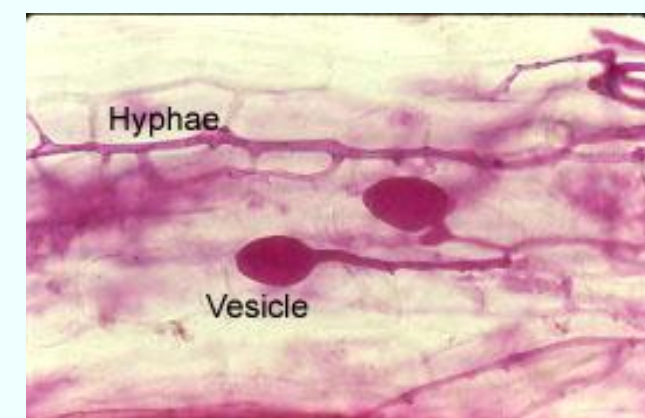
# Impact of Restoration Practices on Mycorrhizal Inoculum Potential in a Semi-Arid Riparian Ecosystem

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## INTRODUCTION

Mycorrhizae are soil fungi that form symbiotic relationships with plant roots. Mycorrhizal fungi play a functional role in riparian ecosystems by increasing nutrient and water availability to plants and improving soil stability (Stutz et al. 2009). Mechanical disturbance of soil has been found to reduce mycorrhizal inoculum in soils (Celik et al. 2011; Li et al. 2007). To examine the impact of restoration practices on riparian mycorrhizal inoculum potential, soil samples were collected at the Tres Rios Ecosystem Restoration and Flood Control Project located at the confluence of the Salt, Gila and Agua Fria rivers southwest of Phoenix, Arizona. The restoration project involved the mechanical removal of *Tamarix spp.* (tamarisk, salt cedar) and grading prior to re-vegetation. Soil was collected from three stages of restoration: pre-restoration, soil banks with chipped tamarisk and other vegetation, and in areas that had been graded in preparation for re-vegetation. Bioassay plants were grown in the soil samples and roots analyzed for mycorrhizal infection percentage to examine impact of the restoration practices on mycorrhizal inoculum potential.



**Figure 1. Arbuscular mycorrhizae** colonize plant roots internally by forming arbuscules between the cell wall and plasma membrane of root cortex cells.



**Figure 2. Ectomycorrhizae** colonize plant roots externally, forming a dense fungal sheath or mantle that covers the outside of the root tips. A Hartig net of hyphae also grows within the root cortex.

## METHODS

**Study Area** - The study site was at the Tres Rios Ecosystem Restoration and Flood Control Project (33° 23' 11" N, 112° 18' 41" W). The Tres Rios project area encompasses 1,500 acres and has consisted of three phases (1) a flood protection levee, completed 6/2008, (2) an effluent wastewater pump station, scheduled for completion 7/2012 and emergent wetlands, completed 7/2010, and (3) riparian corridors and open water marsh areas to replace existing non-native salt cedar in the river, anticipated completion 7/2013 (City of Phoenix, 2010). Soil samples for this study were collected from the riparian corridor that is part of Phase 3 of the restoration.

**Soil Sampling** - Soil samples were collected late spring of 2011 from three sampling areas: pre-restoration, soil bank and graded. Within each sampling area, 25 soil samples were collected using a random walk methodology. Soil was collected up to a 6 inch depth, placed in 2 quart sealed plastic bags and kept under refrigeration until used for planting.

**Growth and Processing of Bioassay Cultures** - *Zea mays var. saccharata* (sweet corn, cultivar: Bilibious) was grown in the soil samples as a bioassay for arbuscular mycorrhizal fungi. After 30 days of growth, the corn was harvested and roots fixed in a 50% ethanol solution then cleared in 2.5% KOH and stained in 0.5 %Trypan Blue utilizing the methodology of Koske and Gemma (1989). A modified grid-line intercept method, utilizing a dissecting microscope, was used to determine the percentage of roots colonized (Giovannetti and Mosse 1980). *Populus fremontii* (cottonwood) seedlings were grown in the soil samples as a bioassay for ectomycorrhizal fungi. The harvested cottonwood roots were fixed in a 50% ethanol solution. A modified grid-line intercept method, utilizing a dissecting microscope, was used to determine the percentage of roots colonized (Giovannetti and Mosse 1980).



## RESULTS AND DISCUSSION

Arbuscular mycorrhizal (AM) inoculum was detected in all three conditions (pre-restoration, soil bank, and graded). The mean inoculum percentage of AM fungi in the three conditions was not significantly different (Table 1).

Data is still being collected on the ectomycorrhizal inoculum potential. Our preliminary data indicates that there were consistently low levels in the pre-restoration condition. This is likely due to lack of vegetation near the sampling points that form ectomycorrhizal associations (e.g. cottonwoods and willows). Soil samples from the soil banks and graded areas either did not contain ectomycorrhizal inoculum or had very low levels.

This study indicates that arbuscular mycorrhizal inoculum levels were sufficient in graded areas to support colonization in plants that will be part of the re-vegetation plan. Stockpiling of soil for use as arbuscular mycorrhizal inoculum does not appear to be necessary.

**Table 1. Infection Percentage: Arbuscular Mycorrhizal Fungi**

	Range (%) (minimum – maximum)	Mean	Standard Error Of the Mean (SEM)
<b>Undisturbed Soil</b>	0 – 50	17.00	3.18
<b>Soil Banks</b>	1 – 56	15.12	3.48
<b>Graded</b>	1 – 53	21.60	3.30

## References

- Celik, I., Z.B. Barut, I. Ortas, M. Gok, A. Demirbas, Y. Tulun, and C. Akpınar. 2011. Impacts of different tillage practices on some soil microbiological processes and crop yield under semi-arid Mediterranean conditions. *International Journal of Plant Production*. 5(3): 237-254.
- City of Phoenix, 2010. Tres Rios Full Scale Wetlands Project. <http://phoenix.gov/TRESRIOS/future>
- Giovannetti, M. and B. Mosse. 1980. An evaluation of techniques for measuring vesicular arbuscular mycorrhizal infection in roots. *New Phytologist* 84: 489- 500.
- Koske, R.E. and J.N. Gemma. 1989. A modified procedure for staining roots to detect VA mycorrhizae. *Mycol. Res.* 92: 486-488.
- Li, L.F., T. Li, Z.W. Zhao. 2007. Differences of arbuscular mycorrhizal fungal diversity and community between a cultivated land, an old field, and a never cultivated field in hot and arid ecosystem of southwest China. *Mycorrhiza*, 17, 655-665.
- Stutz, J.C., V.B. Beauchamp, J. Johnson, L.J. Kennedy, B.S. Richter and K.M. Jacobson. 2009. Mycorrhizal ecology. Pages 73-88 in J.C. Stromberg and B. Tellman, eds. *Ecology and Conservation of the San Pedro River*. University of Arizona Press.