Arbuscular mycorrhizal fungal species richness is lower in the Phoenix metropolitan area in comparison to the surrounding desert

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INTRODUCTION

Little is known about the impact of urbanization on arbuscular mycorrhizal (AMF) fungal community structure (Stabler et al. 2001). Changes in community structure can be seen most vividly where lands that were once historically free from anthropogenic disturbances are converted to residential or urban centers. Plant community responses to anthropogenic disturbances may be critically linked to the dynamics and diversity of the AMF that form mutualistic symbiosis with roots of many terrestrial plants (Bever et al. 2001). van der Heijden et al (1998) demonstrated that the species richness of AMF play a deterministic role in the productivity and diversity of plants in a given ecosystem.

How urbanization effects AMF diversity is still unclear. In a preliminary study, Cousins et al. (2003) found that land use type, land use history and vegetation type may impact AMF community structure. Spore densities were found to be lower at urban sites in comparison to desert sites, but it was difficult to detect any other differences in AMF community structure because of the small number of sites in the study. This investigation compares AM fungi from urban and desert sites that were part of the CAP-LTER Survey 200 project.

METHODS/MATERIALS

Soil was collected from exotic and native plants growing at 14 urban sites and from native plants growing at 14 desert sites and used to start pot cultures in the greenhouse to obtain AMF spores for identification. Spores were collected by wet-sieving and decanting, followed by sucrose gradient centrifugation (Daniels and Skipper 1982). Spores were separated by size and color under a Leica dissecting microscope and mounted on slides in polyvinyl alcohol-lactic acid-glycerol (PVLG) (Koske and Tessier 1983) and PVLG mixed 1:1 (v/v) with Melzer's reagent. Identification was based on spore morphology observed using the Leitz and Nikon light microscope and compared to descriptions and voucher specimens from the International Culture Collection of Arbuscular and Vesicular-Arbuscular Mycorrhizal Fungi (INVAM) web page.

Metropolitan Phoenix and surrounding desert
Desert sites, Urban Sites

Figure 1. Total number of AMF species observed at each land-use type, the mean value of the number of AMF species found associated with each plant, and the mean value of the number or AM fungal species found at each land-use site.

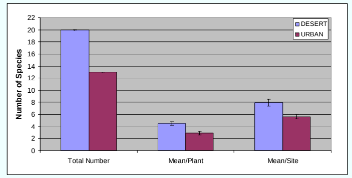


Figure 2a. The relative frequency of each AMF species found.

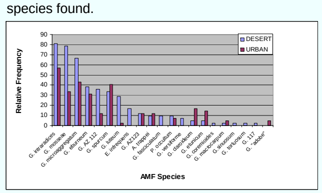


Figure 2b. The number of sites each AMF species was detected.

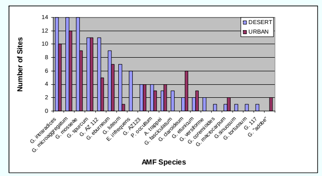


Figure 3a. Total number of AMF species and mean observed with *Parkinsonia spp.* (n=5)

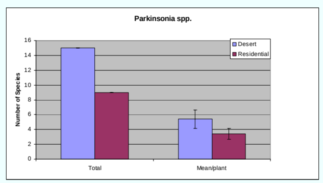
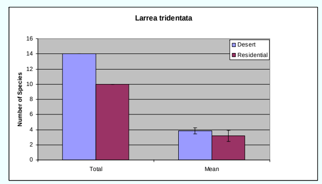


Figure 3b. Total number of AMF species and mean observed with *Larrea tridentata* (urban n=17, desert n=10)



RESULTS

The total number of AMF species detected was greater in the desert than urban areas (Fig. 1).

1/3 of the AMF species found in the desert were not found in the urban area, with 7 AMF species found only in the desert sites. The mean number of AMF species/plant and the mean number of species/site was greater at the desert sites in comparison to the urban sites (t=4.39, df=26, P=0.00 and t=3.22, df=26, P=.003)

- **There was a significant overlap in the species composition between the desert and urban sites (Fig. 2)**
  The most frequently detected species were similar. With one exception, all AMF species detected in the urban sites were also present at the desert sites. *Glomus intraradices*, *G. microaggregatum*, *G. mosseae*, *G. eburneum* and *G. spurcum* were detected in over 50 % of the desert and urban sites (Fig. 4).
- **The total number of AMF species associated with two native plants, *Larrea tridentata* and *Parkinsonia spp,* was greater at desert sites in comparison to urban sites. (Fig. 3).**
  There were no differences in the mean number of AMF species/plant between plants growing in the desert versus urban areas for *L. tridentata* but a greater mean number of AMF species/plant was detected in desert versus urban area for *Parkinsonia spp.*

CONCLUSION

AMF diversity was found to be different at the desert and residential sites. It is not known if these differences are due to urbanization or to differences between native and exotic plants. More work identifying the AMF associated with a larger sample of specific exotic plants and native plants in urban areas would be beneficial. We also plan to study the functional relationship between AMF and a native shrub, *Encelia farinosa*, commonly used as a landscape plant, at both urban and desert locations.

REFERENCES

Bever, JD, PA Schultz, A Pringle and JB Morton. 2001.Arbuscular mycorrhizal fungi: more diverse than meets the eye, and the ecological tale of why. BioScience 51:923-931.

Cousins JR, D Hope, C Gries and JC Stutz. 2003. Preliminary assessment of arbuscular mycorrhizal fungal diversity and community structure in an urban ecosystem. Mycorrhiza 13:319-326.

Daniels BA, and HD Skipper. 1982. Methods for the recovery and quantitative estimation of propagules from soil. In: Schenck NC(ed) Methods and principles of mycorrhizal research. American Phytopathological Society, St. Paul, Minn., pp 29-35.

International Culture Collection of Vesicular Arbuscular-Mycorrhizal Fungi. Species Descriptions from Reference Cultures. http://invam.caf.wvu.edu/fungi/taxonomy/speciesID.htm. Accessed 8 September 2003.

Koske, RE, and B Tessier. 1983. A convenient, permanent slide mounting medium. Mycological Society of America Newsletter 34:59.

Stabler, LB, CA Martin and JC Stutz. 2001. Effect of urban expansion on arbuscular mycorrhizal fungal mediation of landscape tree growth. Journal of Arboriculture 27(4):193-201.

van der Heijdeen, MGA, JN Klironomos, M Ursic, P Moutoglis, R Streitwolf-Engel, T Boller, A Wiemken, and IR Sanders. 1998. Mycorrhizal fungal diversity determines plant biodiversity, ecosystem variability and productivity. Nature 396:69-72.

ACKNOWLEDMENTS

This material is based upon work supported by the National Science Foundation under Grant No. DEB 9714833, Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER).