**Arbuscular Mycorrhizal Fungi (AMF) diversity in perennial and annual plant species.**

Author: Audrey Frampton
Major: Botany
Department of Microbiology and Molecular Genetics, Oklahoma State University, Stillwater, OK 74078, USA

**Key Words:**

Arbusular mycorrhizal fungi

*Bromus rubans*

Diversity

Gypsophilous

Gypsum soil

*Herniaria fructose*

Semiarid ecosystems

Plant Functional types (PTF)

*Senecio auricular*

**ABSTRACT**

 The following is a concise review of “*Perennial plant species from semiarid gypsum soils support higher AMF diversity in roots than the annual Bromus rubens”.* The objective of the study detailed in the article was toobserve annual and perennial plants and determine if the AMF associated varies from each other, as well as the extent of that variation. AMF, or Arbuscular Mycorrhizal Fungi, is a fungus that has a symbiotic relationship with some species of plants through the root systems. These underground systems are often vital for the survival of entire plant ecosystems, from trees to some grasses, and the overall health of the soil. The plant provides carbon for the fungi, and in return the fungi exchange nutrients the plants’ root systems don’t have access to. AMF can be microscopic or large, the organisms can be root-size and reach acres wide. Many of these AMF are microscopic and that is how they are categorized under “Microbiology”.

 The purpose of this paper’s research was to test AMF diversity and variation, and more specifically, how the variation is correlated to different plant species. The AMF and plant species’ diversity was observed via root analyses through techniques such as: nested PCR, cloning, sequencing of ribosomal DNA subunit region, and phylogenetic analyses. AMF diversity in the root systems of perennial *Herniaria fructose* and *Senecio auricular* and the annual *Bromus rubens,* growing in semiarid gypsum soil were analyzed. In the perennial plants, twenty sequencing types of the associated AMF were found, with different compositions and more diversity of the community compared to the annual *B. rubens* AMF community. Seasonal variation and the factor of variation in root systems’’ growth as well as life span of the perennial vs. lifespan of the annual are all variables to consider while moving forward with research.

**Introduction**

 Recent studies in AM fungi ecology focused on diversity specifically, and not the plant or soil interactions. Now, some are finding evidence that the soil’senvironment and plant associations may be key to distribution and diversity. The difficulty lies in accounting for these variables and testing them with accuracy. This study examines function and diversity of AMF specifically in relation to plant type (perennial or annual) and soil type, gypsum. Previous research on AMF is addressed with references to other authors. Some authors hypothesize that AMF play a greater role in plant functional types (PTF) in comparison to specific species, while other authors think the host-plant (species) determines the AMF colonizing plant roots. (Opik *et al*) (Martinez *et al*). In another study, authors determine soil type is a substantial factor in both composition and diversity of species in Central Europe. (Oehl *et al*)

 This study examines the AMF communities’ structure of perennial and annual plant species in a gypsophilous (gypsum-loving) community. They chose two perennial species: *Herniaria fruticose* and *Senecio auricular*, both occurring in gypsum soil exclusively. Thirdly, they chose the annual grass *Bromus rubens,* a more abundant species. The main objective of this study was to determine the diversity of AMF in three plant species with varied life cycles, and to check whether these plant species share the same AMF in gypsum soils with an arid ecosystem. (Alguacil *et al*, 2009 )

**Discussion**

 The location for data collection and the general study area for the experiment was located in El Rincon, Spain. Exact latitude and longitude are provided so the experiment can be reproduced, along with climate description down to the potential evapotranspiration. An overview of experimental design and sampling methods are provided with a total of 36 plants sampled per a replication block.

 Methods that were used for assessing the composition and diversity of AM fungi are as follows: DNA extraction and PCR, Cloning and sequencing, phylogenetic analyses, and statistical analysis of the data. (Alguacil *et al*, 2009 )

**Results**:

 The quantity of varied AMF sequence types were compared using a two way analysis of variance. The plant’s species factor ended up having a significant effect on AMF diversity. The lowest average was for *B. rubens* at 3.87. This varied significantly with the *H. fruticose* average at 5.15 and *S. auricular* at 4.84. (Alguacil *et al*, 2009 )

 Twenty AMF sequencing types were recorded from the roots of the 3 plant species. Of those 2 sequences, there were 5 genera: *Acaulospora, Glomus, Diversispora,* *Archaeospora,* and *Paraglomus.* These results show that composition of AMF is directly correlated to plant species. *B. rubens* displayed the lowest diversity, yet all AMF associated with *B. rubens* were also associated with the other 2 plants. Even though the 2 perennials included the same sequencing types as *B. rubens*, they had a significant amount more of other sequencing types, making them richer or more diverse in their AMF association. (Alguacil *et al*, 2009 )

 The variation is in AMF community structure depending on plant species can be explained by a number of factors such as life cycle, time of year, rainfall, functionality in each plant, phenology, and physiology. For example, one plant may grow exponentially while another is at a slower stage of growth or flowering. These variations explain nutrient requirements and gradients that could alter the relationship of the AMF at different times, more specifically, at different seasons in differed plants. This explains the variation in species that was observed in 5 genera of AMF and how different plants had partnered with different AMF.

 Another example of variation between plant species and more specifically the difference between perennial and annual is the amount of time the roots have been living in the soil. Annual plants root’s will have less time in the soil and therefore less exposure to AMF than the perennial that have older roots systems that are in some cases capable of growing much larger and to greater depths than the annual plant.

 This research is important for various reasons, understanding how plants rely on AMF and the extent that they do. Plants are vital to other organisms, and AMF are vital to many plants and other organisms. This research is new, and there is much to be learned from these symbiotic relationships, from the evolution of plant species to aiding in farming and agriculture needs. These underrated marvels under our feet have a story to tell. Distinguishing the roles of different genus of AMF for certain plants, understanding how they interact can further research in plant pathology, nutrients, soil issues and more. They are a companion to plants that have been there for a long time. They just haven’t been recognized for the boundless network they hold underground.

**References**

Alguacil, M.M., Torres, M.P., Torrecillas, E., Díaz, G., Roldán, A., 2011. Plant type differently promote the arbuscular mycorrhizal fungi biodiversity in the rhizosphere alter revegetation of a degraded, semiarid land. Soil Biology and Biochemistry 43, 167e173.

Alguacil, M.M., Roldán, A., Torres, M.P., 2009. Assessing the diversity of AM fungi in arid gypsophilous plant communities. Environmental Microbiology 11, 2649e2659.

Martínez-García, L.B., Armas, C., Miranda, J.D., Padilla, F.M., Pugnaire, F.I., 2011.

Shrubs influence arbuscular mycorrhizal fungi communities in a semi-arid

environment. Soil Biology and Biochemistry 43, 682e689.

Öpik, M., Moora, M., Liira, J., Kõljalg, U., Zobel, M., Sen, R., 2003. Divergent arbuscular

mycorrhizal communities colonize roots of Pulsatilla spp. in boreal Scots

pine forest and grassland soils. New Phytologist 160, 581e593.

Öpik, M., Metsis, M., Daniell, T.J., Zobel, M., Moora, M., 2009. Large-scale parallel 454

sequencing reveals host ecological group specificity of arbuscular mycorrhizal fungi in a boreonemoral forest. New Phytologist 184, 424e437.

Van der Heijden, M.G.A., Klironomos, J.N., Ursic, M., Moutoglis, P., Streitwolf- Engel, R., Boller, T., Wiemken, A., Sanders, I.R., 1998. Mycorrhizal fungal diversity determines plant biodiversity, ecosystem variability and productivity.

Nature 396, 69e72.

M.M. Alguacil a,\*, E. Torrecillas a, A. Roldán a, G. Díaz b, M.P. Torres b 2012 Perennial plant species from semiarid gypsum soils support higher AMF diversity in roots than the annual *Bromus rubens* Soil Biology & Biochemistry 49, 132-138