Diversity of Arbuscular Mycorrhizal Fungi Associated with Eastern Red Cedar  
by Tracy Hmielowski

Eastern red cedar (Juniperus virginiana) is widely planted as a landscaping tree across the eastern U.S. However, in the Great Plains, eastern red cedar (ERC) is considered invasive. These fast-growing trees are often planted for privacy or wind protection, but with easily dispersed seeds, drought tolerance, and potential allelopathic compounds, ERC can spread from the initial plantings. Increasing abundance of ERC is associated with negative impacts, which include reducing cattle forage on rangelands, causing allergy problems for people, and acting as volatile fuel in wildfires.

One area where the spread of ERC from initial planting into grasslands can be observed is the Nebraska National Forest (NNF). The NNF is located in north-central Nebraska and was established in the 1930s by hand-planting ERC and ponderosa pine. “We were interested in why, at Nebraska National Forest, the pine wasn’t recruiting,” says SSSA member Rhae Drijber, a professor at the University of Nebraska–Lincoln. “[Pine] was pretty well restricted to what was planted,” she says. “Eastern red cedar, on the other hand, was invading and establishing very well—actually too well.”

Initial sampling revealed the presence of arbuscular mycorrhizal fungi (AMF) in ERC roots. Arbuscular mycorrhizal fungi offer beneficial trade-offs to plants, including access to nutrients, pathogen resistance, and drought tolerance, in exchange for carbohydrates. Drijber and colleagues wondered if the AMF association could be contributing to the invasiveness of ERC in the Great Plains and conducted a study to determine the types of AMF associated with ERC and how the AMF community may change over time. The results are reported in a recently published article in the Soil Science Society of America Journal (http://bit.ly/2uBog3i).

Researchers sampled a chronosequence of ERC stands representing five age classes at three sites across the NNF. The age of trees was determined using tree rings, and classes were as follows: 1–5 years, 6–15 years, 16–30 years, 31–45 years, and 46–65 years. These age groups also reflect changes in the plant community over time, with the 1–15 year age group often being individual trees, stands in the 14–45 year range having an open to partially closed canopy, and stands in the 46–65 year age range being closed canopy.

To determine the AMF community through the chronosequence, roots were sampled from individual trees. The researchers extracted DNA from the root samples and used PCR (polymerase chain reaction) to amplify the samples. Denaturing gradient gel electrophoresis (DGGE) methods were used to compare AMF communities among sites and age groups. The AMF community results are reported...
as phylotypes due to the difficulty of assigning sequence data to individual species.

The authors report that a total of 13 phylotypes identified. From the NNF samples, they also determined that the AMF community associated with ERC declined in biodiversity from the youngest age group to the oldest. Specifically, the 1–5 year age group was found to host 11 of the 13 phylotypes while the 46–65 year age group only hosted four phylotypes.

In the 1–5 year age group, the AMF community was very similar for all three sites even though sites were at least 3 km apart on the landscape. Drijber explains that the NNF landscape has “minor variations” with slope and aspect in the grassland communities but a “similar suite of composition of plants in those grasslands” and a parent material that is more uniform than normal. The similarity in the 1–5 year AMF associations indicates the AMF community, much like the grassland community, is similar across the region to begin with.

The decline in AMF diversity over time may be the result of changes in soil properties that occur as ERC stands mature. As ERC grows into thick clumps, the trees shade out other species, and ERC litter accumulates. In addition to this change in vegetation, soils show an increase in total carbon, an increase in Bray phosphorus, a decrease in pH, and an increase in exchangeable calcium. Drijber points out that generalist AMF phylotypes, those found across a wide range of habitat types and soil conditions, “are the ones that continued through the ages,” being present across age groups and differences in soils properties.

Association with a diverse AMF community may aid in ERC seedlings becoming established at this site and others in the Great Plains. Although this study may not provide a solution to the problems of ERC invading grasslands, documenting changes in the AMF community under closed-canopy ERC stands may be important for landowners removing ERC and trying to reestablish rangelands.

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