

## The Role of Mycorrhizal Fungi in Rangelands

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Mycorrhizae are root associations that can be important to plants for nutrient uptake, growth, reproduction, and overall survival. Drs. Tom O'Dell and Mike Castellano spoke primarily about ectomycorrhizae, which are found almost exclusively with woody plants and usually have a high host specificity. In rangelands, however, endomycorrhizae are more common. These fungi are also referred to as arbuscular mycorrhizae. Arbuscular mycorrhizae are commonly associated with the roots of rangeland grasses and shrubs, and have a much lower host specificity. A particular species of arbuscular mycorrhizae might associate with diverse plant species in a particular area. They produce a hyphal network extending from the root and form arbuscules inside the cells of the root. The arbuscule is the site of nutrient exchange. Arbuscular mycorrhizae also form storage vesicles and hyphal connections within the root. Hyphae exit the root and grow out into the soil. The spores can also be seen externally on the root.

There is conflicting data on how important arbuscular mycorrhizae are, and the data seem to indicate that mycorrhizal importance varies with site, soil, and host plant species.

Arbuscular mycorrhizal fungi are obligate, and they require a host plant in order to survive. Rangeland plants can be defined according to their mycorrhizal dependence. Some are non-mycorrhizal, some are facultative, and others dependent. Species of *Artemisia* (sagebrush) are an example of a rangeland shrub with a high dependence on arbuscular mycorrhizae. *Artemisia* roots are commonly 70% colonized with arbuscular mycorrhizal fungi. *Chrysothamnus* species (rabbitbrush) are also highly dependent, whereas *Atriplex canescens* (four-wing saltbush), *Sarcobatus vermiculatus* (greasewood), and *Atriplex confertifolia* (shadscale) are more facultative. *Purshia tridentata* (bitterbrush) has a high colonization by mycorrhizae. In contrast, *Ceratoides lanata* (winterfat) is commonly non-mycorrhizal, but will often be colonized when it is growing in a complex with mycorrhizal shrub species. Bunchgrasses such as *Agropyron spicatum* (bluebunch wheatgrass), *Stipa* spp. (needlegrass), *Oryzopsis hymenoides* (Indian ricegrass), *Poa* spp. (bluegrass), and others commonly have arbuscular mycorrhizae. Grasses that are

non-mycorrhizal include the annual exotics *Bromus tectorum* (cheatgrass) and *Taeniatherum caput-medusae* (medusahead wildrye).

There will typically not be a great diversity of arbuscular mycorrhizae species present in a given area. These few species are able to colonize a large variety of host plants however, and it is possible to have several different grass and shrub species colonized by one species of fungus. Some research has shown that hyphal networks can even connect different plant species.

When does an arbuscular mycorrhizae become a species of concern? As with other fungi, this is a difficult question to answer. We can say that when the host plant is disturbed, it will be a problem for the obligate fungus. Topsoil disturbance or removal may eliminate the hyphae and spores that serve as inoculum for new plants. In habitats burned by range fires, grasses such as cheatgrass often replace the native sagebrush/ bunchgrass communities. Cheatgrass does not regularly form arbuscular mycorrhizae, making fungal recovery difficult. Fire removes the higher vegetation, but fungal inoculum will remain viable in soil for a limited amount of time. If mycorrhizae-forming plants do not recolonize a disturbed area, the fungus cannot become established. Soil erosion, especially following fire, limits mycorrhizae formation. Off-road vehicles remove vegetation, disturb soil structure, and disrupt hyphal networks. Livestock grazing can also have an impact on mycorrhizae in soil, especially when use levels are high-intensity. Grazing compacts soil and removes photosynthetic plant parts. Grazing itself stresses the plant, and in turn the plant does not release carbohydrates for mycorrhizal formation.

Three genera of arbuscular mycorrhizae are dominant in southwestern Idaho rangelands. They are *Glomus*, *Gigaspora*, and *Acaulospora*. There is not a lot of information about the importance and/or role of these genera, and hence it is difficult to know how concerned we should be about them. As we learn more about soil specificity and fertility, we will learn more about the arbuscular mycorrhizae in Idaho rangelands. Host plants need to be the first line of concern — if the habitat is there and undisturbed, the fungi will probably be okay.

## References

Allen, M.F. 1991. The ecology of mycorrhizae. Cambridge University Press, Cambridge. 184 pages.

Trappe, J.M. 1981. Mycorrhizae and productivity of arid and semi-arid rangelands. Pages 581-599 In: Advances in food producing systems for arid and semi-arid lands, ed. J.T. Manassah and E.J. Briskey. Academic Press, New York.