University of Idaho Extension

Forest Management No. 40

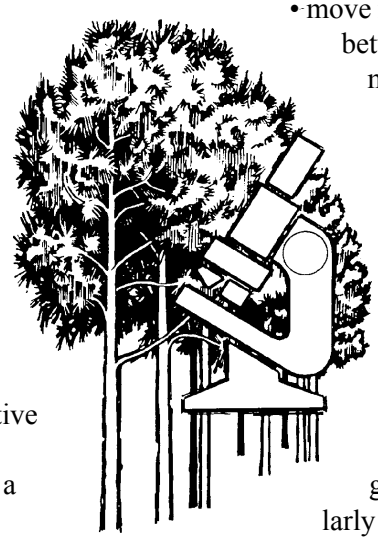
UI Extension Forestry Information Series

Mycorrhizae – the friendly forest fungi

Chris Schnepf

Many forest owners do not immediately see fungi as a beneficial organism. If you have seen patches of fir dying cancerously from root disease or learned about the profound effect white pine blister rust has had on north Idaho's forest ecology, it may be easy to forget that the majority of forest fungi do not kill trees.

You probably know that microbes inhabit your stomach and other parts of your body, performing beneficial roles (e.g., helping you to digest food). Most of us could not name any of these if asked. There are also a whole host of relatively unknown microbes and fungi that help trees by recycling forest nutrients, decomposing slash, and improving soil, to list a few of their positive functions. Some suggest that even tree-killing fungi (the native ones, at least) perform a positive role by taking out trees that are poorly adapted to a forest site.



Mycorrhiza = "fungus root"

One of the groups of fungi that most directly benefit tree growth is called *mycorrhizal* fungi. Mycorrhiza is translated from Latin as "fungus root". These fungi enter the roots of trees and other plants and form a symbiotic relationship (a relationship in which both the host and the fungi benefit). Mycorrhizal fungi get carbon (the product of photosynthesis) from trees and the trees get a larger effective absorbing root surface (more nutrients and moisture) from the hyphae (the fungus equivalent to roots) and mycelia (matted hyphae) of mycorrhizal fungi. In addition to rooting capacity, mycorrhizae can also:

- provide reservoirs for nutrients that might otherwise be leached from the soil;
- physically block pathogenic fungi access to tree roots;
- help "unlock" soil nutrients (convert them into forms that can be used by plants);
- exude or decay into substances that act as "organic glues", helping to aggregate soil particles and improve soil structure;
- move nutrients and photosynthate (carbon) between trees (they can even move materials between different tree species, where the same fungus is capable of associating with multiple tree and shrub species);
- exude antibiotic substances that deter root pathogens; and
- provide food for "fungivores", organisms ranging from ants to deer, that feed on mycelia or fruiting bodies of forest fungi.

Mycorrhizae are essential for good growth on many tree species, particularly on nutrient-poor or droughty sites.

Identifying mycorrhizae

Mycorrhizal fungi form relationships with over 95% of the plants on earth, and there are many, many different species. Over 2,000 fungi have been reported to form mycorrhizal relationships with Douglas-fir alone! Mycorrhizae are separated into two general types. *Ectomycorrhizae* cover the outside of rootlets, just penetrating the rootlets' outer cells. *Endomycorrhizae* do not form a sheath over rootlets. Instead their filaments grow deeper into the rootlets and out into the soil.

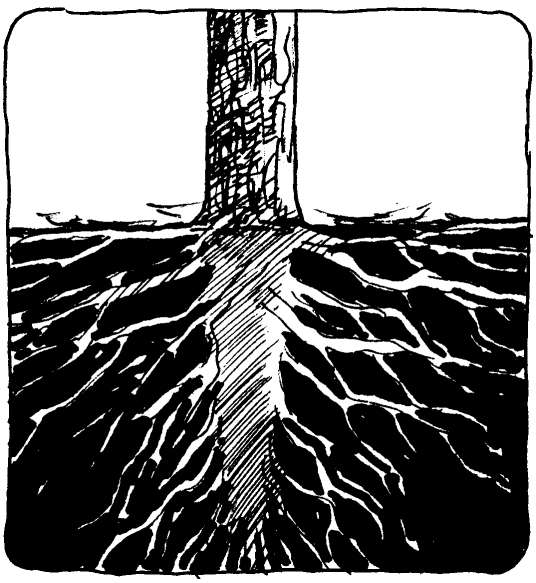
Ectomycorrhizal fungi are the most common. If you have ever seen plants grown hydroponically, you may have been struck by the many small root hairs. If you dig up seedlings in the forest, you may notice that the roots look a little thicker than those hydroponic roots –

CONTINUED ON PAGE 2

that is because they are covered, to some degree, by ectomycorrhizal fungi.

Mycorrhizal fungi produce many different kinds of fruiting bodies. Some are above-ground mushrooms. For example, golden chanterelles (*Cantharellus cibarius*) are the fruiting body of a mycorrhizal fungus. Other fruiting bodies are underground (e.g., truffles).

Managing Mycorrhizae?



There has been a large amount of research on forest fungi that kill trees. There has been much less research on forest mycorrhizal fungi (even less on fungi that decay downed logs, etc). The amorphous nature of forest fungi often makes them difficult to pin down and do precise experimental research in a forest setting. So, with the standard academic caveat of "we need more research", here are a few general principles you can apply on your forest regarding mycorrhizal fungi:

- *There is usually no need to add mycorrhizae to well-established forest sites.* Native forests are usually well-stocked with native mycorrhizal species. However, trees planted to non-forested areas such as agricultural fields or dramatically altered sites (e.g., a reclaimed mining area) may very well benefit from mycorrhizal inoculation. Some hardwood nurseries in the eastern U.S. have actually inoculated seedlings with mycorrhizae in anticipation of their being planted in farm fields.

- *Leave more coarse woody debris distributed across the site.* Coarse woody debris (wood larger than 3 inches in diameter) helps mycorrhizae because as it decays into the soil it provides better soil moisture for the fungi, particularly during drought periods. Ideally, woody debris from Douglas-fir, pines and larch is best because it decays with 'brown rots", leaving debris products that last longer than those left by "white rots" which typically decay true firs or hemlock. You don't have to leave a lot of material — typically 1-2 cull logs left per acre are adequate (to estimate how many tons of coarse woody debris you have, see a previous Woodland Notes article entitled *Tons of Slash*, available online at www.cnr.uidaho.edu/extforest/Vol14,No1.htm.)

- *Minimize compaction and soil disturbance.* Compaction reduces pore space in soils. Pore space provides the air that tree roots need to draw the moisture out of the soil. Many scientists also believe that compaction and excessive soil disturbance impairs the growth of beneficial forest fungi, including mycorrhizal fungi. Soil compaction can be quite variable by the type of soil, time of the year, type of equipment, and care of the operator using the equipment. Operating on snow or when soils are dry and limiting equipment to designated trails will help minimize soil compaction. For more information, see an Oregon State University Extension publication titled *Soil compaction on woodland properties* (OSU EC 1109).

For more information

Mycorrhizal fungi play a fascinating role in our forests. If you would like to learn more about these fungi and research being conducted on them, check the web site of the USFS mycological research team at http://www.fs.fed.us/pnw/mycology. In addition to useful links to ongoing research on mycorrhizal fungi, the web site also includes photos of mycorrhizal fungi and their fruiting bodies, publications on mycorrhizal fungi, and links to other sites on these fungi.

This article first appeared in Woodland NOTES, Vol.15, No. 1.

About the Authors: *Chris Schnepf* is an Area Extension Educator - Forestry and Professor at the University of Idaho.