

MYCORRHIZAL FUNGI AS A MANAGEMENT

TOOL IN FOREST TREE NURSERIES

by

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Before we start, I would like to emphasize that I am not an expert in the field of mycorrhizae. Rather, I am a forester who is primarily interested in these fungi as they pertain to growing tree seedlings.

I want to talk with you today about the role of mycorrhizae in nursery management. I plan to treat the subject in three parts: 1. what are mycorrhizae?; 2. present state of the art; and 3. the future potential for mycorrhizae in tree nurseries. In all my remarks, I will be referring to ectomycorrhizae, the kind normally found on Western conifers.

1. What are mycorrhizae?

As practicing nurserymen, I am sure you have seen mycorrhizae on your nursery stock. So instead of dwelling on what you already know, I will show you the basic anatomy of a root infected with a mycorrhizal fungus. A mycorrhizae can be defined as a symbiotic association between a fungus and the root system of a plant.

This fungus forms a sheath over the feeder root which is called the mantle. Fungal hyphae also penetrate into the cortex of the root, forming what is known as the Hartig net. In this symbiotic association the fungus receives food from the tree root in exchange for the disease protection and increased nutrient uptake that it provides for the tree.

On most species of conifers mycorrhizae are considered essential to the growth of the tree, especially after outplanting. It has been proven that it is possible to grow seedlings in the absence of these fungi in special experimental chambers. Their true benefit comes, however, after outplanting when the tree must adapt to less-than-optimal conditions.

I would like to emphasize one point at this time. The key word to remember in dealing with mycorrhizae is variability. This variability results from the fact that there are three separate components in a mycorrhizal system: host tree, the fungus, and the soil environment. As an example, there are over 150 species of fungi that are mycorrhizal on Scots Pine. Considering the wide range of sites on which this tree is planted, you can readily appreciate the variation that can occur.

2. Present state of the art.

Prior to 1970, most research on mycorrhizae was aimed at physiology and taxonomy and very little was of direct interest to you as nurserymen. At the present time several studies are being conducted to test the practicality of inoculation procedures and field performance.

As an example of present technology, I would like to show you what we are doing with containerized seedlings in Region 2. We are currently testing one species of mycorrhizae, Pisolithus tinctorius, on two species of trees: ponderosa and lodgepole pine. These are being grown in the Colorado State Forest Service greenhouse at Fort Collins, Colorado.

Basically, the procedure consists of inoculating the normal potting mixture with a given quantity of a fungal-treated mix. The fungus present in this inoculum will then colonize the new feeder roots of the tree seedling as it grows through the container.

The fungus is grown in specially designed jars filled with vermiculite, peat moss and a nutrient solution. After 2-3 months, the fungus has grown throughout this mixture and it is ready for use. The first step is to remove the inoculum from the culture jars and wash it thoroughly to remove the nutrient solution. This phase is critical because these nutrients will encourage damping-off fungi if they are left and mixed into the containers. Once clean, the inoculum is screened to a given size to assure good mixing with the potting soil. This inoculum is then blended with the potting mix and placed in the containers as usual. From this point on, the procedure is the same as usual, with one restriction. Fertilization should be avoided for the first few weeks to discourage damping off.

The final result of this procedure will be seedlings that are well covered with mycorrhizae, better adapting them for survival in the field.

This basic procedure has also been adapted to bare root stock in the nursery bed. This type of inoculation is much more difficult because of the variable conditions in the nursery bed. There have been successful trials, however, especially with the southern pines.

3. The future of mycorrhizae in nursery management.

I feel that mycorrhizal management will eventually become a normal procedure in tree nurseries. Several questions must be answered before this can be achieved, however.

- a. Beneficial mycorrhizal fungi must be identified for individual tree species and perhaps for specific site conditions.
- b. Inoculation procedures for large-scale production must be developed. Commercially available inoculum will soon be available. Other types of inoculum, such as spore suspensions, may prove to be practical.

- c. The effects of various soil types and cultural treatments must be analyzed as to their effects on mycorrhizae. Fertilizers, herbicides, weed killers, fungicides, and other soil amendments must influence mycorrhizal formation and growth, but as yet, these effects have not been determined.

But, what can be done at the present time? Let's go back to our three-celled mycorrhizal system. You, as nurserymen, can influence two of these three factors: the fungal symbiont and the edaphic environment of the nursery bed. If you are sure that suitable fungi are present, then you can work towards optimizing environmental conditions in the nursery. If you wish to encourage one fungus over another, it will be possible to introduce desired species of mycorrhizae.

One last point. Although there has been a considerable amount of work done on mycorrhizae, I feel that one of the greatest errors we can make is to over-extrapolate research results. As I pointed out earlier, the variability we are dealing with is tremendous. Each of your nurseries is unique in one or more ways from any other. Therefore, I propose that we begin to try small field-plot trials to stimulate beneficial mycorrhizae at all our nurseries. By such small-scale experiments we can do much to determine proper nursery management practices that will encourage good mycorrhizal development and lead to better quality nursery stock.

Thank you for your time. Are there any questions?