Ectomycorrhiza — ecology of the fungal partner

BENGT SÖDERSTRÖM

Much attention has been paid to the effects of mycorrhizae on host plant growth and numerous papers have been published which demonstrate that seedlings grow better if they are mycorrhizal, tolerating higher environmental stress levels, etc. However, rather little information is available concerning the ecology and physiology of the fungal partners when they are growing as symbionts.

The traditional and often accepted view of the morphology of a mycorrhizal rootlet is that it is covered by a smooth fungal mantle. However, anyone who has studied conifer mycorrhizae in podzolic soils knows that many strands and hyphae grow out into the soil from the tips and it has been demonstrated that the mycelium, not surprisingly, can grow far away from the roots. Techniques are now available which allow studies of the fungal partner growing in symbiosis in unsterile systems. In specially designed laboratory systems, we have been able to demonstrate that the soil-dwelling mycelium is very directly dependent on an energy supply from the roots. If this support ceases, the respiration of the mycelium will be drastically reduced within 24 hours. It is also clear that carbon (carbohydrates) is transferred from the host to the fungus and translocated further to the soil-dwelling mycelium. It has been shown that translocation of nutrients occurs in the opposite direction as well; they are taken up by the mycelium from the soil and transferred to the host plant. This has earlier been shown for phosphorus by using 32-P and we have recently been able to demonstrate that ammonium (as 15-N) is taken up by the mycelium and used for synthesis of amino acids, which are then found in the free amino acid pool of the mycelium and in the proteins of the host plant. This has been demonstrated to occur in different fungi. These observations become even more interesting in the light of new data indicating that some ectomycorrhizal fungi are proteolytic. We might thus be able to confirm Frank's hypothesis, formulated about 100 years ago, that ectomycorrhizal fungi have access to the soil organic nitrogen pool.

Using the special laboratory growth technique mentioned above, we are now studying other mycorrhizal systems, such as beech and larch, and also the effects of various soil treatments on the fungal mycelia, and their growth and nutrient uptake.

Bengt Söderström, Lund University, Dept. of Microbial Ecology, Helgonavägen 5, S-223 62 Lund, Sweden