

MYCORRHIZA RESEARCH SUMMARY

Benefits to plants

1. Increased plant nutrient supply by extending the volume of soil accessible to plants.
2. Increased plant nutrient supply by acquiring nutrient forms that would not normally be available to plants (Tarafdar & Marschner 1994, Schweiger et al. 1995, Kahiluoto & Vestberg 1998).
3. Some ECM and ericoid fungi have the capacity to breakdown phenolic compounds in soils which can interfere with nutrient uptake (Bending & Read 1997).
4. Root colonisation by ECM and VAM fungi can provide protection from parasitic fungi and nematodes (Duchesne et al. 1989, Grandmaison et al. 1993, Newsham et al. 1995, Little & Maun 1996, Cordier et al. 1998, Morin et al. 1999).
5. Non-nutritional benefits to plants due to changes in water relations, phytohormone levels, carbon assimilation, etc. have been reported, but are difficult to interpret (Brundrett 1991, Smith & Read 1997).
6. Mycorrhizal benefits can include greater yield, nutrient accumulation, and/or reproductive success (Lewis & Koide 1990, Stanley et al. 1993).
7. Mycorrhizas can cause growth form changes to root architecture, vascular tissue, etc. (Daniels & Hetrick et al. 1988, Miller et al. 1997).
8. Suppression of competing non-host plants, by mycorrhizal fungi has been observed (Allen et al. 1989).
9. Significant amounts of carbon transfer through fungus mycelia connecting different plant species has been measured (Simard et al. 1997). This could reduce competition between plants and contribute to the stability and diversity of ecosystems.
10. Networks of hyphae supported by dominant trees may help seedlings become established or contribute to the growth of shaded understory plants (Hogberg et al. 1999, Horton et al. 1999).
11. Nutrient transfer from dead to living plants may occur (Eason et al. 1991).

Other roles in ecosystems

12. Soil hyphae are likely to have an important role in nutrient cycling by helping to prevent losses from the system, especially at times when roots are inactive (Lussenhop & Fogel 1999).
13. Hyphae are conduits that may transport carbon from plant roots to other soil organisms involved in nutrient cycling processes. Thus, cooperating with other members of the decomposition soil food-web.
14. Soil hyphae may have an important role in nutrient cycling by acquiring nutrients from saprophytic fungi (Lindahl et al. 1999).
15. Mycorrhizal roots and fungus fruit bodies are important as food sources and habitats for invertebrates (Fogel & Peck 1975, Rabatin & Stinner 1989, Lawrence & Milner 1996).
16. Mycorrhizal fungus hyphae are an important food source for soil invertebrates (Setälä 1995, Ingham & Massicotte 1994).
17. Mycorrhizas influence soil microbial populations and exudates in the mycorrhizosphere and rhizosphere (Ames et al. 1984, Bansal & Mukerji 1994, Olsson et al. 1996, Andrade et al. 1998).
18. Hyphae of VAM fungi are considered to contribute to soil structure. Their role in mechanical aggregation has been questioned (Degens et al. 1994), but secretions such as glomalin may be more important (Wright & Upadhyaya 1998). Hyphal mats produced by ECM fungi considerably alter soil



structure (Griffiths et al. 1994).

19. Mycorrhizal fungi contribute to carbon storage in soil by altering the quality and quantity of soil organic matter (Ryglewicz & Andersen 1994).

How mycorrhiza help nutrient uptake

The demand for a particular mineral nutrient depends on plant internal requirements, while the supply of that nutrient primarily depends on its availability and mobility in soils (Russell 1977, Marschner 1995).

Mineral nutrients such as phosphorus have very limited mobility in soils so that depletion zones - where all the available nutrient has been utilised, quickly form around roots (Bhat & Nye 1974, Russell 1977, Marschner 1995). Thus to obtain more phosphorus, plants must bypass these depletion zones by further root activity elsewhere in the soil. The outcome of this quest for phosphorus (and other relatively immobile soil resources) should largely be determined by the surface area of a plant's root system. The most important role of mycorrhizal fungus hyphae is to extend the surface area of roots. The capacity of plants to influence nutrient availability in soils will also depend on the extensiveness and activity of their root system, since young roots are the primary source of exudates (Curl & Truelove 1980, Uren & Reisenaur 1988).

Soil Disturbance

Propagules of mycorrhizal fungi may be absent from soils where severe soil disturbance has resulted in topsoil loss, or where host plants are limited by adverse soil or site factors such as salinity, aridity, waterlogging, or climatic extremes (Brundrett 1991). Most studies of mycorrhizal associations in highly disturbed habitats such as mine sites have found reduced levels of mycorrhizal propagules (Danielson 1985, Jasper et al. 1992, Pflieger et al. 1994, Brundrett et al. 1996). Less severe forms of soil disturbance, including agricultural tillage, soil animal activities, fire and erosion can also reduce levels of mycorrhizal fungus propagules (Habte et al. 1988, O'Halloran et al. 1986, Read & Birch 1988, Vilarino & Arines 1991).

Spores and other propagules of mycorrhizal fungi can be introduced to new sites by wind or water erosion, or by the activity of animals which feed on fungi (Allen 1991, Brundrett 1991, Claridge & May 1984, McGee & Baczocha 1994, Janos et al. 1995). In a disturbed habitat, the effectiveness of natural vectors will depend on the proximity of undisturbed habitats containing suitable fungi (and their associated animals) as well as the phenology of fruiting of fungi. Effective natural colonisation of disturbed habitats, such as mine sites in Australia, by mycorrhizal fungi has been observed, but there is as yet insufficient information about the time required for this process to occur (Gardner & Malajczuk 1988, Jasper et al. 1992, Brundrett et al. 1995). It is suggested, that artificial introduction of mycorrhiza can help improve soil fertility in such situations.

References

<http://cropsoil.psu.edu/sylvia/mycorrhiza.htm>

<http://www.mycorrhizas.org/>

<http://mycorrhizas.info/index.html>