Alpine ecosystem rehabilitation: the mycorrhiza effect

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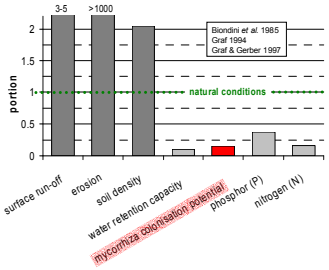
Introduction

Ecosystem rehabilitation is a major challenge in view of protection against natural hazards. Eco-engineering methods are particularly appropriate in erosion control and prevention of shallow landslides. However, their acceptance is hampered, primarily due to uncertain plant growth and long term establishment of a functional vegetation cover. The specific application of mycorrhizal fungi provides a natural solution to lower the risk of growth failure. Furthermore, these fungal partners stabilise the soil and improve plant succession processes.

The degraded soil

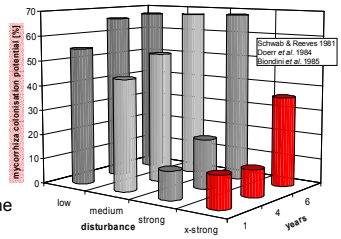
Construction and maintenance of alpine ski slopes and infrastructure often result in serious damage of the natural vegetation cover.

On barren soils, heavy rainfall triggers off erosion and shallow landslides that often endanger people and infrastructure at the bottom of the valley.



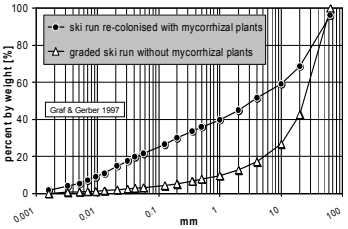
Severe disturbance of naturally developed vegetation (i.e. graded ski slopes) reduces the mycorrhiza colonisation potential of plants.

Characteristics of a degraded alpine soil: drastic loss of fine soil material due to increased water run-off as well as low water and nutrient retention capacity.

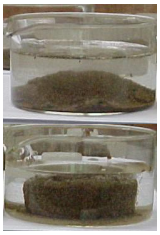


Soil recovery by mycorrhizal fungi

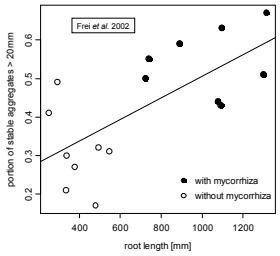
Micro-organisms and, in particular, mycorrhizal fungi substantially contribute to the development and stabilisation of degraded soil. The symbiotic plant partners enmesh fine soil particles with their hyphal networks forming aggregates and further stabilise them with products of their metabolism (polysaccharides).



Re-colonisation with mycorrhizal plants increases the aggregate stability and water retention capacity. Conclusively, leaching of fine fractions and nutrients are decreased.

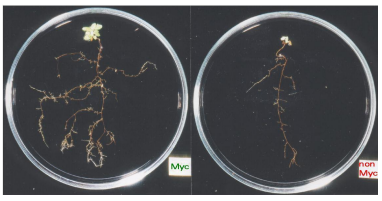


The water stability of soil aggregates is achieved by the fungal mycelia and the increased root growth due to the mycorrhization of the host plants.



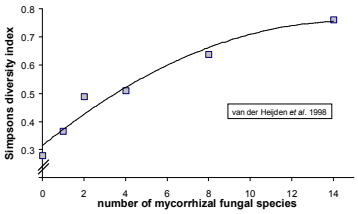
Plant growth and succession improved by mycorrhiza

Compared to non-mycorrhizal roots, the symbiotic fungi increase the water and nutrient absorption surface of their host plants with their hyphal network up to 50 times.



Mycorrhizal fungi stimulate root growth. The root length differs by factors 3-7 compared to plants without mycorrhiza. Accordingly, the symbiosis results in better growth of the entire plant.

Plant diversity strongly depends on specific mycorrhizal fungi. Without them, development of associations is restricted and succession processes are delayed or even stopped.



Conclusions

Mycorrhizal fungi are responsible for the development of a stable soil and pore structure. Accordingly, they contribute to diminish leaching processes and to accumulate water and basic nutrients. Furthermore, they improve growth and succession of plants. On degraded soils the mycorrhiza colonisation potential of plants is, however, drastically reduced. Decisively, successful ecosystem rehabilitation strongly depends on the application of the specific fungal partners.