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Effects of endophytic and mycorrhizal fungi associated with Salix appendiculata on soil aggregate stability

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In view of sustainable soil stability, eco-engineering measures in extremely challenging landslide areas such as Hexenrübi (Dallenwil, Switzerland) ask for well suited combinations of plants and their microbial partners. Mycorrhizal fungi and endophytes can influence soil stability *directly* by their mycelial networks in the soil as well as *indirectly*, altering roots and physical conditions of the host plants.

In a laboratory study *Salix appendiculata* which colonized the less extreme slopes of Hexenrübi naturally and more successfully than the introduced species of the eco-engineering measures, was inoculated with different combinations of mycorrhizal and endophytic fungi. Beside the general impact of the different fungal treatments on soil aggregate stability, it was of particular interest whether direct or indirect effects of the fungi prevail.

Sterilized soil and seeds of *Salix appendiculata* from the Hexenrübi were filled in plastic cylinders and inoculated with *Hebeloma crustuliniforme* (ectomycorrhiza), *Glomus mossae* and *G. intraradice*s (arbuscular mycorrhiza), and a dark septated endophyte (DSE) of the *Phialocephala fortinii*-complex (PAC), individually and in different combinations. After a four months growth period soil aggregate stability was measured by a wet sieving procedure for each of the cylindrical soil samples and quantified as the fraction of water stable aggregates. Different root and plant parameters were analysed and, additionally, root and soil samples were taken for estimating the amount of fungal hyphae *in the soil* (direct effect). For that purpose, the Ergosterol – a fungi specific membrane component- was determined by High-Performance Liquid Chromatography (HPLC). The mycorrhization degree *of the roots* (indirect effect) by ecto- and arbuscular fungi was estimated by a gridline intersect method whereas the colonisation by PAC endophytes was determined by PCR using PAC specific IT-sequences.

All treatments with *Hebeloma crustuliniforme* (ectomycorrhiza) had significantly (p-values <0.03) higher soil aggregate stability, compared to the non-inoculated control as well as to most other inoculation treatments. Arbuscular mycorrhiza had generally a negative influence on soil aggregate stability. Samples inoculated with PAC show a high variation in aggregate stability. Ectomycorrhization positively correlates with soil aggregate stability (p-value=$8.3*10^{-4}$) as well as the dry weight of roots and, consequently, the latter is likewise correlated with soil aggregate stability (p-value=$2.2*10^{-16}$). These findings implement a strong indirect effect of ectomycorrhiza on soil stability.

The direct impact of fungi on soil aggregate stability is difficult to measure as the amount of Ergosterol in the soil rapidly declines related to the exposure to light and heat, which was unavoidable during the wet sieving procedure. Correspondingly, Ergosterol emerged to be close to the detection limit. Still, most of the samples inoculated with *Hebeloma crustuliniforme* showed an Ergosterol peak.

Based on these preliminary results it becomes apparent that *Salix appendiculata* combined with *Hebeloma crustuliniforme* is a strong partnership in view of stabilising slopes that are hardly to colonise with traditional eco-engineering measures.