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What do Boletus, Chanterelle and Co. have in common with Eco engineering?

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A major goal of eco engineering is its contribution to slope stability. The carefully selected plant and technical construction material are an indispensable requirement but not necessarily sufficient in view of long-term success. For that purpose, plant growth and the development of a functional vegetation cover are essential. However, particularly under extreme climatic and environmental conditions even pioneer plants reach their limits in bridging the gap between their proper needs and the effective yield of the soil degraded by erosion or sliding processes.

Besides the conventional solutions that are the application of artificial fertiliser and soil conditioners, a competitive option is to be found in the "Kingdom of Fungi". Under natural conditions, as good as every plant species used in eco engineering lives in a symbiotic relationship with fungi, called mycorrhiza with Boletus and Chanterelle as two prominent representatives. Within these partnerships, the fungi take charge of the host's water and nutrient supply; considerably increasing its efficiency compared to non-mycorrhized roots. Consequently, plant growth, in particular root performance, and survival are significantly improved as is shown in a restoration experiment on an alpine ski slope in the Swiss mountains and has been demonstrated many times elsewhere.

In addition to this indirect contribution to the restoration and re-stabilisation process, the mycorrhizal fungi provide more direct functions related to the development of a stable soil structure starting from a severely degraded soil material. The mycelia producing fungi assemble and stabilise micro- and macro-aggregates out of smallest organic and inorganic soil particles. The formation and stabilisation of the soil structure proceed at different spatial scales directly by electrostatic charge, adhesive and enmeshment mechanisms. Numerous investigations prove that, on the one hand, the sole application of mycorrhizal fungi to loose soil material may result in an increase of aggregate stability but, on the other hand, demonstrate its species specific dependency. Furthermore, mycorrhizal fungi support the soil aggregate stability by serving as a distribution vector for associated micro-organisms, mainly bacteria and archaea, some of them soil stabilising alike.

A positive correlation was found between soil aggregate stability and dry unit weight, based on laboratory as well as field samples. Such a correlation is known for the shear strength parameters – particularly for the angle of internal friction Φ' – of the Mohr-Coulomb failure criterion on which most of the conventionally used models for soil and slope stability calculations are based. Moreover, evidence was provided that the aggregate stability of soil at low dry unit weight ($\sim$15.5 kN/m^3) added with plants and mycorrhizal fungi corresponds to that of untreated soil material at high dry unit weight ($\sim$19.5 kN/m^3) a feature found for the angle of internal friction Φ' too. Conclusively, based on these relationships, effects of plants and mycorrhizal fungi on soil stability may be interpreted as a virtual increase in dry unit weight and a real increase in the angle of internal friction Φ', respectively.

The effect of plants and fungi on soil stability is, however, not restricted to withstand erosion and sliding processes induced by water. Recent experiments in a wind tunnel reveal the potential of this symbiosis related to wind erosion and, therefore, in view of combating desertification. Experiments with differently dense planted soil confirmed the negative correlation with the amount of sediment transport and health threatening fine dust (PM_{10}) emission. The "mycorrhiza network" including and connecting plants, soil aggregate stability, and the angle of internal friction Φ' is of special meaning in view of soil stabilisation and the development of degraded soil. Carefully selected fungus-plant combinations shorten the delicate phase of re-colonisation and the development of a functional vegetation cover at simultaneous amelioration of the site specific conditions – representing the essential requirements for long-term success of eco engineering measures.