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Soil aggregate stability as an indicator for eco-engineering effectiveness?

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Eco-engineering aims at stabilising soil and slopes by applying technical and biological measures. Engineering structures are commonly well defined, immediately usable and operative, and their stability effects quantifiable and verifiable. Differently, the use of plants requires more restrictive boundary conditions and the protection potential is rarely easily calculable and develop-ing as a function of growth rate. Although the use of vegetation is widely appreciated and their stabilising effect recognised, there is an increasing demand on sound facts on its efficiency, in particular, in relation to time.
Conclusively, a certain necessity has been recognised to monitor, assess and quantify the effectiveness of ecological restora-tion measures in order to facilitate the transfer of technology and knowledge. Recent theoretical models emphasize the im-portance of taking an integrated monitoring approach that considers multiple variables. However, limited financial and time resources often prevent such comprehensive assessments. A solution to this problem may be to use integrated indicators that reflect multiple aspects and, therefore, allow extensive information on ecosystem status to be gathered in a relatively short time. Among various other indicators, such as fractal dimension of soil particle size distribution or microbiological parameters, soil aggregate stability seems the most appropriate indicator with regard to protecting slopes from superficial soil failure as it is critical to both plant growth and soil structure.
Soil aggregation processes play a crucial role in re-establishing soil structure and function and, conclusively, for successful and sustainable re-colonisation. Whereas the key role of soil aggregate stability in ecosystem functioning is well known concerning water, gas, and nutrient fluxes, only limited information is available with regard to soil mechanical and geotechnical aspects.
Correspondingly, in the last couple of years several studies have been performed in order to bridge this gap addressing partic-ularly the influence of root growth and mycorrhizal fungi on the resistance of soil aggregates against disintegration and linking it to slope stability. As superficial soil failure is often related to heavy rainstorms and, in this regard, mainly due to water satura-tion, recent investigations focused on the pore water pressure, too.
Summarising main results of the different studies a positive relationship between soil aggregate stability and traditional soil mechanical shear strength parameters was found, e.g. given certain soil conditions, an increase in aggregate stability may be equated to an increase of the angle of internal friction Φ' and/or cohesion c'. In addition, almost all investigations showed a strong positive correlation between root length per soil volume and soil aggregate stability. In respect of mycorrhizal fungi, results are not yet as clear. On the one hand it was found that the use of unspecific (commercial) inoculum had no or even a negative effect on root growth within the first vegetation period and, correspondingly, on soil aggregate stability. However, the use of specific plant fungi combinations almost ever resulted in an obvious acceleration of root growth immediately with con-comitant gain of soil stability. As far as pore water pressure is concerned we did not yet find an interpretation that is fairly straightforward and not overly prone to controversy. It looks like soil aggregated by mycorrhized plants does have a higher capacity for building up pressure than such permeated by non-mycorrhized roots.
Within this scope results of several studies showing these (inter-) relationships and correlations are presented and differences as well as unexpected results discussed.