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TalVeg®: an innovative approach of ecosystem management for enhancing multiple ecosystem services, with a focus on soil erosion and slope stability

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**SESSION 3 – VEGETATION AND SLOPE STABILITY II****SBEE49 – Soil texture and root architecture effects on concentrated flow erosion rates**

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Plant roots are very effective in controlling concentrated flow erosion. Several studies quantified the erosion-reducing effects of plants with different root traits. This is useful for practitioners who want to evaluate suitable plant species to improve slope stability. So far, most research on the erosion-reducing potential of plant roots focused on silt loam soils whereas no or little research exists for sand soils. These soils are common and are also very prone to incisive erosion processes resulting in the formation of e.g. large gullies. At present, no specific relationship between root variables and their erosion-reducing potential exists to reliably assess the erosion-reducing potential of plant roots in sand soils. Therefore the first objective of this study was to assess the erosion-reducing potential of grass and carrot roots in soils with a sand content of 94% through concentrated flow experiments. Our second objective was to compare the erosion-reducing potential of plant roots in sand and silt loam soils. For sand soils, the results show a strong erosion-reducing effect for fibrous roots while this effect was less pronounced for tap roots. This results in a negative root diameter effect showing that thicker tap roots are less effective in reducing concentrated flow erosion rates compared to thin tap roots and fibrous roots. New relationships were established between the root variables root density (RD) and root length density (RLD) and the erosion-reducing potential expressed as a soil detachment ratio of the root-permeated soil sample compared to a bare reference sample (SDR). Soil texture plays a significant role in this relationship as revealed by comparing results for sand and silt loam soils. The nature of this soil texture effect is root-architecture dependent. Fibrous roots are much more effective in sand soils compared to silt loam soils while this effect is opposite for tap roots which are less effective in sand soils. The latter can be attributed to more pronounced vortex erosion around the thicker tap roots in sand soils. These results can be used by practitioners to assess the likely erosion-reducing effect of plant species based on root characteristics (i.e. root (length) density and diameter) and soil texture.

SBEE48 – TalVeg®: an innovative approach of ecosystem management for enhancing multiple ecosystem services, with a focus on soil erosion and slope stability

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Introduction

Vegetation has been widely used on geotechnical engineering structures (e.g., embankments) associated with infrastructures and industrial sites (e.g., terrestrial transport, quarries, mines and urban spaces), as an effective tool against soil erosion and shallow landslides hazards. Besides such a protective role, sustainable vegetation management on these engineering structures is increasingly desired for favoring multiple ecosystem services, such as enhancing aesthetic value, promoting public safety, biodiversity conservation and climate change mitigation via carbon sequestration. In this context, Valorhiz (URL: <http://valorhiz.com/fr>) developed an innovative solution (TalVeg®) that comprises a Decision Support System (DSS). This DSS allows designing and optimizing multi-functional ecosystems considering managers and customers' requirements (considering e.g., maintenance costs, biodiversity and/or

ecosystem services enhancement). The DSS acts at the bio-technosol scale and aids towards the selection of plant species and associated microorganisms. For these purposes, TalVeg® innovation is composed of three technological components:

- Databases of plant, soil and symbiotic micro-organisms
- Mathematical models that simulate plant and water dynamics within soil according to climate scenari
- Computation of biodiversity and ecosystem functions

Methods

VALORHIZ started to implement, in 2015, several pilot sites in railways, highways, quarries and ski slope contexts. Several experimental modalities (with contrasted seed mixes and microorganism inocula) were set up on these sites to test the effect of TalVeg® components on vegetation success (rapid and perennial development of a dense plant cover) and soil functions (soil structural stability, soil shrinkage and water retention curves).

Results & Discussion

The dynamics of plant communities, soil function and biodiversity and their interactions, will be monitored at all sites for over 3 years. The preliminary results (after 6 months) will be presented with an overview of how doing best to manage novel ecosystems with regard to soil erosion mitigation and slope stability maintenance. Potential pathways of incorporating multi-functionality to the dominant function of natural hazard mitigation will also be discussed. This study enables us to gain a better understanding of soil-vegetation interactions in a context of ecological engineering, open new perspectives with regard to the management of degraded ecosystems, and enhance multiple ecosystem services.

SBEE46 – Analytical estimation of soil erosion, deposition and bioturbation using OSL techniques

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Bioturbation, soil erosion and deposition are important and significant processes that affect the mechanisms and rate of bedrock weathering or soil formation. The estimation of the relative fraction of bedrock grains which has been mixed in the soil and transported either vertically or laterally to different depths gives an indication of the degree to which bedrock weathering is controlled by the latter processes. However, despite the great effort dedicated to the analysis of these processes, little is known about the relationship between geomorphological changes and soil formation, especially for long timescales.

This study presents reconstruction of soil processes by single grain optically stimulated luminescence techniques (OSL) and an analytical approach to estimate the soil erosion, deposition and bioturbation mechanisms in several profiles sampled along a hillslope.

The OSL analyses provide a direct measurement of soil forming processes (e.g. bioturbation, colluviation) and with them a more precise formulation of soil formation models at longer timescales. Single-grain OSL techniques have been applied to quartz and feldspar minerals which were extracted from different soil horizons from a hillslope catena located in Sierra Morena, Córdoba, in the south of Spain. The suitability of three different OSL single grain approaches, quartz OSL, IRSL (infrared stimulated luminescence) and pIRIR (post-IRSL) feldspar, was tested on four samples. From this analysis