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Testing the suitability of some endemic and exotic species for eco-engineering applications to control slope processes

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Eco-engineering is a growing, but still under rated field at the interface of landscape ecology and civil engineering. Although the principles are already known for a long period, the attention for green remediation techniques is increasing, especially in slope stabilizing projects as well as in soil erosion protection.
This study discusses tests carried out on the effectiveness of plants to stabilize steep slopes. Four different treatments were compared: A naturally vegetated terrace slope (Brachyopodum retusem grass dominated), a slope completely stripped from vegetation, a slope planted with Arrundo donax (Spanish cane) and a slope with vetiver grass (Vetiver zizanioides), the last one being an often successfully applied, but exotic tropical species for erosion and slope protection. The tests were carried out in double, on unarmored steep bench terrace slopes (30-60° slope angle) on homogeneous marl in E Spain (Rio Serpis Basin). Vegetation was planted in summer and irrigated during the first summer period. Precipitation and soil temperature were measured and runoff and erosion was measured at the installed 'Gerlach troughs'. Soil physical properties were determined such as bulk density and shear strength. The uprooting resistance of the vetiver grass was also determined as well as root density, root depth and other root parameters. Above ground plant characteristic such as plant height and base diameter were also measured.
Results showed that within one year the bare slope was completely covered again with natural Brachiopodum grass dominated vegetation and that the planted vetiver and Spanish cane vegetation seemed to develop successfully. However, investigations showed that especially the roots of the vetiver grasses were not as well and deeply developed as could be expected from literature, although their surface cover and above ground biomass were good. All tested species worked well with respect to retaining soil material under overland flow conditions including the vetiver grass slopes. In the second spring after the start of the experiment however, a large rainfall event occurred and one of the test slopes planted with vetiver grass, slumped downwards over a slide plane at 30-40 cm depth, whereas the other vetiver slope remained in position. The other test slopes did not show any downward movement or erosion phenomena.
The disappointing effectiveness of vetiver might be attributed to 1) hot and dry summer conditions when root growth is reduced or stops, to 2) low winter temperature conditions, which also hampers biomass production or creating frost damage, 3) the relative dense subsoil, which is difficult to penetrate by roots. Although Spanish cane showed good effectiveness, it spreads very fast and uncontrolled to other places, and is then difficult to remove.
The conclusion can be made that despite the wide application of vetiver, also in the Mediterranean, it is not suitable for Mediterranean areas with either too dry conditions or that are too cold in winter. Spanish cane is also not suitable for its uncontrolled expansion. The remaining conclusion is that endemic species that are adapted to the local conditions are more favorable for application in eco-engineering applications, given that the species selected have potential for capturing sediment and increasing infiltration under overland flow conditions, or have well developed deep root systems that increase slope stability.