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Root characteristics of representative Mediterranean plant species and their erosion-reducing potential during concentrated runoff

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Revegetation strategies for erosion control rely in most cases on the effects of the above-ground biomass on reducing water erosion rates, whereas the role of the below-ground biomass is often neglected. In a Mediterranean context, the above-ground biomass can temporally disappear because of fire or overgrazing and when concentrated flow erosion occurs, roots can play an important role in controlling soil erosion rates. Unfortunately, information on root characteristics of Mediterranean plants, growing on semi-natural lands, and their effects on the topsoil resistance to concentrated flow erosion is lacking. Therefore, typical Mediterranean grass, herb, reed, shrub and tree root systems of plants growing in habitats that are prone to concentrated flow erosion (i.e. in ephemeral channels, abandoned fields and steep badland slopes) are examined and their erosion-reducing potential was evaluated. Root density (RD), root length density (RLD) and root diameters are measured for 26 typical Mediterranean plant species. RD values and root diameter distribution within the upper 0.10-0.90 m of the soil profile are then transformed into relative soil detachment rates using an empirical relationship in order to predict the erosion-reducing effect of root systems during concentrated runoff. Comparing the erosion-reducing potential of different plant species allows ranking them according to their effectiveness in preventing or reducing soil erosion rates by concentrated flow. RD in the 0.10 m thick topsoil ranges between 0.13 kg m^{-3} for *Bromus rubens* (L.) and 19.77 kg m^{-3} for *Lygeum spartum* (L.), whereas RLD ranges between 0.01 km m^{-3} for *Ner-*

ium oleander (L.) and 120.43 km m^{-3} for *Avenula bromoides* ((Gouan) H. Scholz.) Relative soil detachment rates, compared to bare soils, range between 0.3 10^{-12} and 0.7 for the 0.10 m thick topsoil. The results show that grasses such as *Helictotrichon filifolium* ((Lag.) Henrard), *Piptatherum miliaceum* ((L.) Coss.), *Juncus acutus* (L.), *Avenula bromoides* ((Gouan) H. Scholz), *Lygeum spartum* (L.) and *Brachypodium retusum* ((Pers.) Beauv.) have the highest potential to reduce soil erosion rates by concentrated flow in the 0-0.1 m topsoil. But also shrubs such as *Anthyllis cytisoides* (L.) and *Tamarix canariensis* (Willd.), having high root densities in the topsoil, can reduce erosion rates drastically. Among the species growing in channels, *Juncus acutus* (L.) has the highest erosion reducing potential, whereas *Phragmites australis* (Cav.) is the least effective.On abandoned fields, *Avenula bromoides* ((Gouan) H. Scholz) and *Plantago albicans* (L.) are the most effective species in reducing concentrated flow erosion rates, while Thymelaea hirsuta (L. (Endl.)) and *Bromus rubens* (L.) perform the worst. On steep badland slopes, *Helictotrichon filifolium* ((Lag.) Henrard) and *Anthyllis cytisoides* (L.) perform the best in the analysis of erosion reducing potential, while *Ononis tridentata* (L.) is the least effective species. These findings have implications for restoration ecology and management of erosion-prone slopes.