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The impact of different soil bioengineering techniques on the surface erosion of levees

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The recent flood events have once more drawn attention to the stability and maintenance of river levees. Subsequently, the attention has also been focused on the prevention of erosion by hydraulic forces in case of flooding or overtopping. Vegetation can limit the soil detaching capacity of flowing water, by their retarding effects on runoff and velocity as well as the physical protection of the levee surface. At low discharge intensity vegetation stands rigid and unsubmerged, reducing velocity below required for soil particle entrainment (Coppin and Richards, 1990). At higher discharge capacities flexible vegetation tend to lay down, dissipating energy and providing resistance to scour (Henderson and Shields, 1984). Roots increase the shear strength of the soil (Schiechtl, 1980) and can create a fibrous mat that resists detachment of the surrounding soil matrix (Henderson and Shields, 1984). The erosive capacity of surface water flow is dependant to type and pattern of vegetation. The denser the vegetation, the better the soil surface is protected against erosion. Sets of regulations regard compact turf to be the best vegetation cover for river levees. A contentious issue are woody plants, and many guidelines (DIN 19712, 1997; FEMA, 2005; USACE, 2000) ban woody vegetation from levees for several reasons. So, the planting of woody plants is not an accepted policy by any agency.

Within the frame of a research project carried out by the Institute of Soil Bioengineering and Landscape Construction (University of Natural Resources and Applied Life Sciences, Vienna), focusing on woody plants on levees, the effects of small to medium growing woody (shrubby) plants on erosion while hydraulic forces (overtopping) are tested. Data are drawn from two natural-scaled research levees. The homogenous levees consist of a mineral silt-sand-gravel and have a fill height of 2.7 m and a slope inclination of 2:3. The tests investigate erosion resistance with respect to four different vegetation covers. The types of soil bioengineering techniques tested were (1) dormant cuttings; (2) living brush mattress (longitudinal); (3) living brush mattress (transversal) and (4) jute netting mulch seeding. The dormant cuttings and living branches tested originated from the Purple-willow (Salix purpurea L.). Measured plant parameters, characterising the vegetation structures were shoot lengths, shoot diameters, and above ground biomass. Root growth is investigated in an extra plot area allowing excavation of the plants.

The proposed contribution discusses the effects of different soil bioengineering techniques using woody plants (shrubs) on surface erosion of river levees. Methodology of research and results after an initial overtopping test are presented. Despite of the cutting plantation all techniques gave adequate erosion protection.