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Test of bioengineering structures in large eroded marly gullies (1 to 3 ha) in a mountainous and Mediterranean climate: resistance of the structures and survival of willow cuttings (Southern Alps, France)

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In the Southern French Alps under a mountainous and Mediterranean climate, bioengineering structures installed in gully bottoms of highly weathered marly catchments aim at trapping a part of the eroded materials in order to reduce suspended sediment in the water system. They are made of brush layers and brush mats of cuttings on deadwood microdams. Purple and white Willows (Salix purpurea and S. incana) are used as they proved their efficiency to survive in such environment and efficiently trap marly sediment, but only in gullies with surface area less than 1 ha. Extrapolating their use to larger gullies could allow increasing the impact of such operations for reduction of sediment yield at the scale of large catchments. To this view, bioengineering structures have been built in spring and autumn 2010 in large eroded marly gullies with surface areas between 1 and 3 ha, in the Roubines and Fontaugier catchments (Southern Alps, France). 165 bioengineering structures (150 in spring and 15 in autumn) were built in 10 experimental gullies. After 3 observation years for each modality (2010 to 2012, and 2011 to 2013, respectively), the results revealed that 2/3 of the structures well resisted to damages due to concentrated flows. However, they were generally filled of sediment very rapidly, thus killing a large number of cuttings, particularly in the brush mats in gullies with surface area comprised between 2 and 3 ha. Therefore it has been proved that cuttings survival is possible in gullies with surface area less than 3 ha. In the French Southern Alps, bioengineering strategies have been improved by adding gullies of 1 to 3 ha in restoration plans. For gullies with surface area superior to 2 ha, it is recommended to first install the brush layers, and 1 to 2 years later the brush mats.