Geophysical Research Abstracts
Vol. 13, EGU2011-4377, 2011
EGU General Assembly 2011

Effectiveness of geotextiles in reducing runoff and soil loss on steep slopes

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Civil engineering projects often lead to disturbed and uncovered soils with steep slopes which are very sensitive to runoff and soil loss processes. The degradation of those slopes causes severe onsite and offsite impacts, thus the design and implementation of erosion control measures is crucial in any project of this kind. One of the most used control measures is probably the deployment of geotextiles (either synthetic or natural) over the sloping surface.
Geotextiles have demonstrated to be effective in reducing erosion and subsequent slope degradation processes. However, most studies devoted to assess the effectiveness of those elements have considered small or intermediate slope gradients (around 30º at the most), whereas real engineering works often lead to steeper slopes needing protection. In addition, even if a large amount of laboratory studies exist in this topic the number of articles reporting field experiments (considering large plots, real precipitation and prolonged study periods) are seldom.
In this conference we will report the results of a research project where the effectiveness of synthetic and natural geotextiles for runoff and soil loss reduction has been assessed on 45º and 60º slope gradients. The research was carried out on an experimental slope (with an approximate slope length of 3.5 m) built in Pamplona (Spain) following standard construction procedures in order to resemble real slopes. Two natural geotextiles (a jute mesh and a coconut mat) and a synthetic polyester grid (Fortrac 3D®) were evaluated and compared with a control plot. After each significant rain event the runoff and soil loss produced on each plot were recorded. In addition the rate of vegetation growth at the initial development stages was also assessed using a greenness index.
The results obtained illustrate that both natural and synthetic geotextiles reduced the soil loss rates observed in the control plots. Their effectiveness was higher in the 45º slope than in the 60º slope. The polyester grid and the coconut mat produced the lowest erosion rates. Regarding runoff, natural materials lead to higher runoff rates than the control plots, whereas Fortrac 3D® resulted in significantly lower runoff rates. The establishment of vegetation was faster in the synthetic grid, conversely the coconut mat hampered the vegetation growth leading to a bare slope surface well after the start of the experiment. Once the vegetation cover fully developed the differences among treatments were clearly reduced. Therefore, the use of geotextiles seems to be particularly convenient when short-term slope protection is needed.