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Effectiveness of biological geotextiles in reducing runoff and soil loss under different environmental conditions using laboratory and field plot data

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Preliminary investigations suggest biological geotextiles could be an effective and inexpensive soil conservation method, with enormous global potential. Biological geotextiles are a possible temporary alternative for vegetation cover and can offer immediate soil protection. However, limited data are available on the erosion-reducing effects of biological geotextiles. Therefore, the objective of this study is to evaluate the effectiveness of selected types of biological geotextile in reducing runoff and soil loss under controlled laboratory conditions and under field conditions reflecting different environments (i.e. continental, temperate and tropical). In laboratory experiments, interrill runoff, interrill erosion and concentrated flow erosion were simulated using various rainfall intensities, flow shear stresses and slope gradients. Field plot data on the effects of biological geotextiles on sheet and rill erosion were collected in several countries under natural rainfall (U.K., Hungary, Lithuania, South Africa, Brazil, China and Thailand). The laboratory experiments indicate that all tested biological geotextiles were effective in reducing interrill runoff (on average 59% of the value for bare soil) and interrill erosion rates (on average 16% of the value for bare soil). Since simulated concentrated flow discharge sometimes flowed below the geotextiles, the effectiveness in reducing concentrated flow erosion was significantly less (on average 59% of the value for bare soil). On field plots, where both interrill and rill erosion occur, all tested geotextiles reduced runoff depth by a mean of 54% of the control value for bare soil and in some cases, runoff depth increased compared to bare soil surfaces, which can be attributed to the impermeable and hydrophobic characteristics of some biological geotextiles. In the field, soil loss rates due to interrill and rill erosion were reduced by a mean of 21% of the value of bare soil by biological geotextiles. This study demonstrates that data from controlled interrill experiments in the laboratory correspond well to those obtained from field plots. Hence, interrill experiments in the laboratory allow one to predict the hydrological and erosion response of geotextiles on larger field plots. According to the field data, Rice straw geotextiles are the most effective geotextiles in reducing relative runoff and soil loss rates. No impact of plot length on the runoff and soil loss reduction by biological geotextiles was observed.