Geophysical Research Abstracts,
Vol. 11, EGU2009-1565, 2009
EGU General Assembly 2009

Effects of initial soil condition on the effectiveness of biological geotextiles in reducing interrill runoff and erosion

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The effectiveness of a surface cover material (e.g. geotextiles, rock fragments, mulches, vegetation) in reducing runoff and soil erosion rates is often only assessed by the fraction of the soil surface covered. However, there are indications that soil structure has important effects on the runoff and erosion-reducing effectiveness of the cover materials. This study investigates the impact of initial soil condition (i.e. fine tilth versus sealed soil surface) on the effectiveness of biological geotextiles in increasing infiltration rates and in reducing runoff and interrill erosion rates on a medium and steep slope gradient. Rainfall was simulated during 60 minutes with an intensity of 67 mm h-1 on an interrill erosion plot having two slope gradients (i.e. 15 and 45%) and filled with an erodible sandy loam. Five biological and three simulated geotextiles with different cover percentage were tested on two simulated initial soil conditions (i.e. fine tilth and sealed soil surface). Final infiltration rates on a sealed soil surface (7.5-18.5 mm h-1) are observed after ca. 10 minutes of rainfall compared to ca. 50 minutes of rainfall on an initial seedbed (16.4-56.7 mm h-1). On the two tested slope gradients, significantly (= 0.05) smaller runoff coefficients (RC) are observed on an initial seedbed (8.2% < RC < 59.8%) compared to a sealed soil surface (75.7% < RC < 87.0%). On an initial seedbed, decreasing RC are observed with an increasing simulated geotextile cover. However, on an initial sealed soil surface no significant effect of simulated geotextile cover on RC is observed. On a 15% slope gradient, calculated b-values from the mulch factor equation equalled 0.054 for an initial fine tilth and 0.022 for a sealed soil surface, indicating a higher effectiveness of geotextiles in reducing interrill erosion on a fine tilth compared to a sealed soil surface. Therefore, this study demonstrates the importance of applying geotextiles on the soil surface before the surface tilth is sealed due to rainfall. The effect of soil structure on the effectiveness of a surface cover in reducing runoff and interrill erosion rates, as indicated by the results of this study, needs to be incorporated in soil erosion prediction models.