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The impact of vegetation on soil water transport properties

L. Lichner (1), P.D. Hallett (2), V. Novak (1), M. Sir (3) and M. Tesar (3)

(1) Institute of Hydrology, Slovak Academy of Sciences, Bratislava, Slovakia, (2) Scottish Crop Research Institute, Invergowrie, UK, (3) Institute of Hydrodynamics, Academy of Sciences of the Czech Republic, Prague, Czech Republic (lichner@uh.savba.sk / Fax: ++421 2 44259404 / Phone: ++421 2 49268227)

Numerous studies have shown that vegetation and associated microbial activity can influence soil water transport by coating soil particles with water repellent (hydrophobic) films that alter surface properties considerably. The objective of this study was to assess an impact of vegetation on soil transport properties of sandy soil at the locality Mlaky II at Sekule (southwest Slovakia). Four sites with different types of vegetation cover were sampled: (1) Meadow covered with mainly grass species, (2) Glade covered with mainly moss, (3) Glade subsoil where the influence of surface vegetation was lessened and (4) Forest under pine trees. The soil transport properties determined were the saturated hydraulic conductivity, K_s, the unsaturated hydraulic conductivity at a tension of –2cm, k_s(–2 cm), and the proportion of water flux through the pores with radii $r$greater than approximately 0.5 mm, B_r. Two measures of water repellency were assessed; the persistence using the water drop penetration time (WPDT) test, and the severity using an index of water repellency,R, evaluated from the sorptivities of water and ethanol with the Decagon minidisk infiltrometer. The experimental error associated with the latter approach was assessed on homogeneous sand columns.

Unsaturated hydraulic conductivity, k_s(–2 cm) was found to increase in the same order that WDPT decreased. Forest soil had the smallest k_s(–2 cm), which corresponded to the largest WDPT.This trend was followed by Glade soil, Meadow soil and finally Glade subsoil. This trend suggests a relationship between the capillary suction and hydrophobic coating of soil particles. K_s behaved differently, with Meadow soil having a saturated hydraulic conductivity about half that of the Glade and Forest soils, and even less than the Glade subsoil where conductivity was the fastest. These dif-

ferences could be a result of both the patchy growth of vegetation with some areas of bare soil at the glade site and the macropores (dead roots) in more homogeneous humic top-layer at the pine forest site. The proportion B_r of flux through the pores with radii $r$more than approximately 0.5 mm decreased in the order as follows: Forest soil » Meadow soil $>$ Glade soil » Glade subsoil, revealing the prevalence of preferential flow through macropores (dead roots) in the pine forest site and a negligible share of macropores in the pure sand. The index of water repellency, R, decreased in the order as follows: Forest soil $>$ Glade soil $\approx$ Meadow soil $>$ Glade subsoil.

It was also shown that the Decagon minidisk infiltrometer is well-suited for estimating the index of water repellency in the field over a wide range of water repellencies (in our case from R = 0.28 to 360). Greater characterization of water repellency levels in field studies would allow for this biological impact on water transport to be assessed. With current trends in climate change, the impact of water repellency will likely worsen, thereby limiting the capacity of soil to support plants, increase erosion and pollution through overland flow. Field results like those presented in this study are needed to assess the potential impact.