Geophysical Research Abstracts
Vol. 18, EGU2016-3452-1, 2016
EGU General Assembly 2016

Application of minidisk infiltrometer to estimate soil water repellency

Vincenzo Alagna (1), Massimo Iovino (1), Vincenzo Bagarello (1), Jorge Mataix-Solera (2), and L'ubomír Lichner (3)

(1) Dipartimento di Scienze Agrarie e Forestali, Università degli Studi di Palermo, Palermo, Italy (massimo.iovino@unipa.it), (2) Departamento de Agroquímica y Medio Ambiente, Universidad Miguel Hernández, Elche, Spain (jorge.mataix@umh.es), (3) Institute of Hydrology, Slovak Academy of Sciences, Bratislava, Slovak Republic (lichner@uh.savba.sk)

Soil water repellency (SWR) reduces affinity of soils to water resulting in detrimental implication for plants growth as well as for hydrological processes. During the last decades, it has become clear that SWR is much more widespread than formerly thought, having been reported for a wide variety of soils, land uses and climatic conditions.

The repellency index (RI), based on soil-water to soil-ethanol sorptivity ratio, was proposed to characterize sub-critical SWR that is the situation where a low degree of repellency impedes infiltration but does not prevent it. The minidisk infiltrometer allows adequate field assessment of RI inherently scaled to account for soil physical properties other than hydrophobicity (e.g., the volume, connectivity and the geometry of pores) that directly influence the hydrological processes. There are however some issues that still need consideration. For example, use of a fixed time for both water and ethanol sorptivity estimation may lead to inaccurate RI values given that water infiltration could be negligible whereas ethanol sorptivity could be overestimated due to influence of gravity and lateral diffusion that rapidly come into play when the infiltration process is very fast. Moreover, water and ethanol sorptivity values need to be determined at different infiltration sites thus implying that a large number of replicated runs should be carried out to obtain a reliable estimate of RI for a given area.

Minidisk infiltrometer tests, conducted under different initial soil moisture and management conditions in the experimental sites of Ciavolo, Trapani (Italy) and Javea, Alicante (East Spain), were used to investigate the best applicative procedure to estimate RI. In particular, different techniques to estimate the water, S_w, and ethanol, S_e, sorptivities were compared including i) a fixed 1-min time interval, ii) the slope of early-time 1D infiltration equation and iii) the two-term transient 3D infiltration equation that explicitly accounts for the effects of gravity and lateral expansion. According to Pekárová et al. (2015), the combination of all the ethanol and water sorptivities was used to calculate an aggregated repellency index, RI_a, that accounts for the influence of spatial variability. Alternatively, the plot of the water cumulative infiltration vs. square root of time, exhibiting a clear "hockey-stick-like" shape, was used to estimate a single-test repellency index, RI^*, that overcomes the limitations of the traditional approach given that information on both the hydrophobic and the wettable states of soil are gathered from a unique infiltration test.

The mean RI values were affected by the technique used to estimate S_w and S_e. In particular, the choice of a fixed time interval lead to overestimation of RI up to a factor of 3.2 as compared with the other techniques. The RI_a yielded unbiased estimations of the mean RI values and also allowed to quantify the variability of SWR within a given area. A statistically significant relationship was found between RI^* and RI but also between RI^* and the water retention cessation time, that is the time hydrophobic turns into wettable soil, thus indicating that RI^* is potentially able detect both the degree and the persistence of SWR.

Pekárová P., Pekár J., Lichner L'. 2015. A new method for estimating soil water repellency index. Biologia, 70(11):1450-1455.