Geophysical Research Abstracts, Vol. 8, 01368, 2006
SRef-ID: 1607-7962/gra/EGU06-A-01368

Double-ring and tension infiltrometer measurements of saturated hydraulic conductivity and dye tracer movement

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The tension infiltrometer (TI) and double-ring infiltrometer (DI) are used for in-situ estimation of soil hydraulic properties. We compared zero-tension TI and ponded DI infiltration techniques, each combined with dye tracer application, for simultaneous estimation of K_s and of dye-stained areas taken as conservative estimate of the mobile soil water fraction. After water infiltration into a structured field soil using the DI, TI (without contact sand) and TI_{sand} (with contact sand) methods until steady-state conditions, three pulse depths of 25, 50, and 100 mm of a 2 g L^{-1} Brilliant Blue FCF dye solution (BB) were infiltrated. The K_s values for DI (820 to 2070 cm d^{-1}) were two to six times larger than using TI_{sand} and four to ten times larger than for TI. Only the 100-mm application using the DI yielded significant BB displacement into the subsoil in preferential flow paths, with dye coverages mostly below 10 per cent. Hence, prolonged ponding at the soil surface was required to initiate significant preferential flow in the subsoil. For DI, more than 90 per cent of the dye was constrained below the infiltration area. For TI and TI_{sand}, lateral dye losses constituted up to 28 per cent of total dye coverage. Furthermore, the effect of a plough compaction pan on the flow pattern was analyzed at another plot using a novel large double-square (0.5 m^2 and 1 m^2) ponded infiltration device. Horizontal dislocation on the plough compaction zone reached nearly 1 m, which was explained with low K_s values measured in soil cores taken across the compaction zone. The constant-head dye infiltration techniques may yield both hydraulic data and information on flow paths in situ.