



Estimation of the sensitivity zone of an eight-rod TDR probe

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This work presents an eight-rod TDR probe for soil moisture gradient measurement in the soil profile. The probe has eight rods mounted in series which are placed horizontally in the soil profile to measure dynamic changes of soil moisture in top soil layer. The distance between the neighboring rods is 1 cm. In order to measure moisture at specific depths in the soil profile, the rods can be connected in various combinations, in a way that one rod always works as a signal and the nearest rod is a ground. The remaining rods are not connected.

The aim of this research was to estimate the sensitivity zone of the presented probe in dependence of the ground rods connection method. The electromagnetic simulations and experiment were conducted. Simulations were performed in EMPro software suite (Agilent Technologies). The measurements were conducted using a TDR-meter (TDR/MUX manufactured by E-Test, Sp. z o.o.). The first four rods were placed in a dry material with low electrical permittivity, and the remaining rods - in moist material with higher permittivity. At a half of the distance between the middle rods there was a sharp border between the dry and moist materials. To estimate the sensitivity zone of the presented probe, each of the remaining rods was connected one by one and the dielectric responses were collected.

The experimental results showed that there is a difference in the dielectric response in the case when the signal rod has an additional ground. When the additional ground was connected to the rod placed in a moist material, the measured TDR time was larger, because the electric field was enclosed in a larger volume in a material with larger permittivity. TDR time depended on the distance between the additional ground and the signal rod. All combinations were tested and the results are presented in the work.

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