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Time Domain Reflectometry and Electrical Resistivity Tomography applications for optimizing water use in irrigation

A. Satriani (1), A. Loperte (1), and M. Catalano (2)
(1) IMAA, CNR, Tito scalo- Potenza, Italy (satriani@imaa.cnr.it), (2) ALSIA, Regione Basilicata, italy

This abstract deals with the joint use of the Time Domain Reflectometry (TDR) and Electrical Resistivity Tomography (ERT) for soil moisture monitoring and spatial distribution estimation in agriculture. In fact, an effective use of irrigation water for a sustainable agriculture helps to cut irrigation cost and the exploitation of technologies for water resource monitoring and management can help to achieve this objective.
The work has regarded a flat experimental vegetable area of about 1000 m2 with the bean crop (Phaseolus vulgaris L), which was an subdivided in two adjacent plots of land five meters distant each from other. From sowing and for the whole cultural cycle, irrigation monitoring was performed by using non-invasive surveys, based on measurements of physical properties of the soil, as the dielectric constant and the electrical resistivity.
A drip irrigation system was used with the water pumped by a nearby water reserve, represented by a small artificial lake, but a different irrigation treatment was performed for each plot.
In the plot A, the irrigation water supply was managed by the farmer, with an intensive irrigation treatment. Differently, in the plot B, the irrigation water supply was decided on the basis of the results of the TDR and ERT surveys. In particular, the amount and the time of irrigation were determined on the basis of the measurements of physical properties of the soil using TDR and ERT, with a specific focus to the soil moisture content estimation and spatial distribution . In fact, during the crop cycle, the soil moisture was measured weekly before and after irrigation, by a 20 cm vertical time domain reflectometry probe located at the center and at the ends of the bean rows. Moreover, the soil water distribution was determined by an electrical resistivity tomography using a multielectrode method.
On the basis of the TDR and ERT results, a reduced water supply was performed, which did not affect the bean yield, and moreover improved the environmental sustainability of crop.
Therefore, the use of non-invasive technologies opens interesting perspectives for the optimization of water use in irrigation practice for its sustainable management.