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Application of Electrical Resistivity Tomography (ERT) to study to soil water and salt movement under drip irrigation in a saline soil cultivated with melon

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The issue of salinity in agricultural soils is a growing problem. Soil with a high sodium content in the root growth zone compromises plant health and growth. Irrigation is one of the main techniques used to reclaim high-salt soils, as water dilutes the sodium concentration. In this study, electrical resistivity tomography (ERT) is proposed as a reliable non-invasive technique to quantify sault movement during the irrigation process. The first step was to identify the best set up of electrodes for this type of investigation. 3D-ERT measurements were carried out in two different campaigns to identify the most suitable electrode distribution. The study area is a segment of land, located in Barbaruta (GR, Italy) and used for the cultivation of melons. The investigation site is characterised by irrigated soils in which an accumulation of sodium has occurred over time. To detect the movement of salt during the irrigation phases, ERT surveys were carried out before, during, and after the irrigation phases.

Considering the objective of the experiment, the measurement carried out during the first campaign (July 2021) was performed by creating a 3D grid in which the 72 electrodes were spaced 0.2 m apart and arranged in 5 parallel lines, spaced 0.2 m apart, two of which (lines 1 and 5) were 2.8 m long, for a total of 15 electrodes, and three of which (lines 2, 3 and 4) were 2.6 m long, for a total of 14 electrodes. This configuration made it possible to include two melon plants.

The survey carried out in the second campaign (August 2021) was carried out with a 3D grid in which the 72 electrodes were spaced 0.3 m apart and arranged in three parallel lines, 0.3 m apart and 6.9 m long, for a total of 24 electrodes in each line. This configuration allowed five melon plants to be incorporated. A Dipole-Dipole configuration was adopted for all the acquisition of electrical resistivity data. The commercial software ViewLab 3D was used to process the geoelectric data.

Data analysis showed that the range of conductivity values increases from dry to wet soil conditions, and conductivity increases with depth. The ERTs sections, carried out after the irrigation phase, showed areas where conductivity decreases over time during irrigation, this can be explained by the leaching of salts because of water input. While other areas show higher

conductivity after irrigation, and this may mean not only an increase in water content but also a displacement of salts with water input. For this reason, further analysis is required, including the use of Induced Polarisation (IP).

The test showed that the best configuration is the one with the electrodes arranged in three lines, as it allows more plants to be incorporated.

The test also led to the need to avoid stressing the plants during the measurement phase. This made it necessary to create a special set of electrodes to be installed during the transplanting phase, so as not to disturb the plants during the growth phas.