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Electrical Resistivity Tomography (ERT) to monitor the efficiency of different irrigation systems in horticulture field

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Water management in agricultural systems is essential for optimal crop yields without incurring excessive water costs and wastage. The choice of irrigation method is crucial for better water management and distribution. The drip system appears to be among the best methods in the field of precision agriculture. In addition to the irrigation system, mulching with ridge plastic film to drain excess water is widely used to increase crop yields in terms of plant water availability.

In this study, the time-lapse Electrical Resistivity Tomography (ERT), a not-invasive geophysical technique, is proposed as a simple and reliable method to evaluate the effectiveness of the irrigation systems and to monitor the changes in water content over time and over a volume of soil. ERTs data were compared to moisture one retrieved from sensors that record continuously over time, but punctually. The ERT investigations were conducted in melon-growing lands in southern Tuscany (Italy).

The aim of the work was to evaluate, by means of volumetric measures of the soil conductivity, the effectiveness of three different drip systems and of the mulch ridge: a two-wings drip system and a three-wings drip line with the same flow rate and a three-wings drip lines with a higher flow, in two different seasonal periods (spring and summer). In both the monitored fields the ridge was created in a half portion of the field itself, while in the other part the land was left plat.

The data collected showed that the 2-wing system was particularly ineffective, and that the distribution of irrigation water favoured some areas more than others. While they led to satisfactory results for the 3-wing system and same water flow than two wings and the 3-wing system and highest water flow. The first system has shown that the same quantity of water as the classic irrigations system (two wings) distributed over three wings instead of two leads to a greater concentration of water in the root zone over time, slowly draining downwards. On the contrary, the second system distributes the water uniformly like the first system, but the quantity introduced was excessive, leading the soil to always be positioned above the field capacity and draining a lot of water downwards. The excessive accumulation of water below the root zone

represents a waste of water, as this cannot be used by the root system. The tests, in addition to considering which system was optimal, also evaluated the effectiveness of the mulch ridge, leading to the deduction that during the spring season a ridge of height equal to or greater than 20 cm is to be considered better than a ridge of less than 20 cm or absent, as it allows excess water, represented by rainfall, to be drained. However, during the summer period, when rainfall is less if not absent, the presence of a much lower ridge (around 10 cm in height) is much more effective as it allows the irrigation water to be retained at the root system avoiding excessive drainage.