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Spatial variability of soil root zone properties using electrical imaging techniques in a peach orchard system

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Worldwide interest in reducing greenhouse gases has led to apply the more accurate, less invasive imaging methods of geophysics for quantifying the root biomass and evaluating their critical role in space and time. The general aim of this work is to apply the combined application of geoelectrical imaging techniques (non-destructive) and conventional soil methods (destructive) on representative soil samples to study the spatial distribution of orchard tree roots and their relation to physical soil properties in tilled soil. This combined application aims at investigating roots, characterising them from other subsurface heterogeneities and studying (empirical) relationships between electrical resistivity, pedo-hydrological properties (e.g., texture, stone content, water content and quality) and root parameters (e.g., woody and fine root length, root density). This serve identify all sources of variability encountered in the experiment in an effort to improve the applicability of electrical resistivity techniques in this field. Using 2-D and 3-D electrical tomography a set of field geoelectrical measurements were carried out at the study site for studying the spatial variability of soil root zone under varying conditions of soil management, stone content, clay content and moisture content. Resulting 2D and 3D resistivity ρ models can image root zones and hydro pedological horizons and heterogeneities. The ρ models are correlated with soil and root multiparameters measured directly on a sequence of core samples collected from trenches excavated below electrical profiles post to the survey. Results reflect a

complex spatial variability of these parameters. The effects on the resistivity of the measured soil system parameters were investigated through multiregressive statistical analysis using backward method with confidence intervals of 95%. Resistivity shows significant relationships with stone content, woody root length and total root biomass density, soil salinity (measured by electrical conductivity) and particularly water content θ.

Keywords: Electrical resistivity imaging, woody and fine roots, root density, root length, soil water content, soil stone content, soil conductivity, tilled/untilled soil, orchard trees.