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2D and 3D high resolution geoelectrical tomography for non-destructive determination of the spatial variability of plant root distribution: laboratory experiments and field measurements.

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A multidisciplinary study on the spatial distribution of plant roots and their relations with soil physical properties has been undertaken with the aim of exploring the capabilities of geophysical methods for reconstructing tree roots, detecting fine roots and studying soil-root relations. High resolution images were obtained with both 2-D and 3-D electrical tomography in artificial homogeneous soil media and in the field.

Laboratory measurements were conducted on containers with whole plants of peach or reconstructed root systems of different geometry, and with soils of different textures. Field determinations were made on agronomical trials in a peach orchard with different soil management techniques including the use of herbaceous crops as a means of soil protection.

Geophysical methods were integrated and validated with direct measurements of volumetric water content in vertical profile by means of time domain reflectometry (TDR), of root density and architecture, soil conductivity and water content on samples collected from trench walls corresponding to a geoelectric profile. Water distribution is inversely proportional to the resistivity distribution, and moreover at variations of low value of volumetric water content correspond significant variations of resistivity.

Woody structures larger than 50 mm and soil volumes with a high density of fine and woody roots were detected with the geophysical techniques. Different patterns of soil resistivity were obtained for the different techniques of soil irrigation and management, corresponding to water content and conductivity and root spatial distribution. This information is of direct relevance for monitoring soil-root processes and for developing management strategies for reducing the environmental impact of agriculture.