EXPLORING LINKS BETWEEN GEOPHYSICAL PARAMETERS AND GRAPEVINE PHYSIOLOGY AND ROOT DISTRIBUTION IN A NON-IRRIGATED VINEYARD

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Abstract

In situ investigation of plant roots is usually challenging due to limited accessibility of the roots, coupled with the spatiotemporal moisture and nutrient dynamics of root zone processes. Numerous geophysical methods have been used in agricultural contexts to study plant-soil exchanges from laboratory to field scales with varying degrees of successes. In this study we combined electromagnetic imaging (EMI), electrical resistivity tomography (ERT) and induced polarization (IP) to map the soil properties across a non-irrigated vineyard located within California's Central Valley. We then used electrical capacitance measurements (ECM) to investigate the electrical signatures of two different vine cultivars across specific rows in the vineyard co-located with the ERT/IP transects. These geophysical data were combined with above-ground physiology data, in situ sensor data, and eight-foot soil cores to provide insight into the relationship between vine physiological state, morphological factors (e.g. root length), and geophysical parameters. The apparent electrical conductivity map from EMI revealed some soil spatial variation across the vineyard, but the range of variance is very low which is expected for a non-irrigated vineyard. We observed a close match between the IP phase response from the soil and phase angle from ECM measurements on individual vines. High magnitude phase responses from IP phase matched the locations with higher root density as shown from the soil cores. The ECM gave mixed results; some inter-cultivar trends were observed in the capacitance and phase responses at some rows, while other rows showed a high degree of similarity. Our results suggest a strong influence of the soil properties on the vine physiological state, but the relationship is still not very clear. A more detailed understanding of the relationship between vine physiological state, root morphology and geophysical parameters will be useful to develop non-invasive in-situ technique for monitoring vine health status, which can be leveraged to improve orchard management for better yield.

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