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Developing suitable methods for effective characterization of electrical properties of root segments

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The root system represents the hidden half of the plant which plays a key role in food production and therefore needs to be well understood. Root system characterization has been a great challenge because the roots are buried in the soil. This coupled with the subsurface heterogeneity and the transient nature of the biogeochemical processes that occur in the root zone makes it difficult to access and monitor the root system over time. The traditional method of point sampling (root excavation, monoliths, minirhizotron etc.) for root investigation does not account for the transient nature and spatial variability of the root zone, and it often disturbs the natural system under investigation. The quest to overcome these challenges has led to an increase in the application of geophysical methods. Recent studies have shown a correlation between bulk electrical resistivity and root mass density, but an understanding of the contribution of the individual segments of the root system to that bulk signal is still missing. This study is an attempt to understand the electrical properties of roots at the segment scale (1-5cm) for more effective characterization of electrical signal of the full root architecture. The target plants were grown in three different media (pot soil, hydroponics and a mixture of sand, perlite and vermiculite). Resistance measurements were carried out on a single segment of each study plant using a voltmeter while the diameter was measured using a digital calliper. The axial resistance was calculated using the measured resistance and the geometric parameters. This procedure was repeated for each plant replica over a period of 75 days which enabled us to study the effects of age, growth media, diameter and length on the electrical response of the root segments of the selected plants. The growth medium was found to have a significant effect on the root electrical response, while the effect of root diameter on their electrical response was found to vary among the plants. More work is still required to further validate these results and also to develop better systems to study the electrical behaviour of root segments. Findings from our review entitled “an overview of the geophysical approach to root investigation”, suggest that SIP and EIT geophysical methods could be very useful for root investigations, thus more work is in progress to develop these systems for assessing the root electrical response at various scales.