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CAN WE USE ELECTRICAL RESISTIVITY TOMOGRAPHY TO MEASURE ROOT ZONE MOISTURE DYNAMICS IN FIELDS WITH MULTIPLE CROPS?

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SUMMARY

Agriculture on shallow or steep soils in the humid tropics often leads to low resource use efficiency. Contour hedgerow intercropping systems have been proposed to reduce run-off and control soil erosion. However, competition for water and nutrients between crops and associated hedgerows may reduce the overall performance of contour hedgerow systems. Electrical resistivity tomography (ERT) is a valuable technique to assess the distribution and dynamics of soil moisture non-invasively. Root water uptake is a spatially variable and small-scale process, which requires at least decimeter resolution and a high sensitivity in order to be able to monitor changes in time and space. Virtual experiments in combination with absolute and spatial performance measures provide a way to optimize the information that can be retrieved from an ERT experiment. We used this approach to identify a suitable measurement methodology to monitor water fluxes in a contour hedgerow intercropping system in Ratchaburi province, Thailand. The virtual experiment showed that there are important differences between the tested measurement configurations. We saw that the optimal ERT array was capable of recognizing distinct water depletion zones under the different crops. However, sharp contrasts in the 1-D water depletion profile are smoothened. ERT measurements conducted in Thailand showed that the soils of our experimental plots were very heterogeneous both along the slope as with depth. This observation highlighted some constraints of the ERT method for soil moisture monitoring in the field, such as the difficulty to define a relationship between electrical conductivity and soil moisture in very heterogeneous soils. Nevertheless, the data indeed revealed contrasting water depletion patterns under monocropping and intercropping systems. ERT allowed us to access information about the vadose zone moisture dynamics that would be unavailable with classical soil moisture measurements.