Studying root water uptake of wheat genotypes in different soils using water δ18O stable isotopes

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The ability to access water at depth is a key aspect of crop production, especially in dry environments. Determining how water uptake varies with soil depth among different genotypes and how this relates to root structure could help in understanding the different water uptake strategies used by plants, and what the consequences are for nutrient uptake and grain yield. Here we used an isotope based approach to determine the contribution of different soil depths to water uptake by wheat genotypes in different soil types. Four wheat genotypes were grown in two soil types (vertosol and kandosol) in Narrabri (NSW), Australia. At the vegetative stage soil cores were collected at eight incremental depths between 0-100 cm, together with plant stem bases. Plant and soil water were extracted and δ18O was analysed using a tunable diode laser (TDL). A multiple-source mass balance method was used to estimate the proportional contribution of each soil depth to plant water uptake. Available ammonium and nitrate were measured at different depths, while root structure was characterised using WinRhizo software. In the vertosol wheat genotypes extracted more water from the top soil (0-5 cm), while in the kandosol each depth contributed to plant water uptake. However, the proportion of water uptake from each depth was genotype dependent. Available N was higher in the topsoil of both soil types, and was positively correlated with average root diameter. Furthermore, in the kandosol proportional contribution of water uptake at each soil depth was positively correlated with the amount of available ammonium ion, suggesting soil dependent relationships between water uptake and ammonium availability. Overall, different genotypes used different strategies for water uptake and further analysis will enable us to establish relationships between root structure and water uptake.