Dynamics of Water Use by Wheat and Canola Crops in Compacted, Acidic Sands Treated with Deep Strategic Tillage and Lime

GAUS AZAM[1], CHRIS GAZEY[1] AND RICHARD BOWLES[1]

[1] Department of Primary Industries and Regional Development, 75 York Road, Northam WA 6401, Australia

Incorporation of agricultural lime by ‘strategic deep tillage’ is one of the quickest methods for managing subsurface soil acidity. Such soil amelioration practice decreases soil resistance by removing compaction and increases soil pH, which allows deep penetration of crop roots, and hence increases the acquisition of soil water from deeper in the soil. As a result of improved soil physical and chemical properties, crop yield also increases and so does the water use efficiency (WUE). Under broadacre cropping conditions, WUE is generally estimated from crop yield and weather data; actual measurement of soil water uptake can lead to more accurate interpretation of results, especially where soil profiles are ameliorated to varying degrees. In this trial we measured the soil water status of soil profiles, which differed due to amelioration treatments. We used two recently developed soil moisture sensors (Diviner 2000 and EnviroPro®), to improve our understanding of the variability in soil water uptake, yield and WUE by wheat and canola. The experiment was established in 2018 in Kalannie, WA, involving three treatments: (i) control, (ii) removal of compaction by tillage to 0.45 m depth, and (iii) removal of both compaction and acidity by lime incorporation to 0.45 m depth. All soil water measurements were calibrated against gravimetric soil water measurements using soil cores from relevant profiles. Mace wheat was grown in 2018 and Bonito canola was grown in 2019. Removal of compaction reduced soil resistance to an optimum level, which allowed wheat roots to grow to the depth of tillage, but the canola roots were restricted by low pH and aluminium toxicity. Removal of both compaction and acidity reduced soil resistance and increased soil pH to optimum levels almost immediately, which allowed both wheat and canola roots to grow to 0.65 m depth. In 2018, the wheat crop extracted more water from the subsoil from the treated plots than from the untreated plots, however, there was no difference between the treated plots. In 2019, a significant difference was noticed in soil water extraction by the canola crop – water uptake was significantly higher in plots where both the compaction and acidity constraints had been removed compared to the control plots or where compaction only was removed. In both seasons, none of the crops extracted any soil water from below 0.20 m in the control plots. New technologies were found to overestimate soil water content but, once calibrated, provided useful hourly soil water status in the different soil profiles.