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Movement of water under irrigation in the West Midlands region

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Key Messages

- There were large differences in water holding capacity between soil types
- There are many tools that can be adopted to improve irrigation water efficiency

Background

Potato growers in the Dandaragan irrigation region face significant production challenges under their centre pivot irrigation systems as the highly variable soil types present across the region have different abilities to hold and retain soil water and nutrients. The limitation of centre pivot irrigation systems currently is that water can only be irrigated as a blanket application across the whole site, or be limited into 'pizza slice' sub-sections of the paddock. This creates severe restrictions in being able to apply water to meet the specific needs of each soil type, and often results in some soil types being over-watered or under-watered depending on the location on the site. The over-watering of soil types can result in the leaching of unused water and nutrients down the soil profile and can potentially cause off-site impacts of nutrient enrichment. The aim of this project was to better understand the movement of water in the soil profile for three distinct soil types in the West Midlands region and assess the potential for the leaching of nutrients and water below the rooting depth of potatoes. This could then guide the implementation of variable rate irrigation in the region, where irrigation can be varied across the landscape to match water applied to soil water holding capacity.

A site was selected on a centre pivot at 'Lightning Ridge' that had the most variation in soil types found across the farm. The pivot was sown to potatoes at the start of July 2019.

Three soil moisture probes were installed to measure soil moisture to 90 cm soil depth in three of the major soil types on the centre pivot, including white sand, brown sand, and loamy sand. The site was managed uniformly for irrigation scheduling and nutrient application was similar across the field, with irrigation scheduling based on measuring soil moisture by hand/feel method. The results for the 30 cm soil depth are presented in this report, as this is considered the effective rooting depth of potatoes.

Results

Soil moisture was measured during the period 17th July to the 31st October 2019 across three soil types: a white sand with low moisture holding capacity, a brown sand with intermediate water holding capacity, and a loamy sand with good water holding capacity. Soil moisture was consistently above field capacity for the brown sand but around field capacity for the loamy sand at the 30 cm soil depth (Figure 1). The white sand was always below the field capacity of the soil and was consistent with the description of a low water holding capacity soil. Small changes in soil moisture represent irrigation events were 5-8mm of irrigation was applied every 1-2 days, while large changes in soil moisture were associated with large rainfall events. 2019 had a low seasonal rainfall pattern where there were few large rainfall events.

Discussion

This study has found that on some soil types there is the potential for the leaching of soil water and nutrients down the soil profile where the soil is above field capacity at the 30 cm soil depth. The use of variable rate irrigation technology will most likely be of benefit to horticultural producers in the West Midlands region where there is a mix of soil types that have differing production capacities, water holding capacities, and irrigation scheduling needs. This technology in isolation, however, will not solve the issue of being able to apply the correct amount of water to each soil type. The use of

soil monitoring equipment to be able to accurately quantify the amount of water held in the soil, water requirements of the crop, and environmental conditions will allow this technology to be used very effectively to ensure the sustainable use of our water resources.

The current method of measuring soil moisture by 'feel' may not have the sensitivity required to inform a variable rate irrigation system. The range of soil moisture that is needing to be measured is between 3 and 9% soil moisture, whereas this method can only define the difference between 3% and 25-30%, which is the saturation point of the soil. Above field capacity, there is extra water in the soil profile that cannot be held by the soil, and so drainage from this layer to deeper layers will occur.

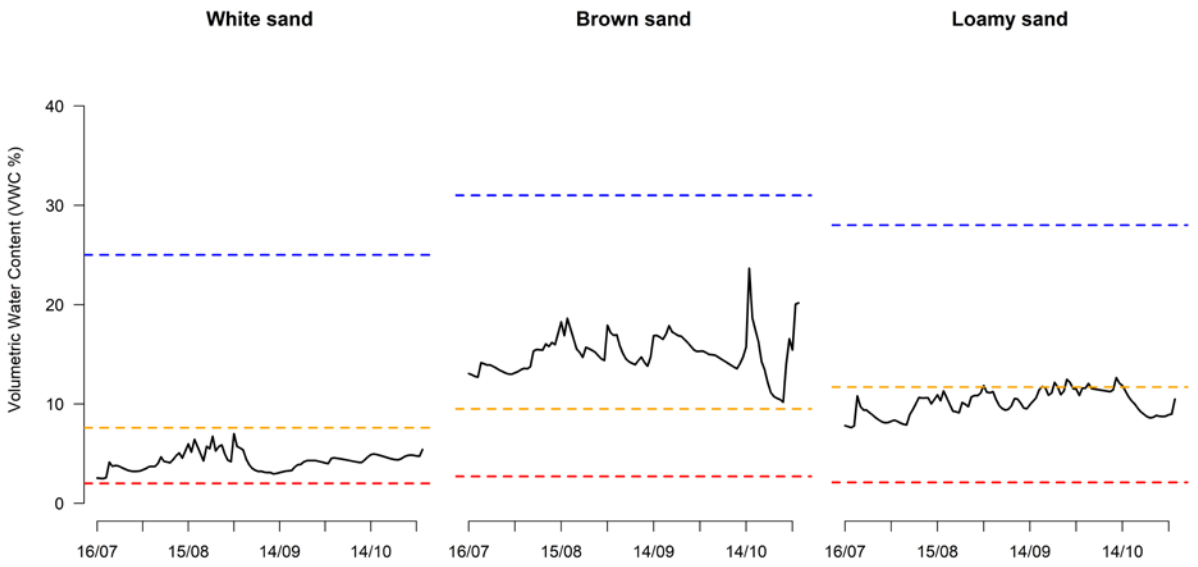

Figure 1. Soil moisture at the 30 cm soil depth for the three soil types evaluated at the Lightning Ridge site between the 17th July and 31st October 2019. For each soil type, the red dashed line indicates the crop lower limit of moisture extraction, orange dashed line represents field capacity, and blue line indicates the saturation point (Apsoil soil database).

This study has highlighted that in order to adopt variable rate irrigation, there are a number of steps that need to be adopted to allow the benefits of variable rate irrigation to be realised. These include accurately mapping the soil types across the centre pivot, characterising the soil to a depth of 1 metre to determine the crop lower limit, field capacity, and saturation point of the soil, and to determine the 'refill point' for potatoes. These tools can be used to interpret the data that is collected by the soil moisture probes. Irrigation scheduling for each soil type for variable rate Irrigation will then be based on the amount of water needed to refill each soil type to field capacity and prevent leaching of water beyond the root zone.

Further information

The full report for this project can be found on the WMG website www.wmgroup.org.au

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