Investigating geophysical methods to assess soil moisture profiles for precision irrigation scheduling

Ahmed El-Naggar[1], Dr Carolyn Hedley[2], A/Prof Dave Horne[2], Dr Pierre Roudier[2]
[1]Massey University, [2]Landcare Research

Water supplies for irrigation are becoming increasingly limited globally and this will force major changes to the design and management of irrigation systems. There is growing interest in the potential role that variable rate irrigation (VRI) can play in improving: crop productivity and water use efficiency while reducing environmental impacts of irrigation. VRI is based on a detailed understanding of soil patterns. This variability in the soil pattern can be identified using a range of rapid, in-situ techniques including electromagnetic mapping (EM).

This study investigates (i) soil differences using EM (at a 4 ha experimental arable plot), (ii) potential water savings using VRI, and (iii) a method to monitor soil moisture profiles, using measurements to calibrate EM survey data.

The EM survey delineated two soil types (Zone 1: Manawatu sandy loam over sand; Zone 2: Manawatu silt loam) and soil moisture monitoring indicated that Zone 1 dried out more rapidly than Zone 2, causing crop stress by early January when no irrigation was applied. This impacted on the yield of a pea crop (Zone 1: 3900 kg DM/ha cf. Zone 2: 5200 kg DM/ha). A soil water balance (for the past 30 years) was used to investigate the potential effects of VRI at the site, and impacts on run-off and drainage. If irrigation scheduling to Zone 2 took advantage of its greater water holding capacity then this area would require approximately 83 mm less irrigation water and drainage would be reduced by approximately 81 mm.

Further research is investigating the use of an inversion algorithm to more accurately assess soil moisture profiles, using the EM survey data calibrated with soil moisture measurements. This aims to improve the provision of soil moisture information to irrigation scheduling decisions. It takes advantage of the EM survey data to improve understanding of vertical soil moisture profiles, as well as spatial soil variability.