2. Irrigation Science

Image analysis and artificial intelligence-based approach for soil-water and nitrogen status estimation

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Optimal crop yields require optimisation of both water and nitrogen application. Industry standard soil-water sensors require contact with the soil and provide information for a single point in the field although there is often spatial variability in soil type and crop growth. Nitrogen content is typically determined using destructive manual soil coring followed by laboratory testing. It is often not practical to install multiple soil-water sensors in a commercial field situation or to conduct multiple soil cores throughout the cotton season. A non-contact soil-water and nitrogen estimation system offers growers potential savings by optimising water and fertiliser management and efficiency and crop productivity. Existing non-contact approaches typically have low spatial resolution and cannot discriminate plants from soil. An alternative approach is a camera-based sensing system that estimates soil-water and plant nitrogen status. This project has developed a proof-of concept infield camera-based plant sensing system and model that estimates soil-water, plant nitrogen status and fruit growth for cotton. A data fusion algorithm was developed that can determine current and predict future soil-water, nitrogen and fruit load of cotton plants based on day of the season, weather data and visual plant response captured using cameras. These models have potential to be used instead of industry-standard models APSIM and OZCOT to predict crop production throughout the season as part of automated control systems to optimise irrigation and fertiliser application. The procedure used to develop the model could be applied to any crop.

A new way to estimate and monitor the water content of soil

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In dryland systems soil water provides a buffer to support crop growth between rainfall events. In irrigated systems, soil water status sets the scene for the irrigation season, and when tracked, provides a basis for irrigation scheduling. A simple and reliable estimate of soil water content can guide key management decisions: whether to plant or delay, how to better match inputs to yield expectations when determined by soil water stress. A Soil Water App for smartphones (SWApp) has been developed and is ready for testing by users over the next 12 months. SWApp uses rainfall inputs from Bureau of Meteorology sites, a local rain gauge - or a wireless rain gauge being developed. A number of soil water sensors are being trailed whose readings can be entered manually or added wirelessly. Growers and consultants will be able to track soil moisture during a fallow and up to anthesis in a crop for any number of paddocks. The SWApp is being further developed specifically for irrigators.

Benchmarking and improving nitrogen use efficiency using IrriSAT – potential applications

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IrriSAT is a satellite and ground station based sensor network that provides information on near real time and forecast crop water use across large scales (Australia wide) and at high resolution (30x30m). A current CRDC project is using the IrriSAT technology for benchmarking water use and yield performance of cotton crops across the Australian cotton growing regions. The system provides information on crop water use and additionally provides a seven day forecast. This information can be used for irrigation management and assisting in making irrigation decisions and well as tracking seasonal water use for benchmarking productivity. Increasing nitrogen use efficiency and better use and management of nitrogen within the cotton growing industry is an important issue for the industry. The IrriSAT platform offers two potential avenues for improving nitrogen use efficiency within the cotton industry which is discussed in the presentation. This includes improving irrigation management through the use of IrriSAT for irrigation management to improve nitrogen use efficiency and