An innovative way to manage irrigation using cheap and simple wetting front detectors

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ABSTRACT

The most common management problem associated with irrigated agriculture is knowing when to apply irrigation and how much of it is required. This is termed irrigation scheduling. Despite numerous techniques and tools developed by the scientific community to aid and improve irrigation scheduling, surveys have shown that farmers growing the same crops in the same region use different amounts of water. This is because of low adoption rates of available irrigation scheduling aids and/or their poor application for various reasons ranging from cost, accessibility and simplicity of the methods. So, as part of a WRC funded project on using *Wetting Front Detectors*, we seek a simple approach that can be used to better manage irrigation using wetting front detectors (WFD). This prototype WFD was developed in Australia, and was designed to be simple so that it can be understood and used by farmers at any level of training. There are two versions; one is electronic called a FullStop and the other is mechanical, called the Machingilana, a sePedi word for a *watchman*. The mode of operation of this WFD is based on the physical properties of water movement in the soil or a porous media. The tool give a 'Yes' or 'No' answer to whether the water has penetrated to a specific depth, and that's all the farmer needs to know to adjust his irrigation amount or interval according to a chosen algorithm.

This experiment on wetting front detectors was undertaken at the University of Pretoria experimental station to: (I) Evaluate two different methods of using electronic wetting front detectors, (II) evaluate two different methods of using mechanical wetting front detectors, and (III) to compare the accuracy of the wetting front detector method against the neutron probe and a computer-based irrigation-scheduling model.

Six treatments were evaluated. They were referred to as the Machingilana (MACH), crop factor (CF), FullStop 1 (FS1), FullStop 2 (FS2), neutron probe (NP) and Soil Water Balance model (SWB) treatment. The first four treatments used WFDs in different ways to manage irrigation. Lucerne (*Medicago sativa*, variety WL 525HQ) was chosen as experimental crop. The NP method was used as control treatment, given the acceptance and credibility this method has received from researchers. The aim was to use dry matter production per volume of water used as an indicator of treatment performance. However, it was later discovered that due to the extensive root system of lucerne, the crop could compensate for either under- or over-irrigation

and dry matter yield was not a good indicator of treatment performance. Statistical analysis of the dry matter yield data collected from three cycles revealed that the treatments were not significantly different at a 5% confidence level, although there was great variation in total amount of irrigation applied to each treatment per growth cycle. This is due to the fact that the crop was able to mine into deeper soil layers for water, although this strategy would not to be sustainable in the long run without extra irrigation applied. In the light of this, the trend in soil water deficit obtained with the neutron water meter for each treatment was used to evaluate the six treatments.

The four treatments based on WFDs (Machingilana, FS1, FS2 and CF) performed comparatively well to the control and SWB model treatments. However, this is not without discrepancies in all the WFD treatments or the control and SWB model treatment, but the problems associated with each treatment's successes or failures have been outlined, and with follow-up research, those problems can be rectified. It is concluded that WFDs can be valuable, simple and affordable tools to better manage irrigation, provided appropriate guidelines for using them are applied.