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

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Key messages

Soil water provides a buffer to support crop growth between rainfall events.

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.

The SWApp will be further refined based on feedback from early testers – we are looking for potential users to test the App now.

SWApp uses rainfall inputs from Bureau of Meteorology sites, a local rain gauge - or a wireless rain gauge being developed in the project. 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.

Aims

This GRDC project is developing a low-cost, grower friendly application for smartphones (iPad and iPhone) to estimate plant available soil-water during fallows and early crop periods. The App uses water-balance simulation, online climate data (BoM data from Silo), local rainfall data and local soil descriptions (ApSoil). The project is also testing low cost automatic rain gauges and soil water sensors, which can provide input data for the water balance simulation. The project has 4 phases:

Phase 1. Review of methods and industry needs (complete);

We reviewed soil moisture measurement and estimation methods and commenced industry consultation on user needs and system design. The review investigated soil water and rainfall sensor specifications and communication requirements for mobile devices (iPhone and iPad).

A reference group of growers and advisors guided the project, and regional forums ensured that grower needs were understood and incorporated into the product released for wider testing.

Phase 2. Sensor testing, data integration and prototype development (now);

A range of sensor and measurement devices is being evaluated for effectiveness and their ability to be integrated with mobile devices.

A prototype has been developed to operate on iPads and iPhones to demonstrate the concept and provide a focus for discussions with growers and consultants. Feedback from users is being collected to guide further development of the SoilWaterApp.

Phase 3. System calibration, validation and regional field-testing;

During this phase, there will be a focus on system refinement, model validation, integration of sensors and customisation of results to best meet industry needs.

Preliminary calibration and testing of the prototype system will use data from existing and historic agronomic studies and datasets collected specifically for validating the App.

Stage 4. Delivery of the App, documentation, training and promotion.

The focus will be on delivery on iPhones and iPads and general release from the Apple App Store. The App will interface with soil moisture sensors, local rainfall data and link to on-line data sources. A website will provide supporting documentation and support user feedback.

What does the prototype App look like?

The App estimates today's soil water content (% of full and mm of rainfall stored) and recent changes in soil water content (solid line). This is shown against the range of conditions estimated from the weather in past years (the shaded areas).

Each paddock is considered separately, and is linked to the nearest BOM climate station for information about rainfall and evaporation. Local rainfall data can also be added. A starting date and a date when the soil water content was known are required. This is typically when the soil is dry after a crop, or maybe a measured value from a sensor.

A fallow or fallow-crop sequence is selected; soil water estimates are made daily during the fallow or fallow-early crop.

Crop residue cover (low/medium/high) and soil types (10 to 15 types per state) are selected from menus.

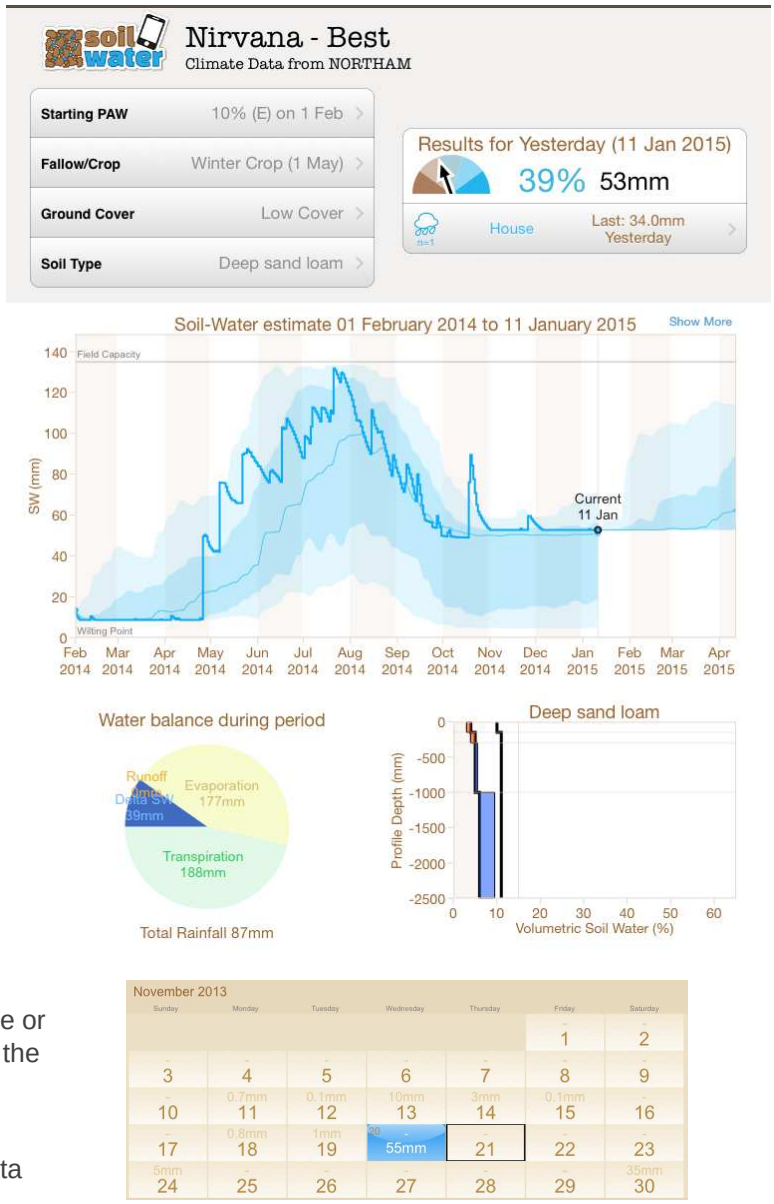
The results, as shown above, include a summary table (mm and % profile filled) and as a graph showing gains due to rainfall and losses from evaporation, transpiration, runoff and deep drainage.

The fate of rainfall is shown as pie chart, and the current estimate of soil water distribution in the profile is shown in a diagram.

If an estimate of soil water from a sensor or soil sample is available, the simulation can be reset to a new starting value.

You can change any of the conditions, such as soil type or residue cover, to see how much difference it makes to the results.

The default rainfall data is from a selected Bureau of Meteorology station, but you can add your own rain data manually or uploaded from a wireless rain gauge.



Conclusions

- A prototype of the App is available and ready for evaluation by a limited number of "beta testers"
- While a lot of consultation between users and developers is in progress, a view of the prototype is shown. A wireless rain gauge is in development with some early versions in the field in 2015.
- The App will be free. An iPad costs about $400 – much less than a single set of sensors and data loggers. The project began in October 2013 and delivers a final product before June 2016.

Key words

Soil water, fallow efficiency, climate, weather, soil management, decision support, system monitoring
Acknowledgments

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