Soil moisture depth profile responses in polytunnel-grown Beetroot under irrigation control with adjustable water volume delivery

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Abstract

This poster presents the innovative Script Editor feature of DeltaLINK 3.0 software when used in combination with the new GP2 Logger and Controller. This powerful new Script Editor function gives the user an accessible way to create sophisticated mathematical functions and models that can be applied in real-time to the measurement data collected by the GP2 - providing useful outputs from the combination of different types of measurements and/or multiple sensors. Potential applications are numerous, including areas such as the calculation of evapotranspiration, irrigation control and disease prediction. In the experimental work shown below we have created a very simple irrigation controller within the DeltaLINK 3.0 Script using soil moisture and water flow sensors. The GP2 collects data from these sensors and a PR2 Profile Probe enabling the relationship between irrigation water volume and changes in soil moisture to be investigated at soil depths of 200, 300, 400 and 600mm.

GP2-based irrigation controller

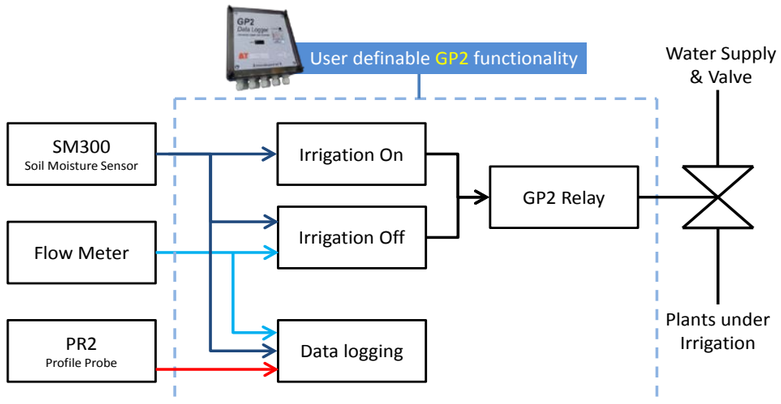

Fig 1 – Block diagram showing irrigation control and data logging functions implemented in the GP2

Measurement and control equipment

- **GP2 - Advanced Data Logger and Controller**

- **SM300 Soil Moisture and Temperature Sensor**

- **Flow Meter, solenoid valve (Toro EZ-Flo -II) and manual shut-off valve**

- **PR2 Profile Probe**

Irrigation control implemented using DeltaLINK Script Editor

The GP2-based irrigation controller employs the DeltaLINK Script Editor to implement the following simple GP2 relay control algorithm:

Turn Irrigation Valve ON when:

- SM300 Soil Moisture < Soil Moisture Trigger Threshold

Turn Irrigation Valve OFF when:

- Flow Meter ≥ Irrigation Flow Limit

Where:

- Soil Moisture Trigger Threshold: 20% Vol.
- Irrigation Flow Limit: Set-points used: 30, 9 & 5 litres

Experimental arrangement

The soil is at this location is a mix of predominantly chalky silt loam to fine sandy silt loam grading to a chalky clay loam at depth with many fine mottles. It has been classified as a chalky clay loam on a bedrock of marly chalk.

Beetroot (*Beta vulgaris)* were planted in 3 rows of 8 in a 0.6m by 1.5m area under a polytunnel. An SM300 soil moisture sensor was installed vertically in the soil so that the electrodes measured soil moisture in soil 2 to 7.5cm below the surface. Irrigation water was delivered along the rows of Beetroot using 3 strip spreader sprinklers.

Fig. 2 – The PR2 Profile Probe and 1 of 3 sprinklers amongst Beetroot, during an irrigation event

PR2 Profile Probe responses

The data collected over a 6 day period is shown in Figure 3 below where the SM300 Irrigation controller (broken blue line) has maintained the soil moisture above 20%. The PR2 Profile Probe data at soil depths of 200, 300, 400 & 600mm is also presented (Prof200, 300, 400 & 600 respectively) with Daily Water Use in litres for each daily irrigation event. From the data in Figure 3 it can be seen that the initial 30 litre irrigation event results in clearly observable changes in soil moisture to a depth of 600mm whilst 5 litre irrigation events are only just observable at 400mm. Soil moisture measurements at 200 & 300mm respond proportionally to irrigation volume as well as in response to the water use by the Beetroot plants. By inspection of the data in Figure 3 it would appear that by switching between irrigation volumes of 5 and 9 litres it may be possible to maintain the soil moisture at 300mm at around the 35% Vol. level.

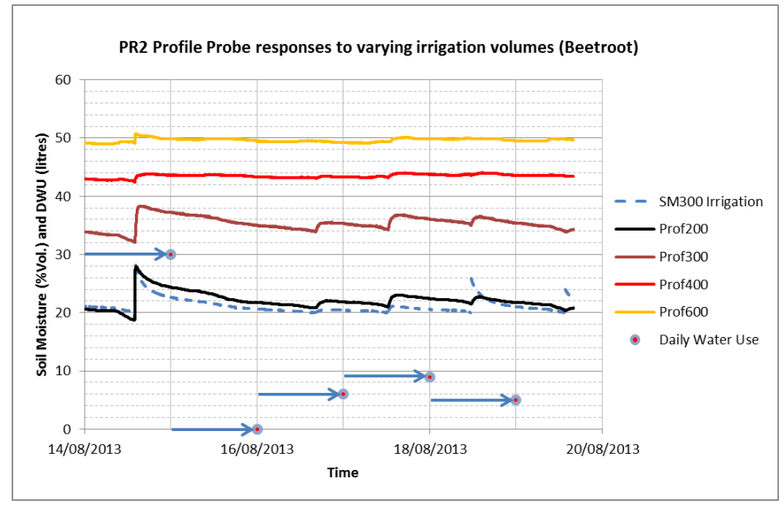

Fig. 3 – SM300 (irrigation Control) and PR2 Profile response to varying irrigation volumes

Conclusions

A small scale experiment using a GP2-based irrigation controller with feedback from a single SM300 soil moisture sensor and a flow meter suggests that consideration should be given to water volume delivered at each irrigation event. Data from a PR2 Profile Probe indicates that excessively large irrigation volumes may result in less efficient water use as a significant amount of water may rapidly percolate to soil depths beyond the root zone. Controlling the irrigation volume delivered at each irrigation event may lead to improved water use, a further benefit maybe the possibility of maintaining control of soil moisture level at a second soil depth.

For more information regarding this and other GP2 Script Editor applications please contact: sales@delta-t.co.uk

DeltaLINK 3.0 Software including the Simulator is available free of charge at the online GP2 Resource centre: http://www.delta-t.co.uk/delta-link-resources.asp

Visit our website here: www.delta-t.co.uk