

Integrating weather based crop modeling and soil water monitoring technologies to provide improved decision support for sugarcane irrigation management

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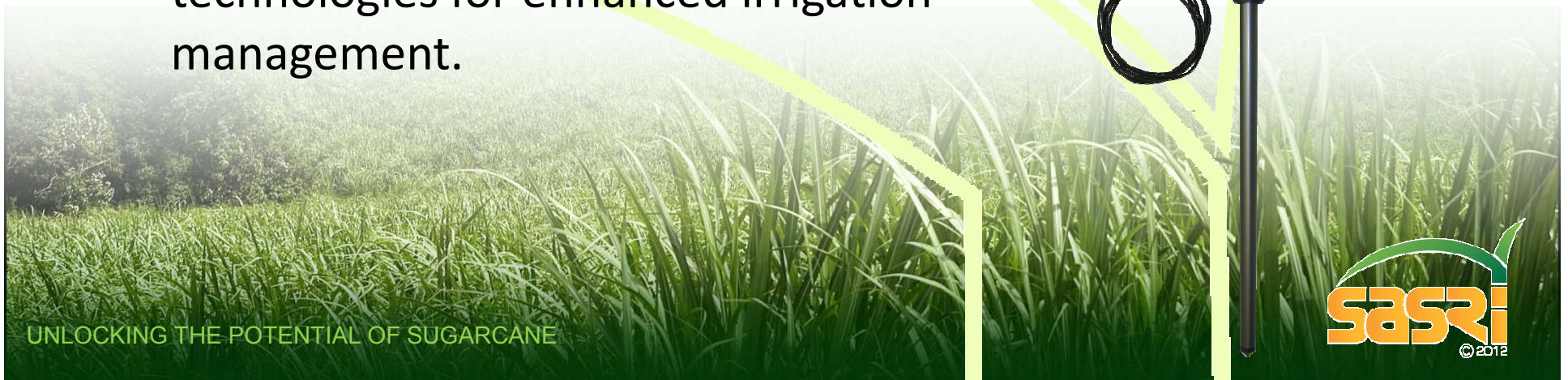


UNLOCKING THE POTENTIAL OF SUGARCANE



Introduction and Background

- Weather based crop models are good at estimating past and future evapotranspiration (ET), irrigation needs and yields over large areas (Allen *et al.*, 1998; Annandale *et al.*, 2005)
- Capacitance soil water sensors are useful for measuring current soil water status at a point (Fares *et al.*, 2011; Evett *et al.*, 2012)
- Opportunity to combine (integrate) the two technologies for enhanced irrigation management.



UNLOCKING THE POTENTIAL OF SUGARCANE



Objectives

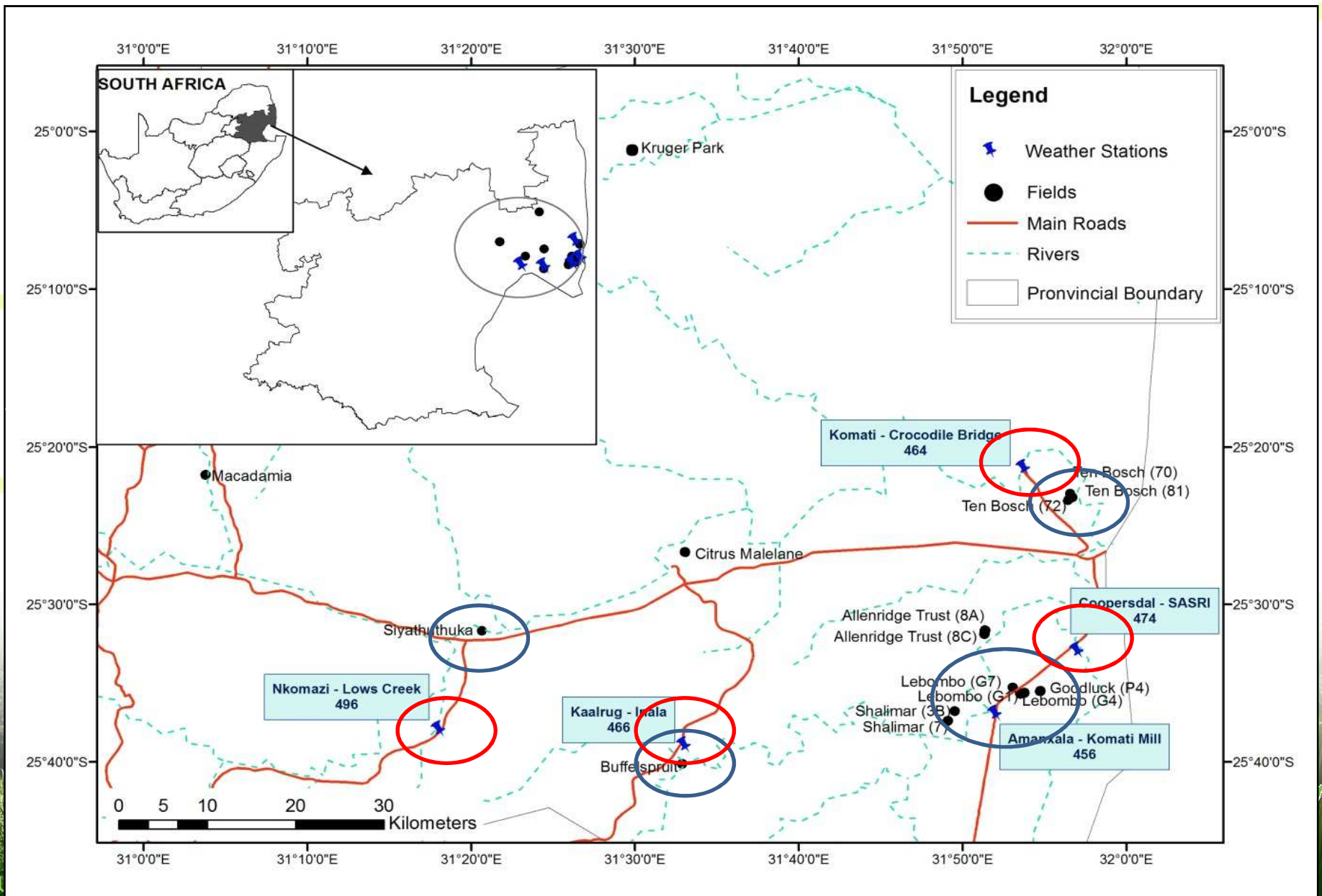
- Integrate real-time capacitance probe data into a weather-based sugarcane crop simulation model



- Assess the value of the integrated system for irrigation management - 13 case studies.



Study area: Onderberg (Mpumalanga)

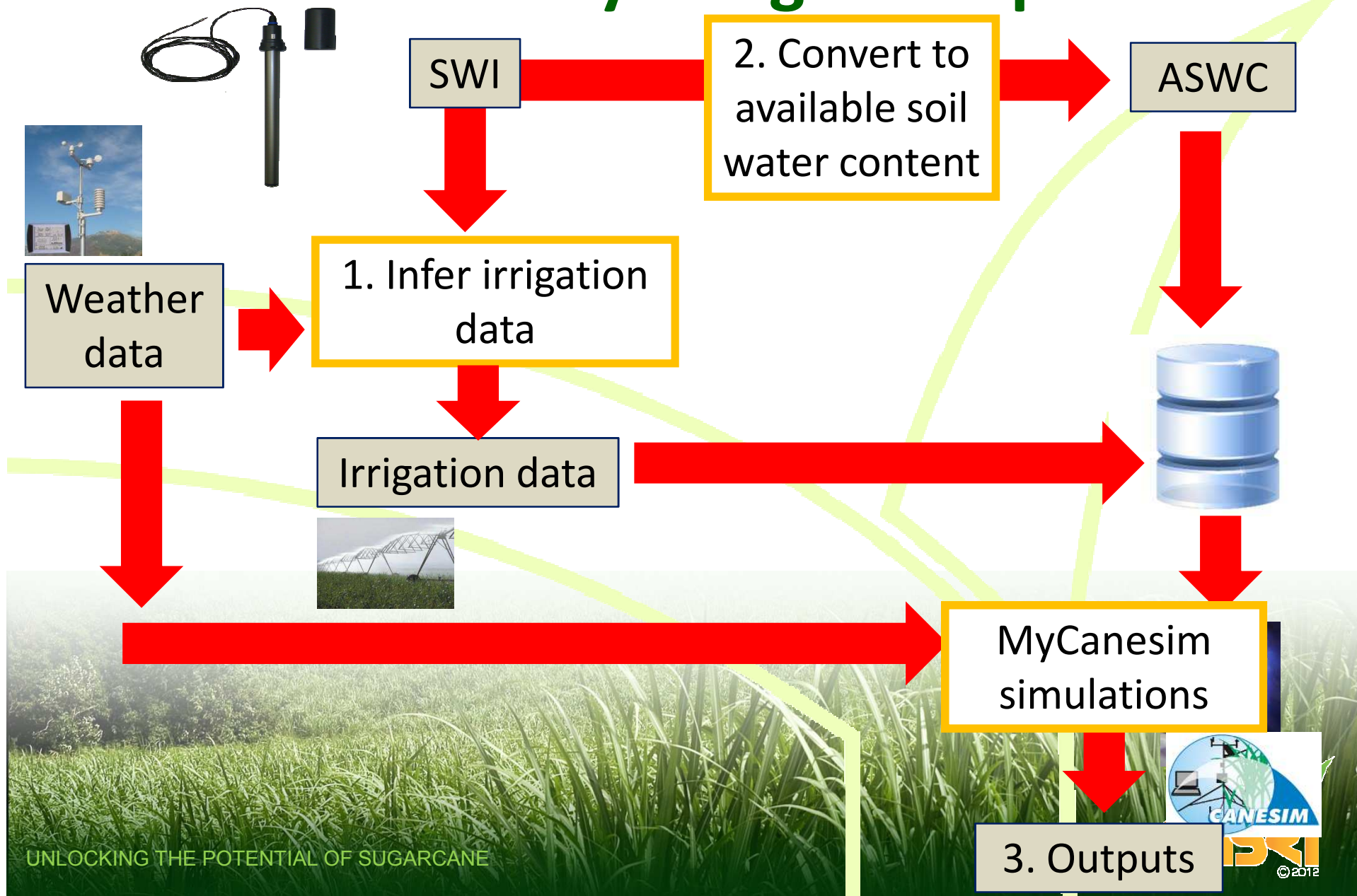


Irrigation Systems

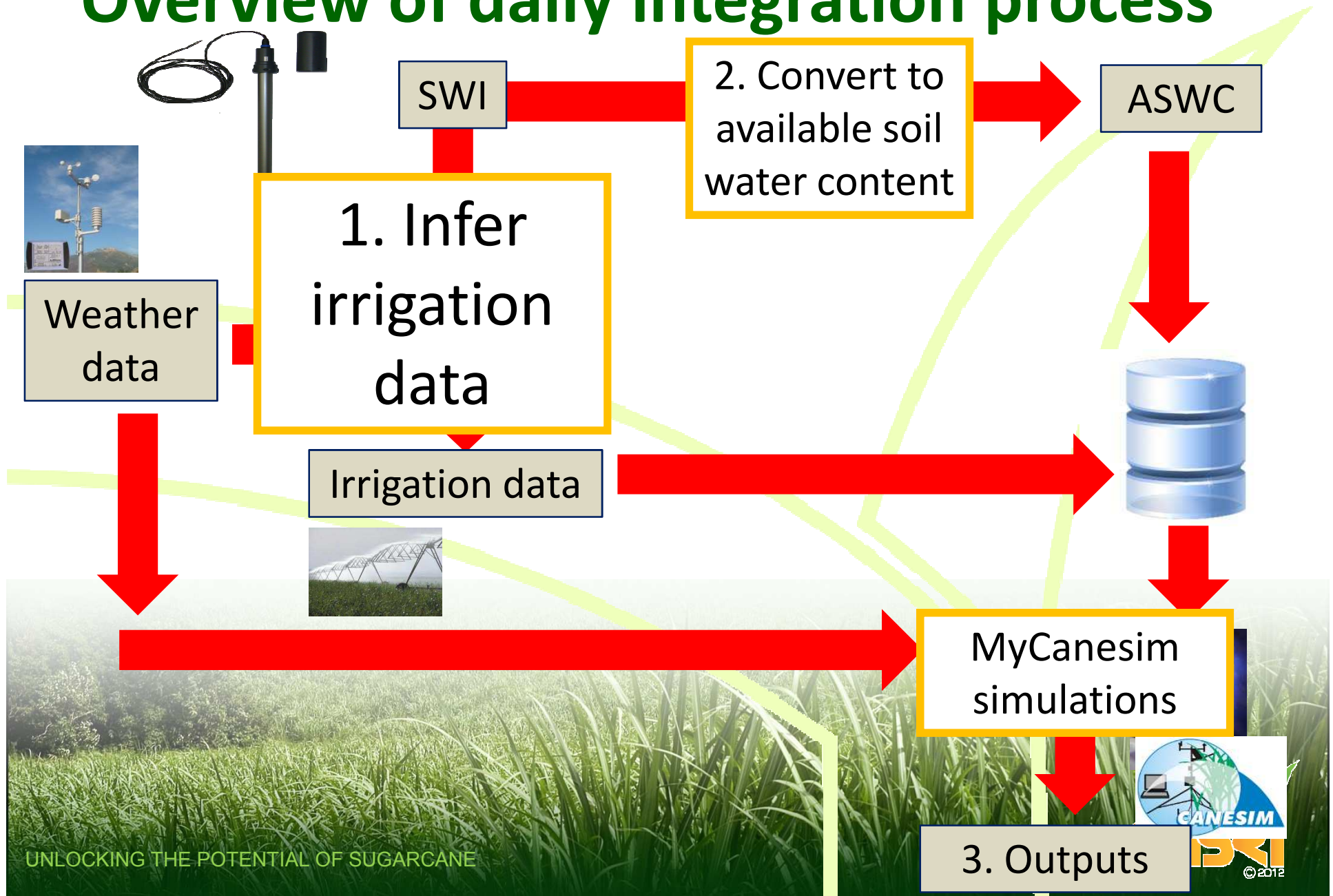
- 8 drip systems: 1 day cycle, 7 mm/day design capacity.
- 5 Overhead system:
 - 3 dragline (7day cycle, 24 - 48 mm capacity),
 - 2 centre pivots (2day cycle, 12-15 mm capacity)
- Estates, private commercial farms, and some small scale farms



Overview of daily integration process



Overview of daily integration process



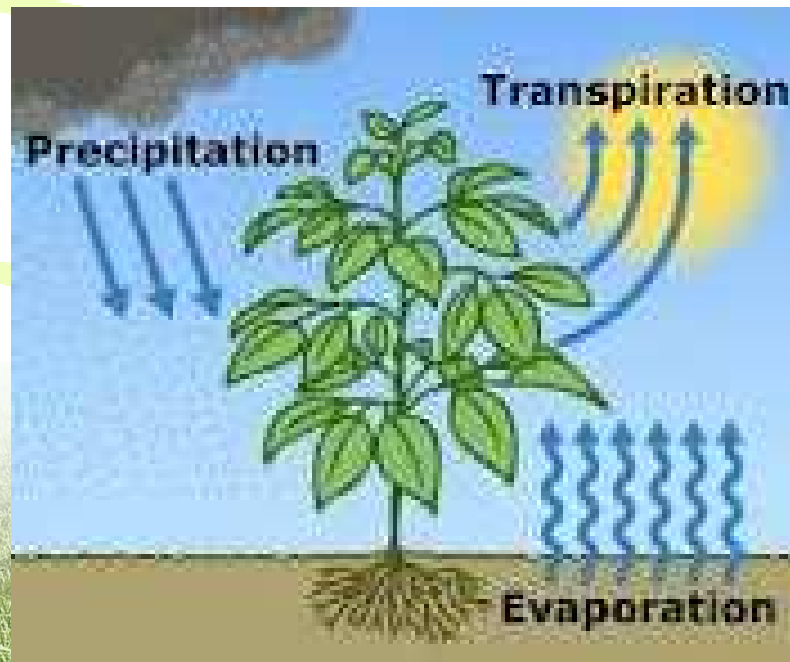
1. Inferring irrigation event data

- Need to calculate irrigation events to
 - Input required for simulations
- Indicated an irrigation event when
 - Significant number of small increases in SWI over a long (6-12hr) period (drip, overhead)
 - A large increase in SWI over a short (2hr) period (overhead)
 - Only when rainfall at the field, nearby field, AWS <math><1/2</math> design capacity

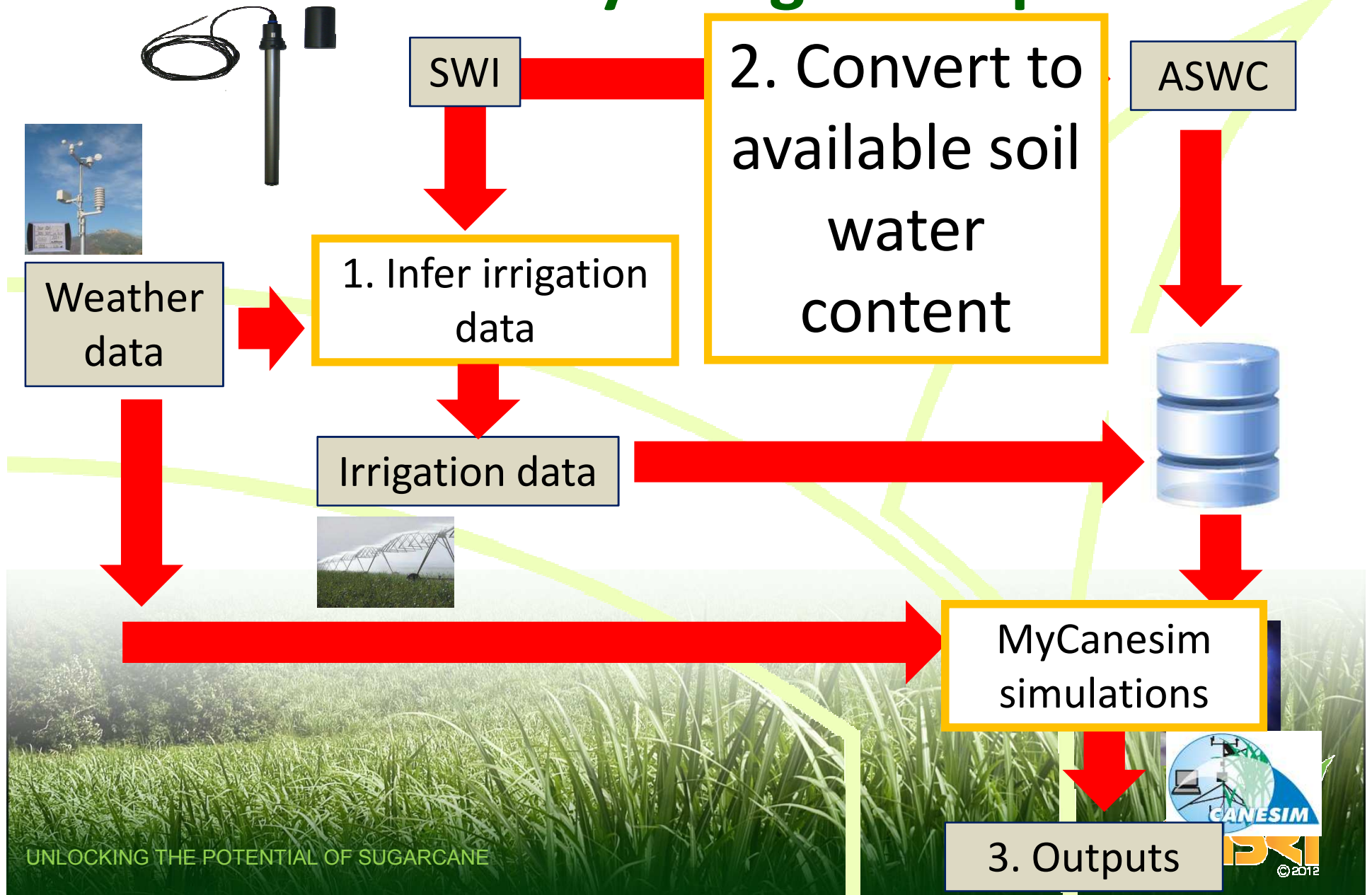
1. Inferring irrigation amounts

- $Irr = \Delta ASWC + ET - R$

For days with $R < 0.5$ design capacity



Overview of daily integration process

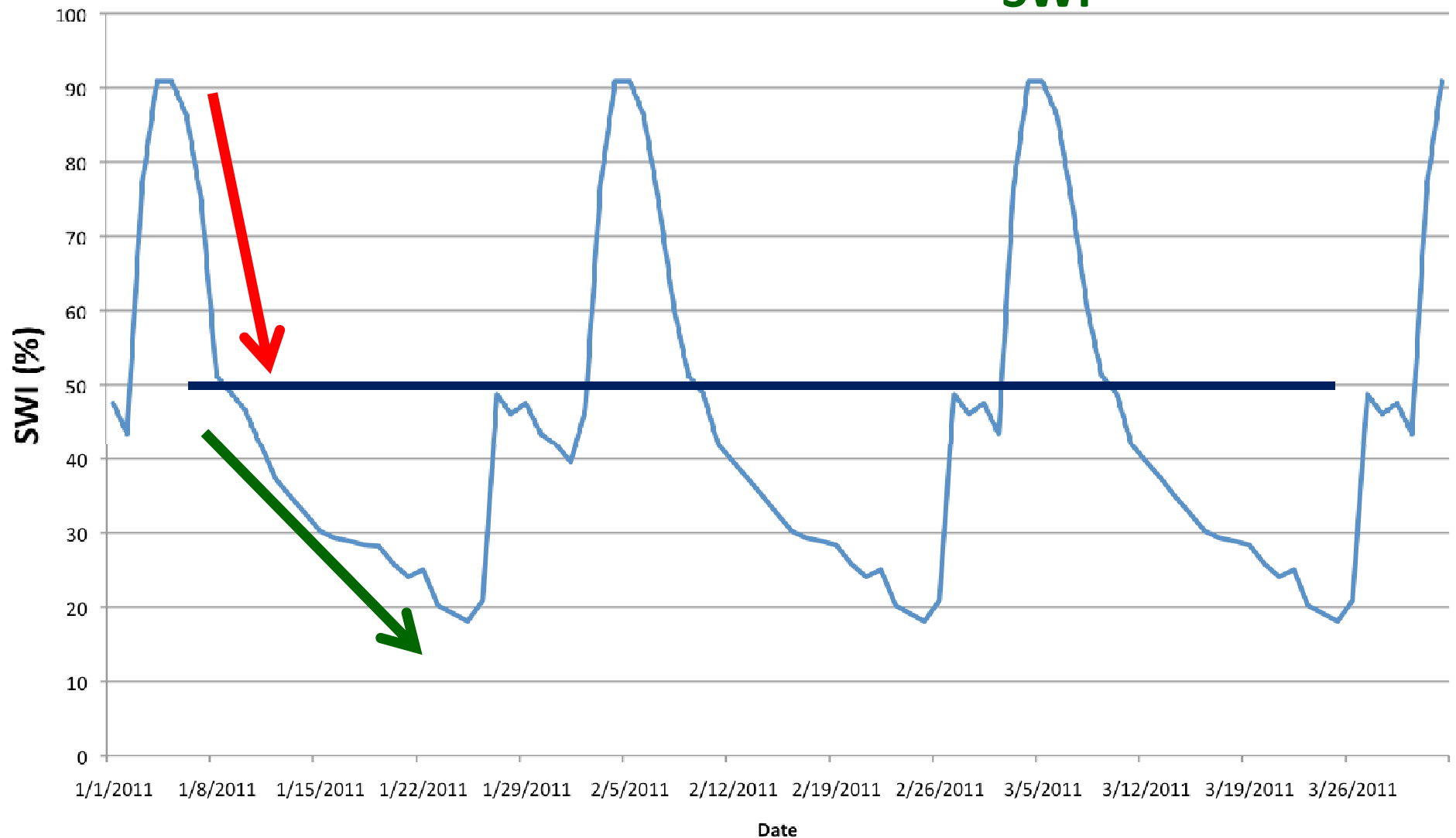


2. Soil water data conversion

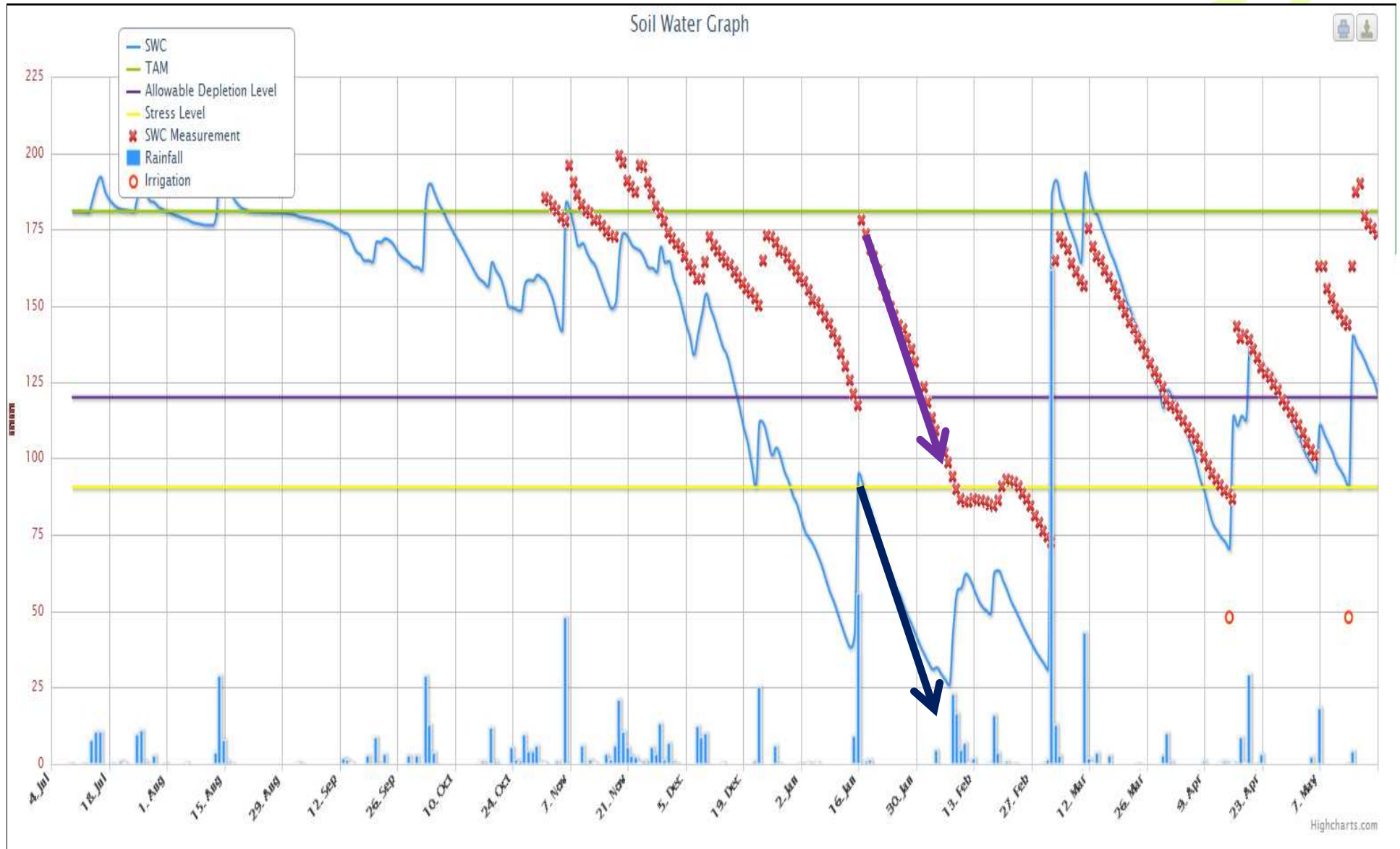
- $ASWC = TAM - (FC_{SWI} - SWI) \cdot CR$
- ASWC – available soil water content (mm)
- TAM – ASWC at field capacity (mm)
- SWI – soil water index as measured by probe (%)
- FC_{SWI} – SWI field capacity determined from point where drainage stops (%)
- CR – conversion ratio determined from night time irrigation or dry periods of extraction (mm/%)



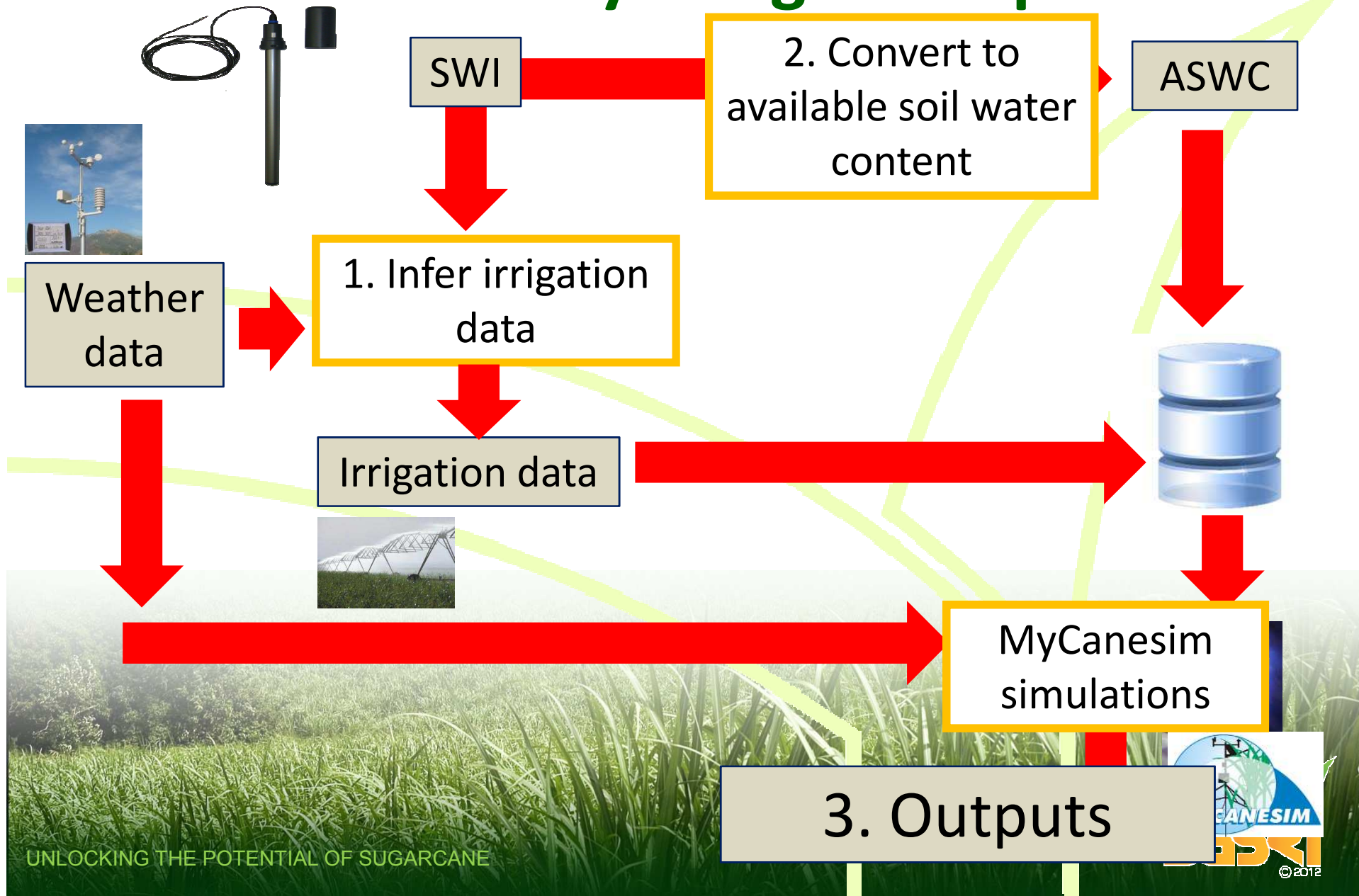
2. Estimation of FC_{SWI}



2. Estimation of CR



Overview of daily integration process



3. Output from integrated MyCanesim

- Tables
 - Current and future Irrigation advice
 - Current crop water use and yield
 - Final crop water use and yield
- Graphs
 - Available soil water content graph
 - Crop status graph
 - Water budget graph



Grower Code 900003

- Farms
- Grower: 900003
- Pongola SMS Irrigation advice
- Irrigation Blocks
- Rain Gauges
- Reports
- Help

Welcome to My Canesim

Introduction

Welcome to the My Canesim system. The system consists of a sugarcane crop model linked to daily weather data. It can be used to simulate the crop water balance and crop growth for user specified scenarios. Examples of its applications are:

- to provide real time irrigation advice to groups of growers or for a number of fields on a farm,
- to estimate the yield and quality of past and future crops, and
- to compare the performance of different production strategies.

How to get started:

The inputs required to perform simulations are weather and rainfall data, field and crop information, irrigation system and strategy. The best way to set up the system initially is:

1. Create a Project.
2. Create an Irrigation Block (only if it is irrigated one) and enter data
3. Create a Rainfall Gauge (only if you have your own records) and enter data
4. Create a Scenario(s) and enter data
5. Run a Scenario

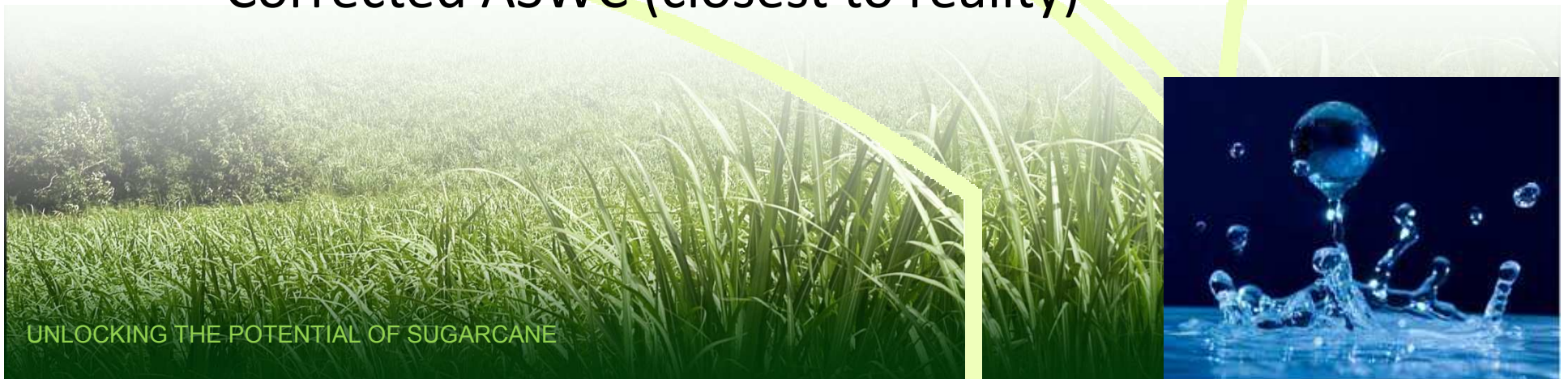
Outputs are displayed in various reports under the report section of the menu bar.

Acknowledgements:

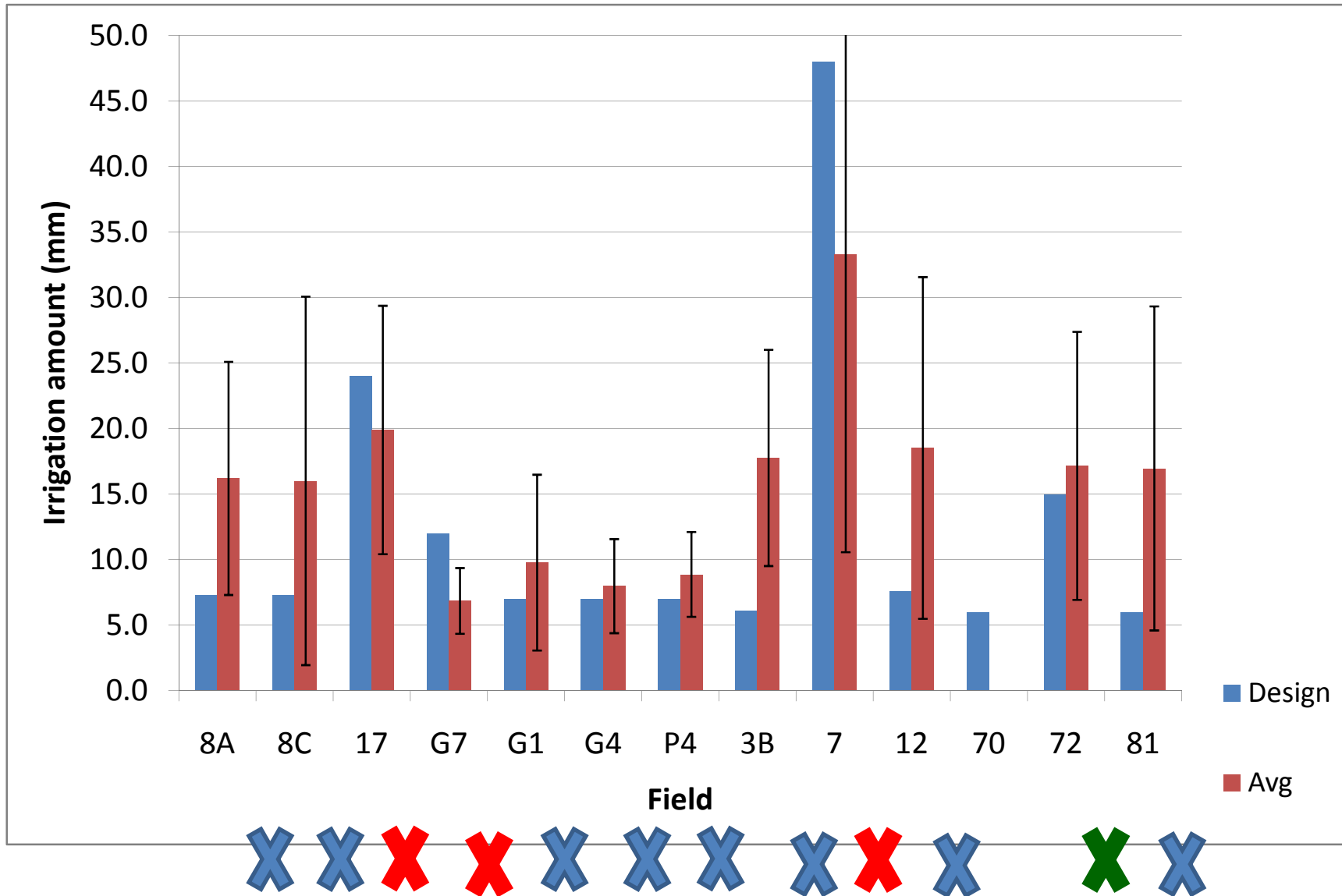
Development: Retlin (now [Fanco](#)); Funding: [Water Research Commission](#) and [SASRI](#)

Evaluation

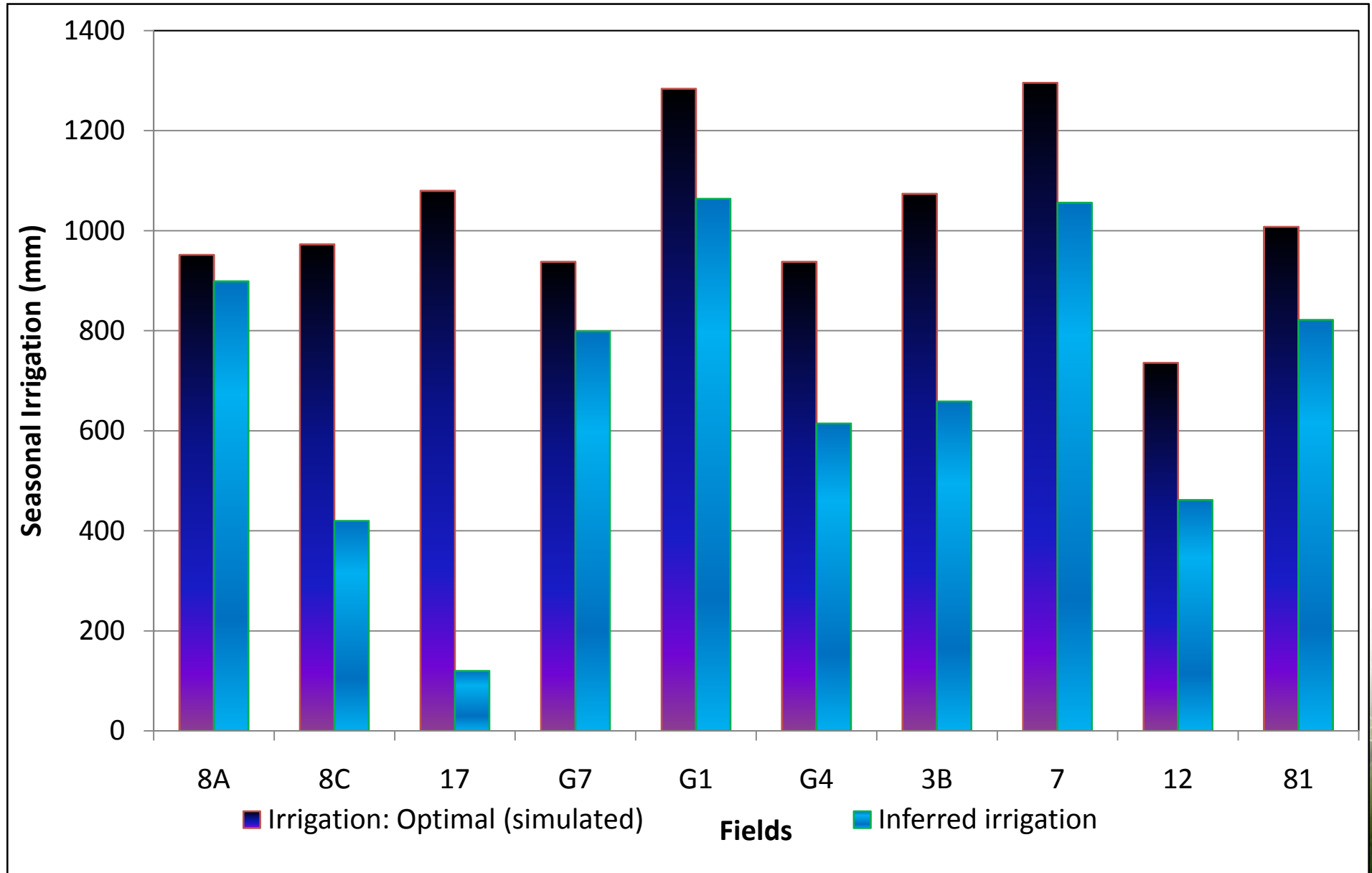
- Irrigation amounts: design capacity vs inferred application
- Compare simulated water use and yield for:
 - Optimal irrigation (simulated)
 - Inferred irrigation (estimated)
 - Corrected ASWC (closest to reality)



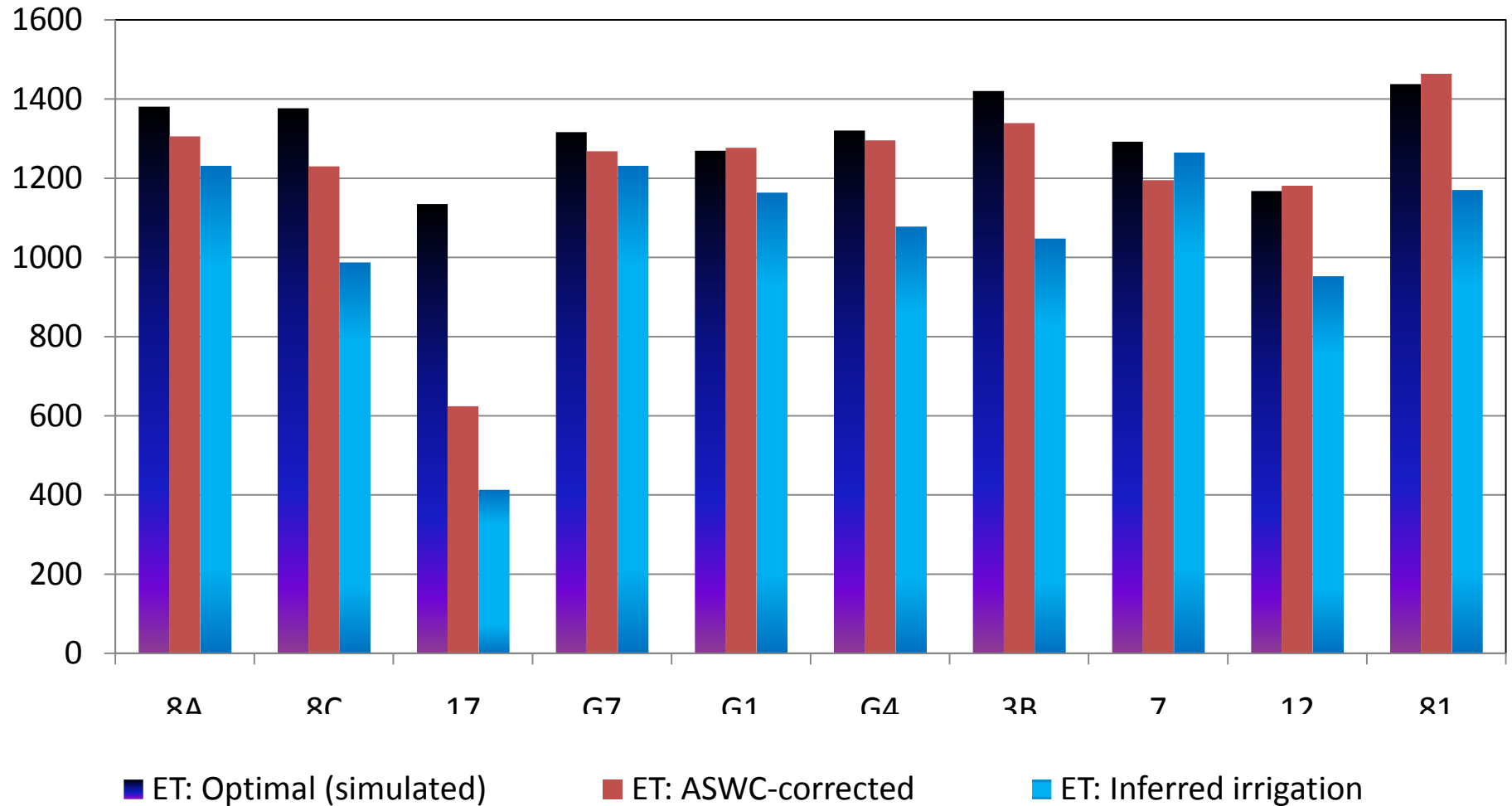
Comparison of irrigation amounts



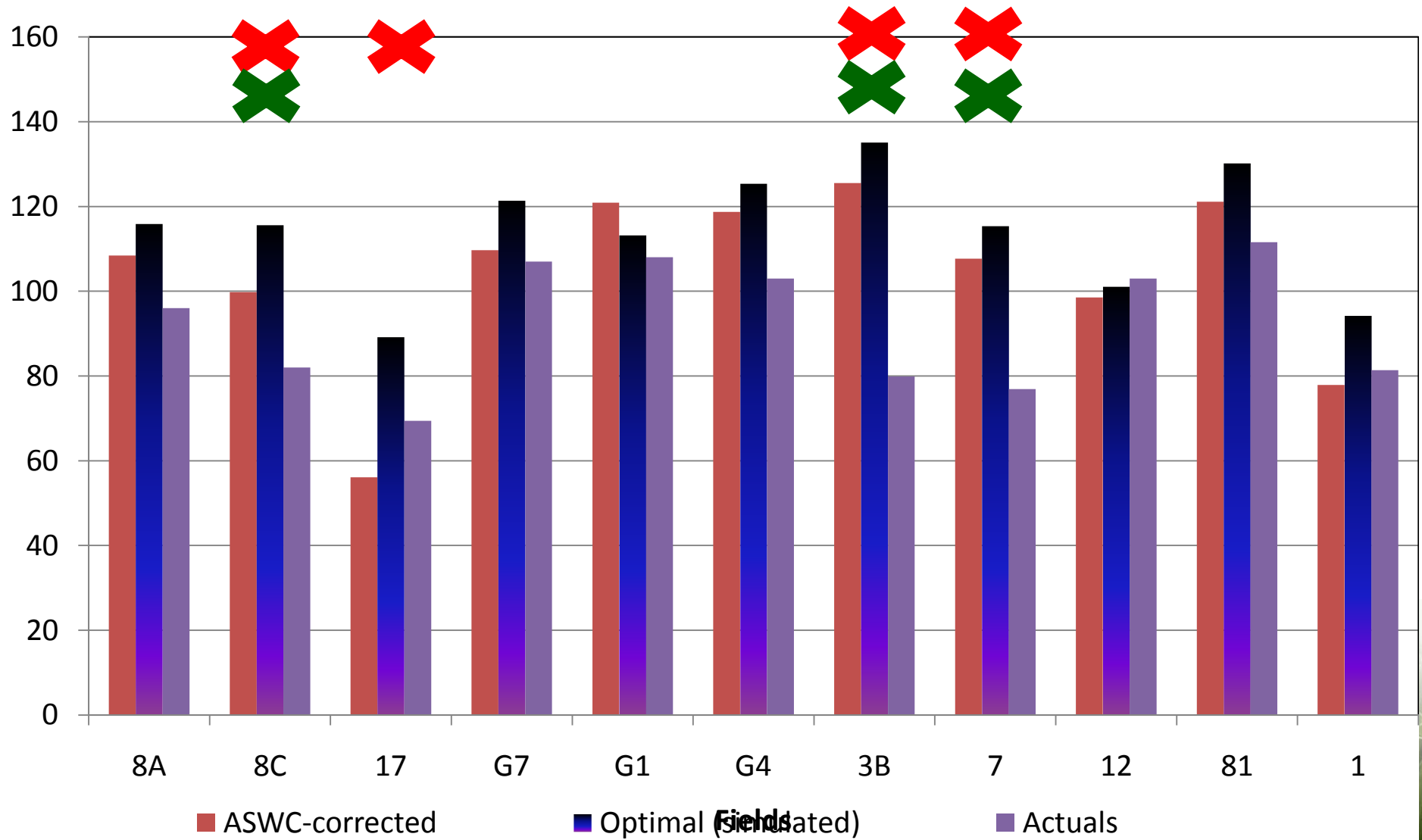
Simulations: Irrigation (mm)



Evapotranspiration (mm)



Yields (t/ha)

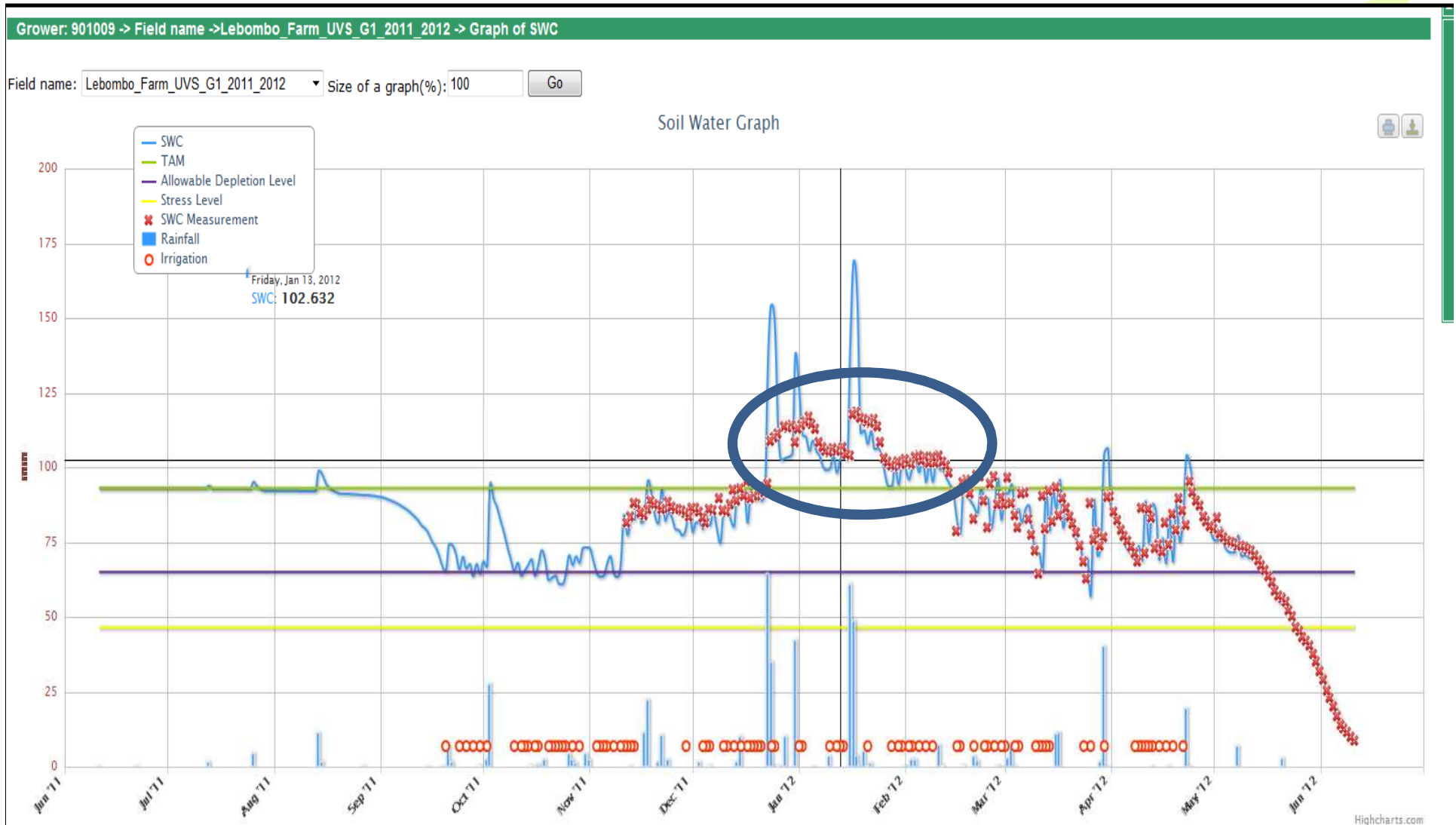


Information transfer

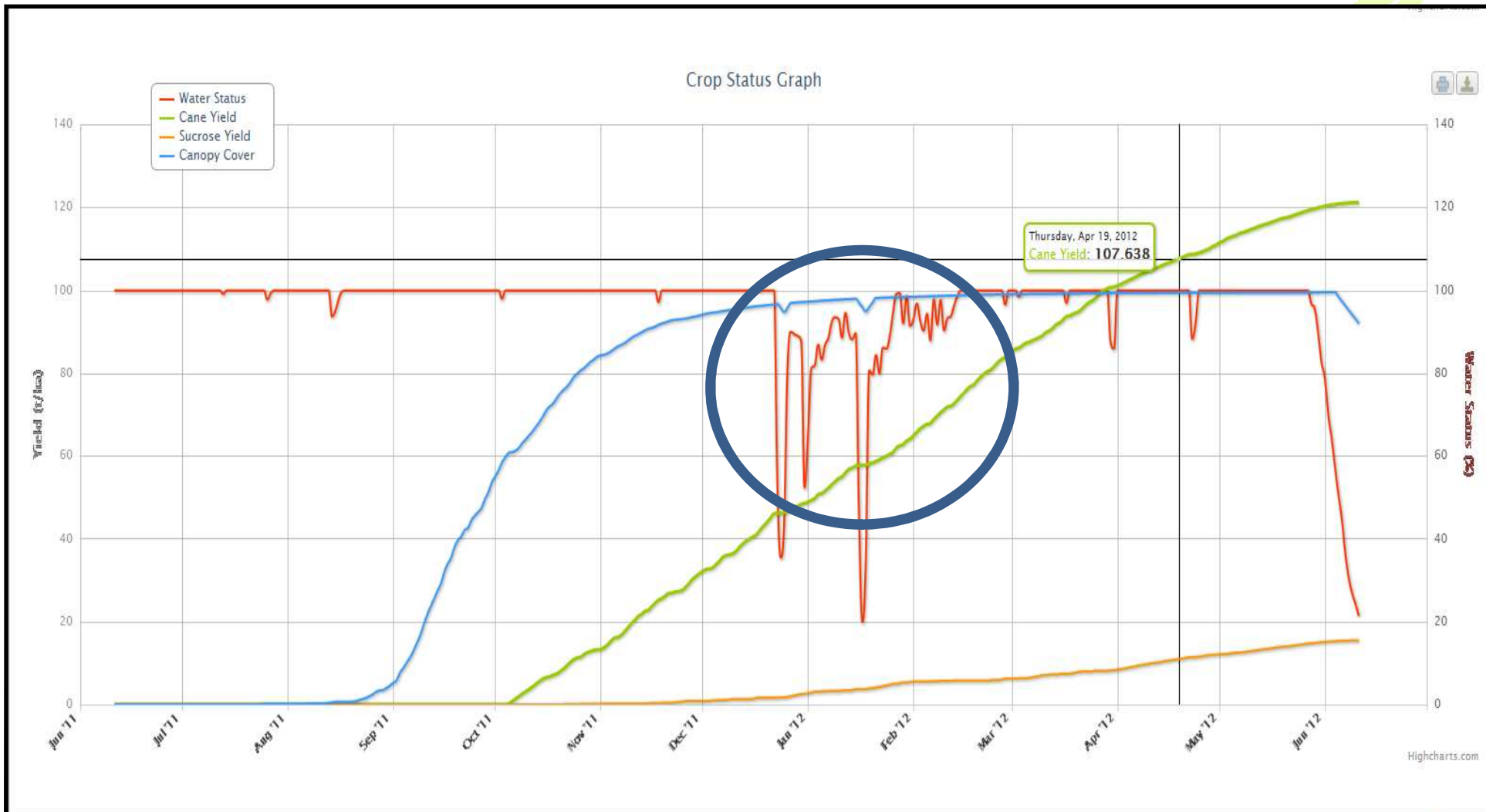
- Met with farmers, extension and scientists, at Onderberg and Umfolozi
- Showed Aquacheck graphs and MyCanesim simulations
- Gave integrated MyCanesim outputs (booklets) to farmers
- Identified good and bad management of irrigation, agronomy and impacts on yield
- Discussed improvements to management and to the integrated system



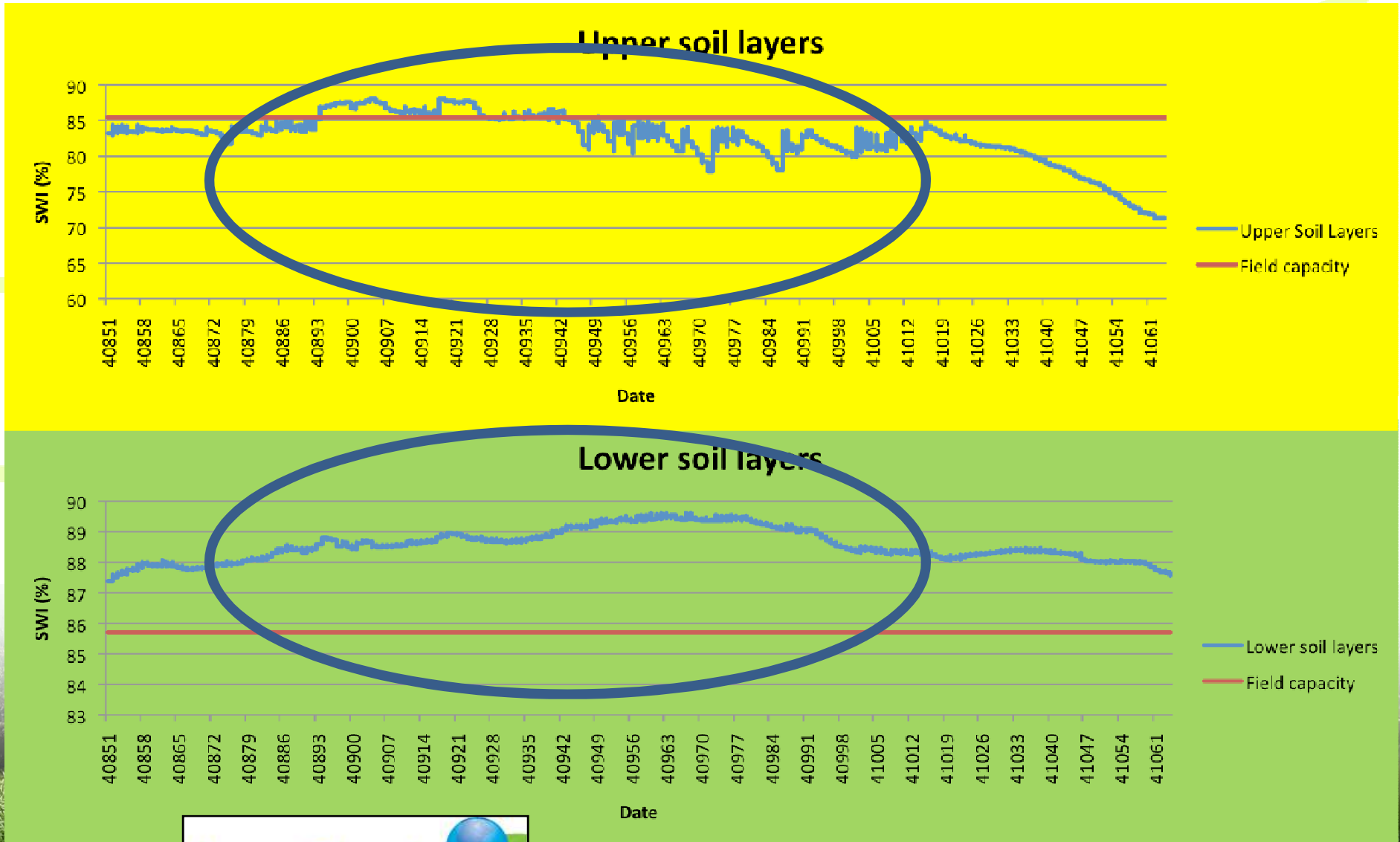
Soil water graph – G1



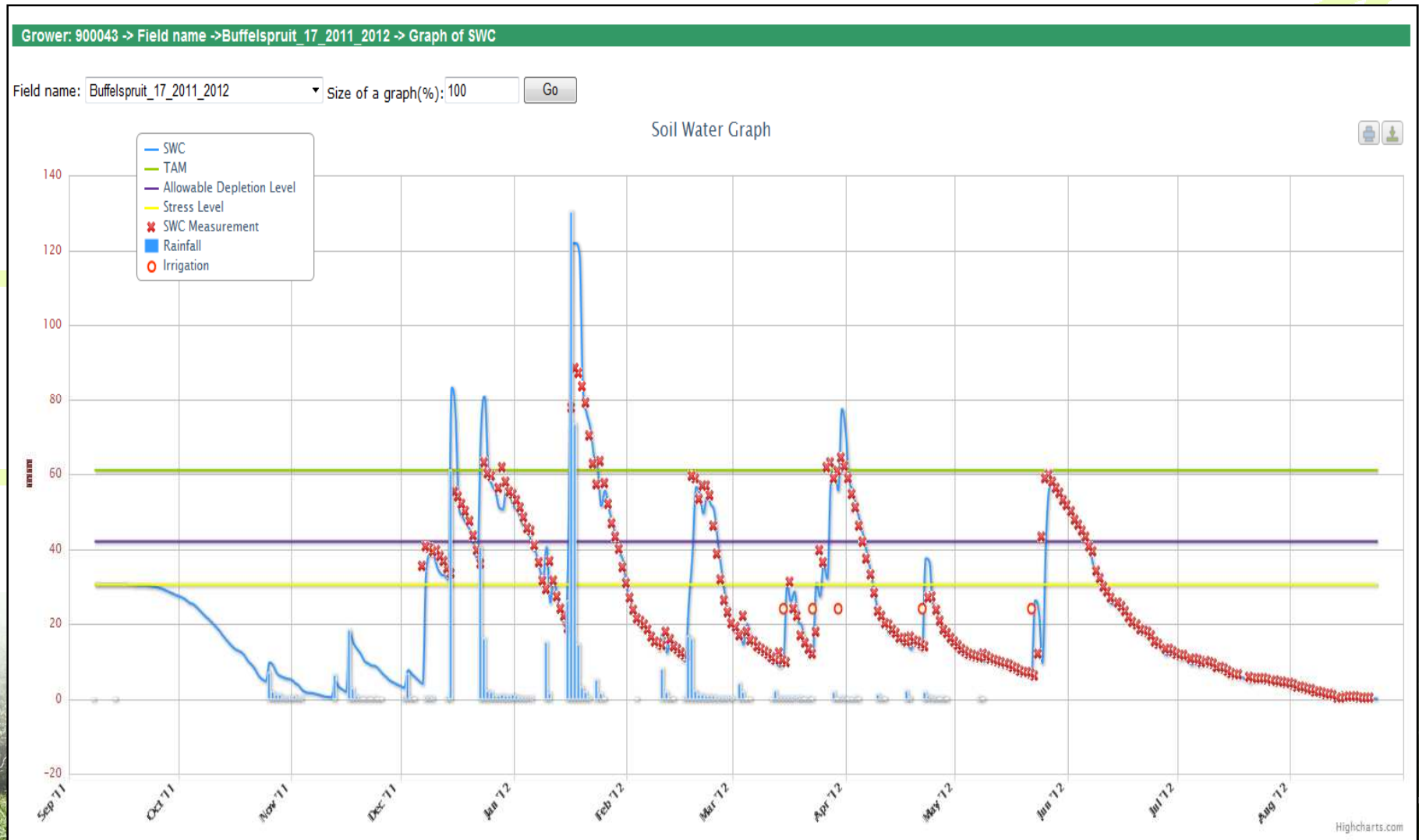
Crop status graph – G1



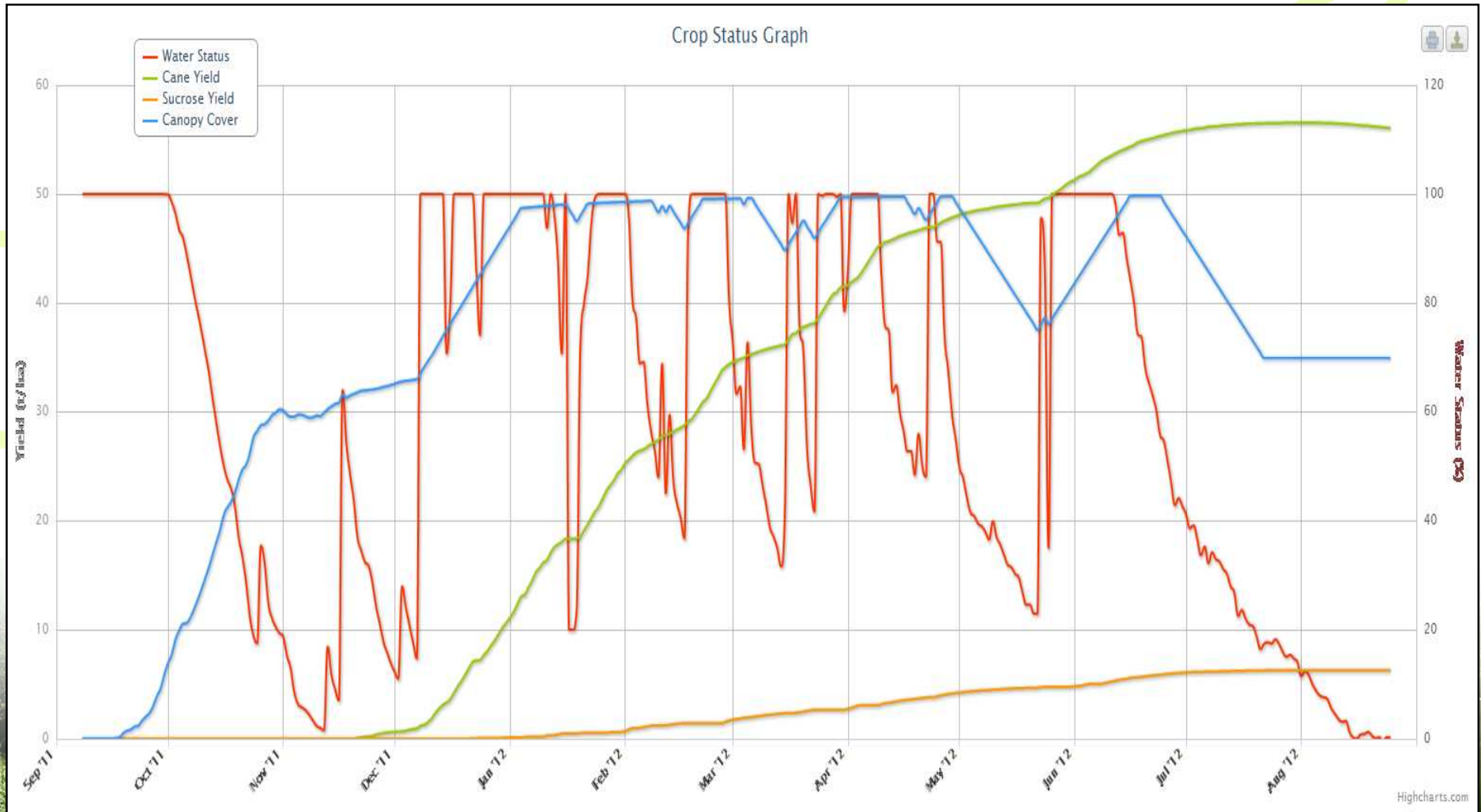
Aquacheck soil water: Lebombo G1



Soil Water Graph – Buffelspruit 17



Crop Status Graph - Buffelspruit 17



Conclusions

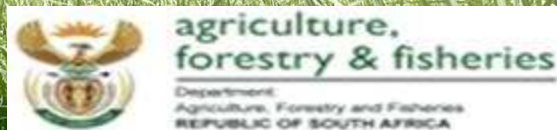
1. Probe based soil water status data successfully integrated with weather based MyCanesim simulation system.
2. Integrated MyCanesim provides enhanced support for irrigation water management for sugarcane.
 - Irrigation practices can be adjusted and
 - yields and water use efficiency can be benchmarked.
3. Evaluation suggest:
 - Inferred drip amounts > design - probes were located close to emitters.
 - Inferred overhead amounts < design - canopy interception and poor system efficiency.
 - Irrigation derivation algorithm needs improvement
 - Simulations suggest that good irrigation practices were followed in 10 out of 12 cases
 - Actual yields were well below (>30%) SWC-corrected simulated yields in 3 cases – indicating problems other than irrigation.
6. Capacitance soil water data is useful for irrigation water management
7. In this project we mainly used the integrated MyCanesim to look at past actions. We need to test real-time scheduling with the integrated system.

Acknowledgements

- WRC, DAFF for funding
- Caren Jarman for managing the WRC project this study was part of
- Farmers: Nico Nel, Herman Badenhorst, John Hewitt, Dane Ralfe, L. Shabangu and F. Magagula (Mpumalanga) and Andrew Russel (Umfolozi) – for use of their farms
- Extension: Pieter Cronje, Alex Searle, Octavius Madonko, Florence Mavimbela - organisation and communication,
- SASRI research farm assistants, Francois Olivier – field samples and helping with probe installation
- Students: Walter Maswanganyi (SASRI) – data processing
- Dave Mayers (Liquidfibre) – data processing and Aquacheck website



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MyCanesim soil water balance: Lebombo G1

