Evaluation of Canopy Temperature Sensors for use in Commercially Grown Cotton for Irrigation.

Introduction

Irrigation scheduling is an extremely important part of growing high yielding cotton crops. Water is a greatly limiting factor, particularly in the current climatic conditions with no general security Namoi river allocation since August 2013. The use of a suite of tools to enhance irrigation decision making processes and to be able to refine the use of our precious water resource in a most efficient manner is the aim of any water user and crop consultant. Currently most of the technology that has been widely adopted concentrates on the soil area under the plant. Canopy sensor technology has the potential to be a cost effective method of making irrigation recommendations using widely researched canopy temperature as an indicator of plant stress due to moisture requirements.

This project was undertaken after a presentation given by Onoriode Coast at a grower meeting held by Steve Madden Agriculture. The presentation illustrated positive yield results by using accumulated stress hours using canopy temperature sensors to schedule irrigation. In the initial year the intention was to be able to look at the accumulated stress hours on four cotton crops on four different farms across the Lower Namoi Valley that had canopy temperature sensors during the season. Unfortunately, the uploading of the data from the Sensor DB (provided by CSIRO) that allowed the information to be analysed using the Ausbiotic program could not happen as Sensor DB was not working from 1st January 2016 until June 2016. All data is historical but is still helpful in the evaluation of the technology as an irrigation decision making tool.

Chart 1: Accumulated Stress Time 14-1-16 t0 15-3-16 Canopy Sensor 5003

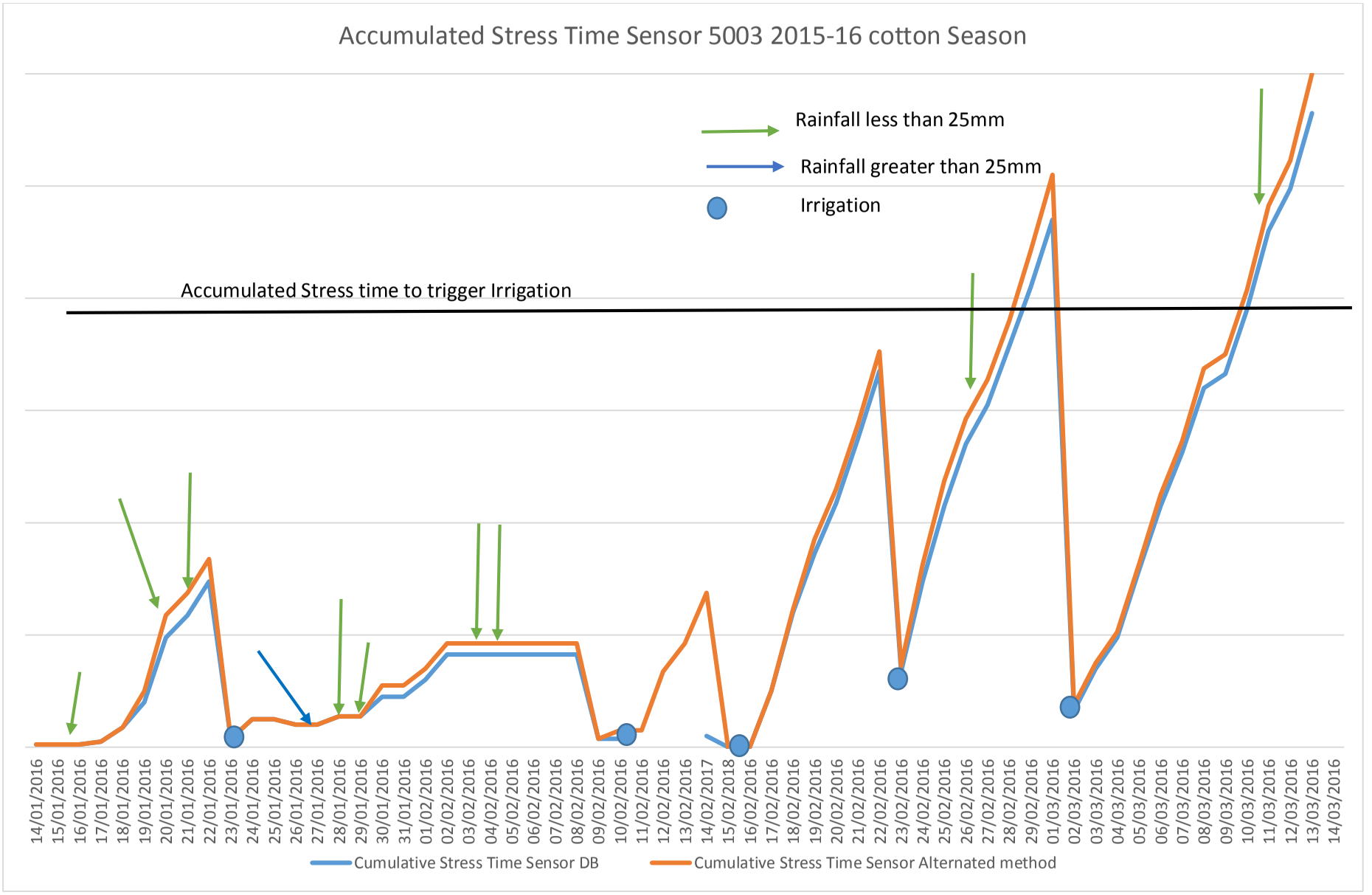


Chart2: Soil Moisture Probe Data associated with Sensor 5003

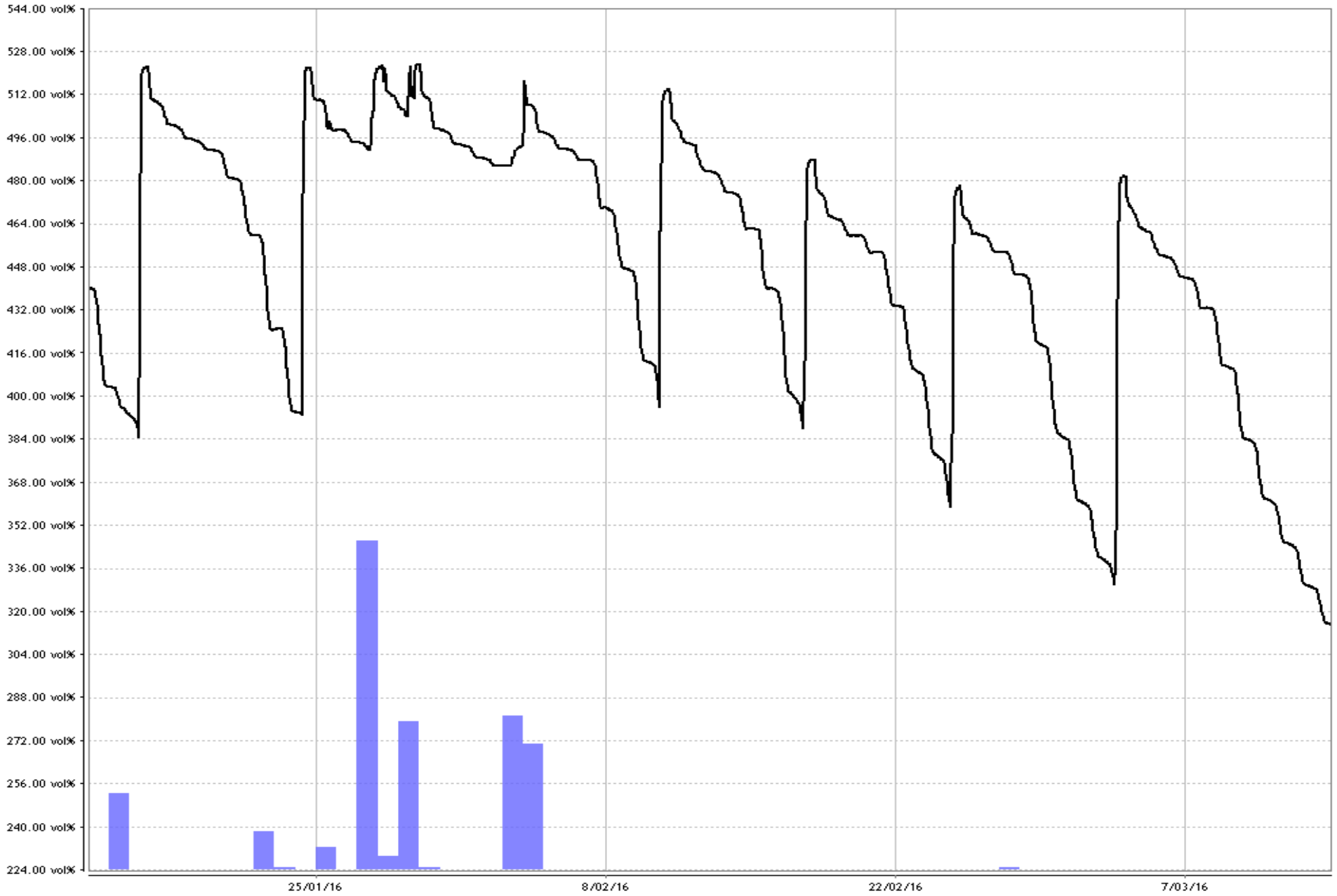


Chart 3: Accumulated Stress Time 24-12-15 to 15-3-16 Canopy Sensor 5002

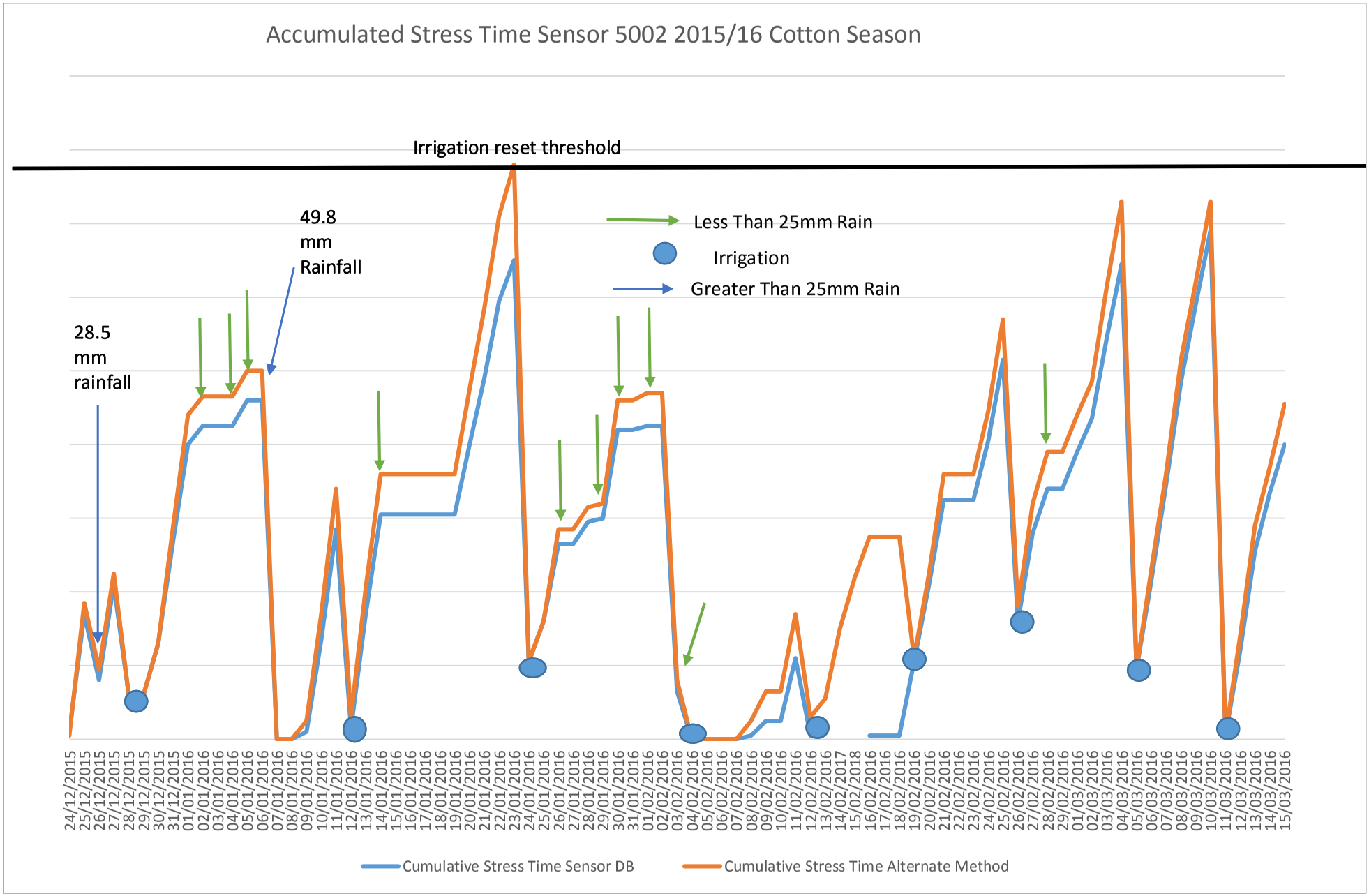


Chart4: Soil Moisture Probe Data associated with Sensor 5002

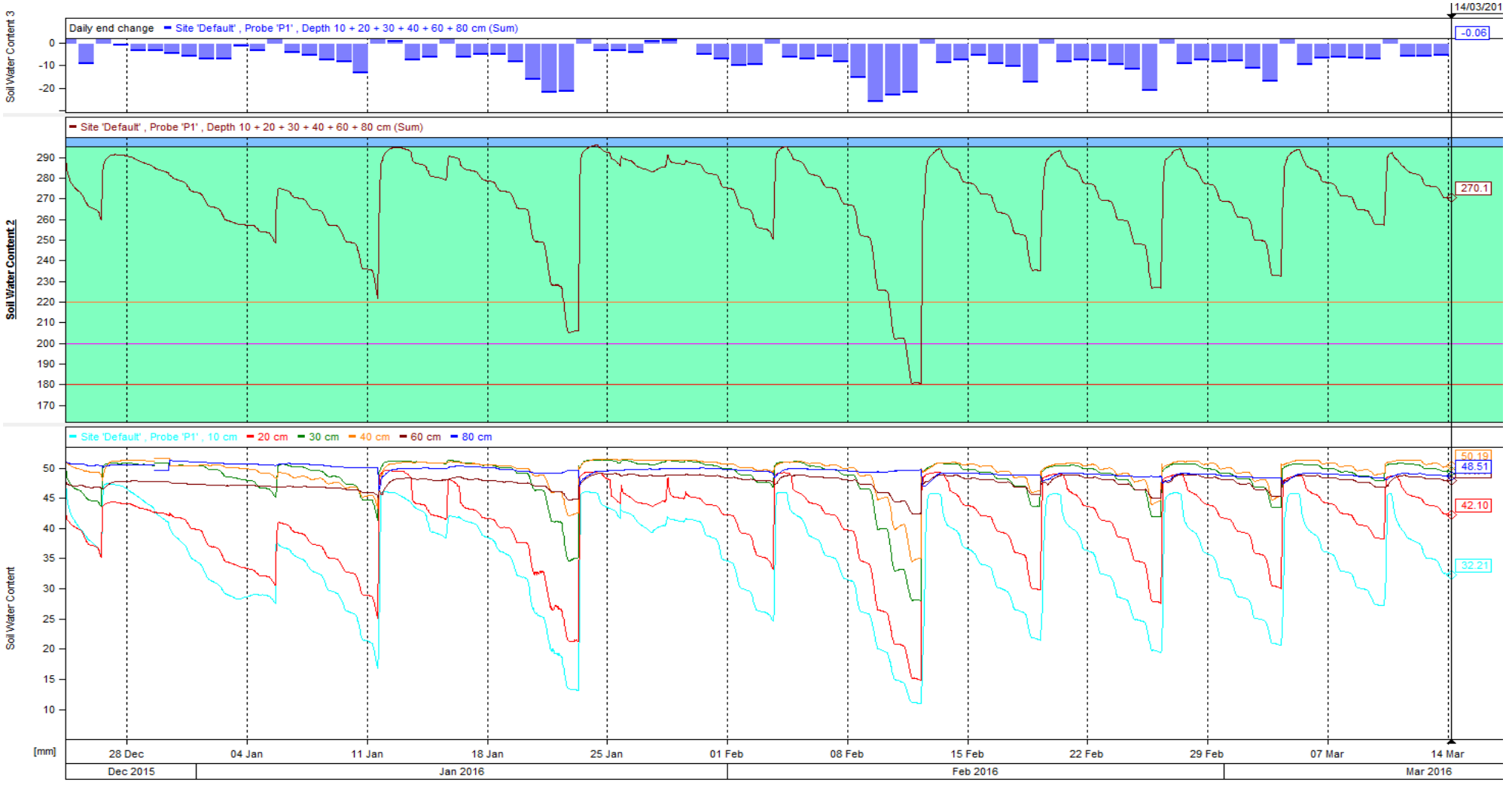


Chart 5: Accumulated Stress Time 14-1-16 to 15-3-16 Canopy Sensor 5004

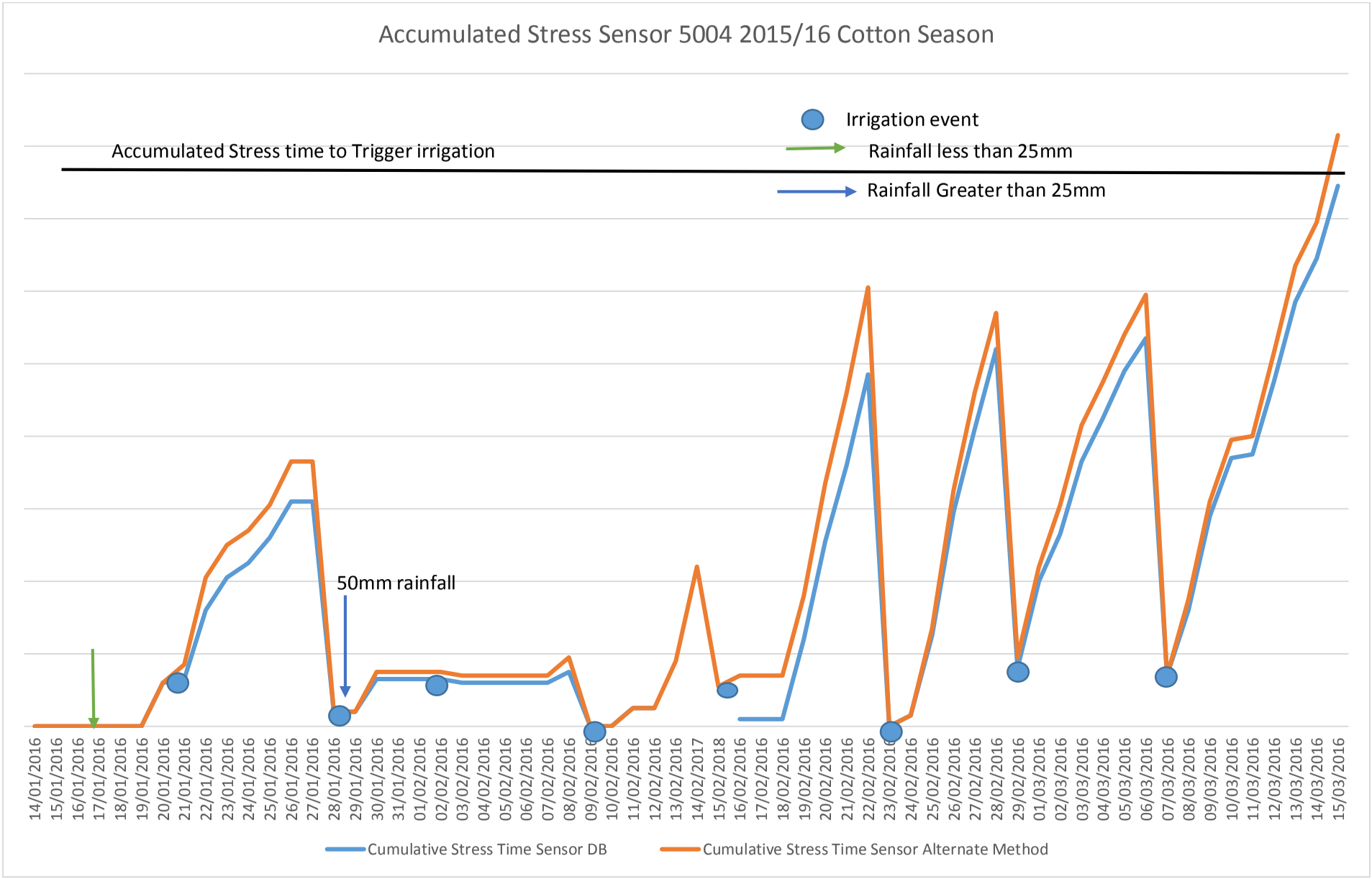


Chart 6: Accumulated Stress Time 24-12-15 to 15-3-16 Canopy Sensor 5005

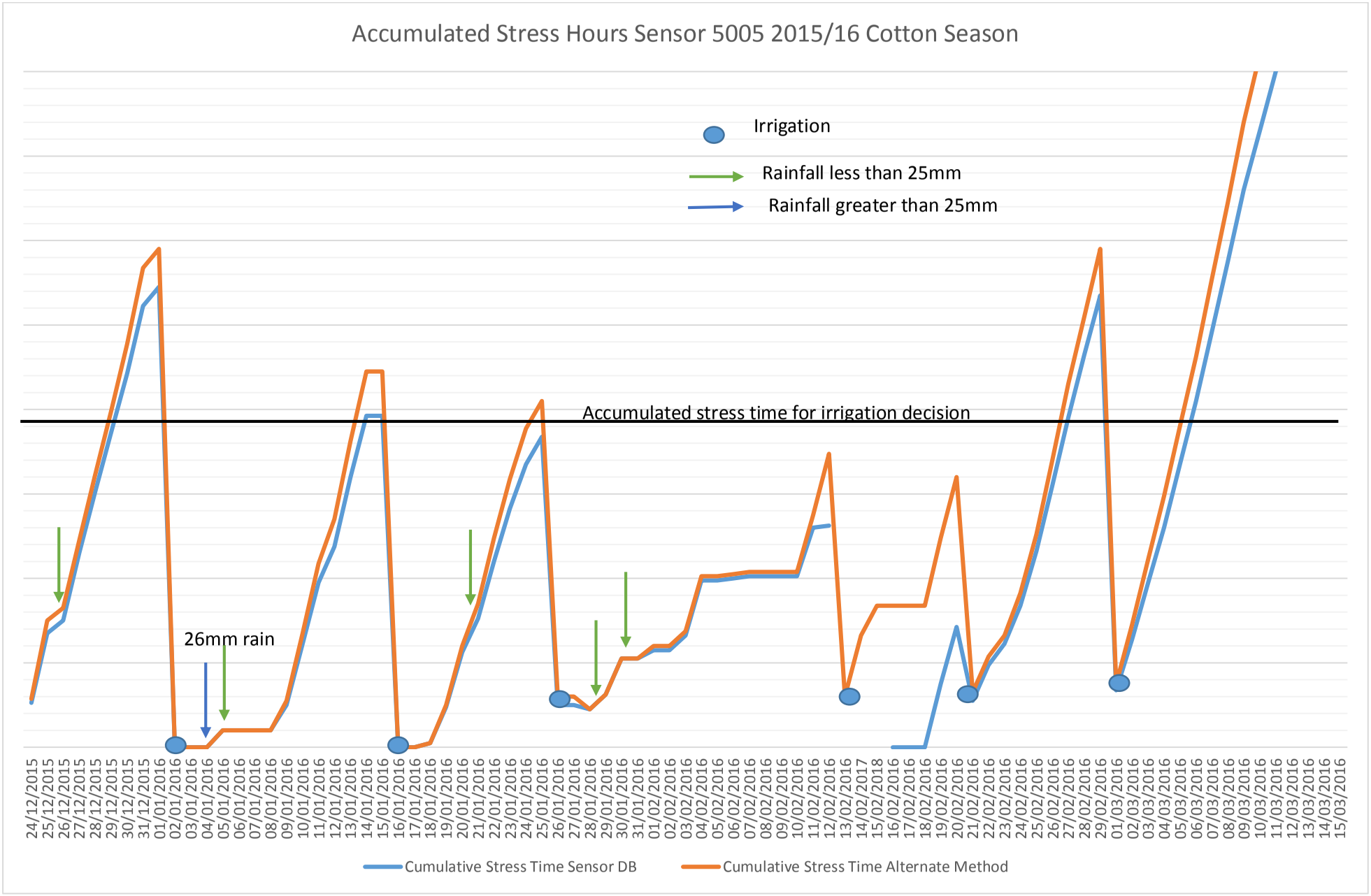
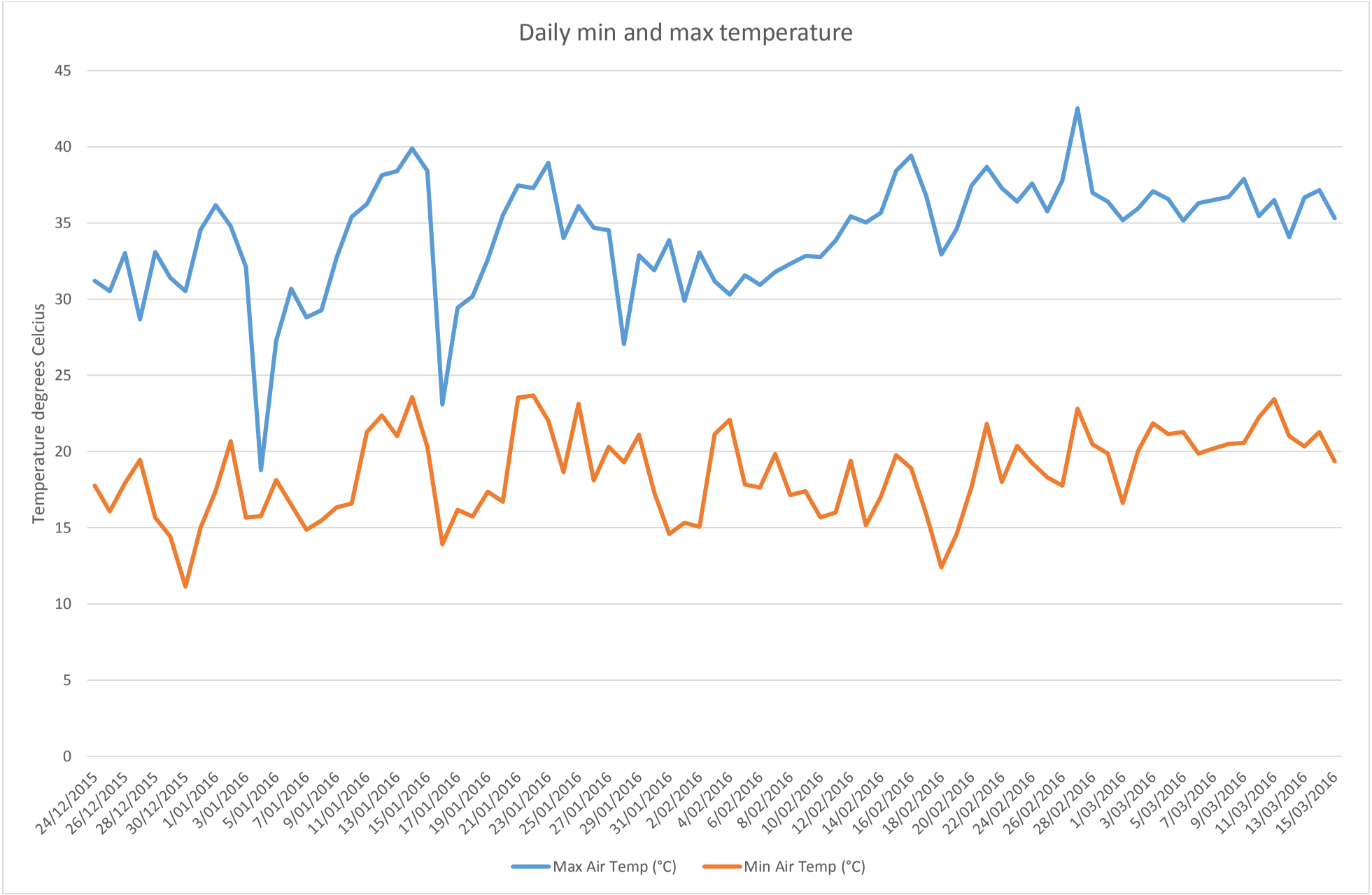


Chart 7: Maximum and Minimum Temperatures at Myall Vale Weather Station 24-12-15 to 15-3-16



Results

Results from the Sensor DB and an alternate method Arducrop to download data have been graphed above. It should be noted that no data was available from Sensor DB from 12-2-16 to 16-2-16, but the data was however available from the "Arducrop' download. The Arducrop data was kindly downloaded and supplied by Tracey May at CSIRO once the cotton season was finished and the problem was identified. There are some differences between the Arducrop data and the sensor DB data. The Arducrop data when analysed using Ausbiotic, resulted in slightly higher accumulation of stress hours. According to information provided by Hizbullah Jamali (CSIRO) the Sensor DB program uses a daylight savings timestamp which may be causing this difference. Researchers working with Canopy Temperature sensors have been using the Arducrop website for downloading project data. At this stage it is intended that access to both the Arducrop website as well as the Sensor DB database will be used for data collection during the 2016-17 cotton season.

All of the data analysed by the Ausbiotic utilised weather information from the Myall Vale Weather station with the exception of rainfall and irrigation data which was specific to each site provided by owners of each cotton crop studied. The lack of more suitable on site weather data may result in some differences in stress time accumulation following rainfall events.

Sensors 5002 and 5005 were installed on the 23rd of December 2015. Sensor 5002 was installed in a field that also had a soil moisture probe installed so that the soil moisture could be monitored as part of the existing irrigation scheduling program. There was no soil moisture probe installed in the field containing probe 5005.

Data from the sensor 5002 shows that 3 of the 9 irrigations were carried out very close to the irrigation trigger as identified by accumulated stress time point on the graph. The irrigations carried out after rainfall on the 4th January 2016 and the 17th February 2016 indicated that the accumulated stress period did not reach the threshold to trigger an irrigation. While the soil moisture data indicated that the irrigation in January may have been sightly early the soil moisture data indicated that crop had depleted the soil moisture prior to 17th February more than prior to any other irrigation across the season.

The crop in which sensor 5005 was position indicated that the irrigation carried out around the 2nd January 2016 was late if using the accumulated stress hours as an indicator of irrigation timing. Other irrigations were carried out as the accumulated stress hours approached the trigger except during the period from 4th February to the 17th February as with other sensors.

Unfortunately probe 5003 and 5004 were not installed until 14th January 2016 just before an irrigation cycle of both fields and prior to multiple rainfall events which did not allow the crop to reach the accumulated stress time required for an irrigation trigger during the late part of January.

The first irrigation done in the field that contained sensor 5003 was after some rainfall events and the air temperatures measured around this time were lower as noted in Chart 7. The following two irrigations during the period 4th to 17th February 2016. Little stress accumulation was seen by any of the sensors fitted in this period. The two final irrigations were done as the accumulated stress period reached or exceeded the threshold.

The field with Sensor 5004 the irrigations were carried out prior to the accumulated stress period being reached to trigger an irrigation. When speaking to the farmer he did suggest that they may have irrigated this field slightly earlier than they normally would have due to some issues with poorer than normal early growth of this crop. Again the period from 4th to the 17th February 2016 shows a low level of stress accumulation.

Table1, indicates that all fields were high yielding commercial crops.

Table 1: Cotton yield in fields with Canopy Temperature Sensors 2015-16 Season.

Sensor Number	Yield Ba/ Ha	Yield Ba/ ac
5002	13.20	5.34
5003	16.67	6.75
5004	13.04	5.27
5005	14.00	5.66

Discussion of Findings

4th February to 17th February 2016

Stress accumulation during the period 4/2/2016 to 17/2/2016 as measured by canopy temperature seemed very low across all of the sensors. This period is a period of high water usage by the crop as it coincides with peak boll fill and this is backed up by the soil moisture probe graphs associated with canopy sensor probe 5002 and 5003.

There was some interruption to the Telstra Mobile Data network during this period and the Database DB did have issues with no data during this period as well, however looking at the raw data from the canopy sensors there does not seem to be any issues with what was recorded.

Based on the canopy temperature sensor stress accumulation time alone in this period there would be a lack of confidence in making irrigation recommendation's solely using this method. The lack of stress accumulation identified during this period needs further investigation in the future as it does not seem to be consistent with the way that the technology works at other times.

Uniformity of Data Collected from the Canopy Sensors

The difference in the stress accumulation periods calculated data downloads from Arducrop and Database DB needs to be rectified and standardised. Whilst the stress accumulation period is claimed to be conservative as the technology is made available to more users it should be standardised. This is being addressed by researchers at ACRI.

Ease of Use of Ausbiotic.

Entering farm, crop, rainfall and irrigation data into the Ausbiotic database is relatively straight forward, however there are a couple of common issues that were encountered. Despite having 25mm entered as a rainfall event to be identified as an irrigation, at time the program would question whether a rainfall event less than 25mm was to be classed as an irrigation and would not accept that it was not (8.8mm was one amount that the program would not accept as not being an irrigation). Due to this issue there was a couple of occasions were data needed to be run as a rainfall event less than 25mm was considered a reset event.

On one other occasion when running the Ausbiotic program data would not successfully run the program using the file protocol I was given. After many hours of frustration and trying the program was shutdown overnight and when reopened the next day successfully run the data using the same files that had unsuccessfully run the day before.

Final Irrigation

The final irrigation timing noted on sensor 5002 and 5005 exceeded the irrigation trigger point for accumulated stress hours. This did not seem to affect the yields of the crop and when discussed with Hizbullah Jamali and Mike Bange seemed to be a common commercial practice. The later irrigation has some practical benefits for scheduling of the final irrigation as well as for the performance of defoliants for a clean pick.

Follow up

The use of stress accumulation period for as an irrigation scheduling tool shows great potential as the findings of Onoridw Coast and Hizbullah Jamali have shown. Unfortunately, as there were technical issues with obtaining the data this year as a tool for scheduling during the season its potential was not seen this year.

Looking at the data historically the technology at times certainly fits it purpose as a tool for making irrigation recommendations however there were times when it may not. Despite this the project will be extended to include the 2016-17 season.

The findings of the project so far will be presented at the Steve Madden Agriculture annual grower meeting which is normally attended by 25 to 30 growers in the Namoi Valley.

We are happy to report the findings of the report to any interested groups or individuals.

Thank you

I would like to thank Tracey May, Hizballah Jamalli and Mike Bange for their cooperation and support. It has been a pleasure to work with such an interested and enthusiastic team.

I would also like to thank Geoff Hunter, the LNCGA and CRDC for their continued support of this project.