FINAL REPORT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

UQ00064

StressMaster: A decision support tool to manage irrigation in real time in managed environments

PROJECT DETAILS

PROJECT CODE:	UQ00064
PROJECT TITLE:	STRESSMASTER: A DECISION SUPPORT TOOL TO MANAGE IRRIGATION IN REAL TIME IN MANAGED ENVIRONMENTS
START DATE:	01.02.2012
END DATE:	30.06.2016
SUPERVISOR:	KARINE CHENU (RESEARCH FELLOW)
ORGANISATION:	QUEENSLAND ALLIANCE FOR AGRICULTURE AND FOOD INNOVATION, THE UNIVERSITY OF QUEENSLAND
CONTACT NAME:	KARINE CHENU

Summary

Genotype-environment interactions impede wheat improvement to drought adaptation. Variability in rainfall and soil moisture leads to numerous drought patterns which all impact yields differently. By targeting representative drought patterns, scientists can identify key germplasm, traits and genes for better adaptation to their regions. A web-application, StressMaster, has been developed to assess irrigation options in order to target relevant drought patterns. The tool enables adapted management as the season advances. Applied to the Managed Environment Facilities (MEF), StressMaster has helped better manage MEF trials and target key material adapted to Australian environments.

any loss, damage, cost or expense incurred or arising by reason of any person using or relying on information in this publication. Products may be identified by proprietary or trade names to help readers identify particular types of products but this is not, and is not intended to be, an endorsement or recommendation of any product or manufacturer referred to. Other products may perform as well or better than those specifically referred to. Check www.apvma.gov.au and select product registrations listed in PUBCRIS for current information relating to product registration.

Old or Archival Reports (Projects that concluded in 2007 or earlier)

The information contained in these older reports is now several years old, and may have been wholly or partially superseded or built upon in subsequent work funded by GRDC or others. Readers should be aware that more recent research may be more useful for their needs. Findings related to agricultural chemical use are also potentially out of date and are not to be taken as a recommendation for their use.

Conclusions

The StressMaster application has been efficiently designed and implemented for usage at the MEF.

It has been successfully used to assist irrigation scheduling of two water treatments at each MEF site, each year. Over the duration of the project, all four 'typical' drought patterns occurring in the wheatbelt have been mimicked several times at the MEF.

StressMaster has also allowed the characterisation of each trial in terms of temperature, evaporative demand, radiation and rainfall. Those environmental variables, together with the drought and nitrogen (N) patterns reported by StressMaster, have been made available to MEF researchers from other projects to improve the understanding of trait adaptation.

In summary, StressMaster allows better trial management, thus speeding up the research process as the data collected are more relevant. It also allows better characterisation of the trial environments and thus adds value to the trial results, during the data analysis process. Overall, StressMaster gives greater impact for the dollars invested.

Recommendations

Make the StressMaster application available to other researchers (outside of MEF projects) and organise training sessions.

Encourage multi-disciplinary projects involving good trial management, phenotyping, environmental characterisation, physiology and genetic studies.

Couple environmental characterisation and statistical analysis for better returns on research investment.

Use environmental characterisation for other trials, such as the National Variety Trials (NVT).

Outcomes

Accurate phenotyping and screening in representative, managed environments increases the return from investment in pre-breeding programs and can lead more rapidly to higher yielding varieties in rain-fed crops. MEF users have been using and can keep using the application developed in this project to screen germplasm under water stress conditions (controlled irrigation) that mirror target production environments. Such management of the environment will lead in the medium term to greater progress in discovery and assessment of major traits, genes and germplasm relevant to adaptation to water limited environments.

Achievements/Benefits

The StressMaster application has been designed, implemented and is available on the web at http://cropdesign.net/stressmaster

StressMaster allows users to simulate the drought pattern that wheat crops have experienced in the Australian MEFs. Simulations use local weather data up to the current date and predict the likely future drought pattern for the remainder of the season based on long term historic climatic records (with an option to limit records to the same Southern Oscillation Index (SOI) phase when appropriate). Different irrigation scenarios can be tested to predict their influence on future drought events, assisting researchers to obtain desired type(s) of environments that are representative across the wheatbelt.

StressMaster also allows users to monitor the N status of the crop over the season. Hence the application also assists in decision making for fertilisation levels.

StressMaster has been used to define irrigation regimes at the MEF sites of Narrabri, Yanco and Narrabri, in 2013, 2014 and 2015. The project has increased the relevance of the phenotyping of wheat lines (benchmarking germplasm and diverse populations varying for potential adaptive traits) by allowing crops to be grown in more representative environments.

New features have been added to StressMaster at the end of the project to characterise a suite of environmental variables and estimate stress indices relative to heat, frost, drought and N limitation.

The environment of the different trials from 2012 to 2015 has been characterised in detail and the results have been made available to other MEF projects. Those results add value to the data analysis process, as they allow a better understanding of the value of traits in diverse environments.

Overall, the project has been used to add value to other MEF projects by increasing the representative value of the environments tested, and by delivering detailed information relative to key environmental indices affecting physiological traits and yields.

Other research

- There is an opportunity to extend StressMaster to be usable for other sites. Other GRDC projects could thus benefit from the application. Such extension would require development of a customer based module to enable users to enter specific soil characteristics and/or choose a soil relevant to their paddock in a soil database.
- The outputs of the StressMaster application could be systematically combined with statistical analyses to add value to research project outputs.
- There is also an opportunity to combine modelling with the phenotyping that is carried out at the MEF to develop new methodologies to better understand how wheat traits impact yields in different drought environments.
- The StressMaster application could be extended to other crops.

Additional information

Attachments

1. List of scientific and technical communications.

2. StressMaster report.

3. Project summary.