

# FINAL REPORT

DAQ00176

## Development, validation and delivery of a diagnostic framework to assist growers manage constraints to achieving water limited grain yield

### PROJECT DETAILS

**PROJECT CODE:** DAQ00176

**PROJECT TITLE:** DEVELOPMENT, VALIDATION AND DELIVERY OF A DIAGNOSTIC FRAMEWORK TO ASSIST GROWERS MANAGE CONSTRAINTS TO ACHIEVING WATER LIMITED GRAIN YIELD

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### Summary

This diagnostic agronomy initiative involved state agencies in three GRDC grains regions. The initiative aimed to create a common framework that enabled growers and advisers to diagnose constraints limiting crop yields, access reference material on the constraints and assess the economic risk of amelioration strategies.

The northern project produced a framework for wheat and chickpeas, known as CropIT. The framework used software named LUCID, an open source Content Management System (Drupal) and an embedded customised search portal. CropIT can be accessed via website (hosted by Federation University) and as a standalone app (android and IOS).

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## Conclusions

CropIT is a web and app-based resource that enables users to identify, understand and manage wheat and chickpea crop constraints that may occur in the northern region.

CropIT contains information (including videos and photos) on wheat and chickpea production considerations and constraints (pre, in and post crop), diagnostic keys, economic considerations and calculators used to assess cost of amelioration, yield calculators which predict crop yield at the beginning of the season and one that compares achieved yield with potential yield allowing for in-crop rainfall, along with a search engine that retrieves information from reputable, relevant websites.

Each component of CropIT represents a valuable tool for assisting in the identification and management of pest, disease, environmental, nutritional and physiological constraints during the cropping lifecycle for wheat and chickpeas. The benefit that CropIT has over other related tools is how these tools interact. Built from the ground up using insights and requirements provided by the target end users, CropIT facilitates the diagnosis of constraints either through LUCID or by information gained from fact sheets. It then encourages users to consider economic risks, and helps them to gain a better understanding of types of risk associated with treatment strategies.

CropIT exists on a server at Federation University, as well as an app for android and Apple operating systems. All completed components have had limited road testing with end users. This was due to delays beyond the project's control.

## Recommendations

CropIT can handle information for a number of crops. Sorghum is grown widely across the northern region. Compilation of information and a diagnostic key for sorghum constraints would be beneficial.

## Outcomes

The investment made by GRDC has ensured a lot of credible, industry reviewed information has been curated and captured in interactive information pages, which consist of a rich assortment of media. Where appropriate, information pages link to the RiskIT tool, where the economic risks associated with user-defined treatment options can be assessed. Links to appropriate and current reference material ensure users do not need to spend time looking for relevant data and can be well informed about constraints.

Northern region specific diagnostic matrices for wheat and chickpeas, capture field based observations likely to be most representative of those in the paddock. This will result in users being able to accurately diagnose in-crop constraints and adopt the most appropriate course of action. Having the content and diagnostic keys in a standalone app provides access to information and functionality without the need for an internet service, an additional benefit for those in regional areas.

## Achievement/Benefit

The northern diagnostic framework has been finalised and enables growers and advisers to:

1. Recognise pre-season factors that may impact on wheat and chickpea crop yields.
2. Review an extensive collection of information on crop yield constraints quickly and efficiently.
3. Have improved ability to diagnose wheat and chickpea in-crop constraints.
4. Understand the cost and risk around crop constraint amelioration options.
5. Readily access reputable information published online worldwide.

All of the above allows for more informed decision making.

The diagnostic framework exists as a website and app (android and IOS) and has been named CropIT. The brand CropIT has been registered and approved. CropIT has an open source Content Management System (CMS) and uses software named LUCID.

The project team worked closely with the southern and western projects to ensure a national framework appropriate for all three GRDC grains regions was established. While initially all projects envisaged one national diagnostic page, with links to the three regional nodes, project progress meant each project built its own websites, which are not linked. The northern framework, CropIT, is intuitive to use. Considerable effort was put into extensive consultation with target end users prior to building the framework. As a result, it promotes ease of access to information and functions, and uses nomenclature consistent with that used by end users.

An important aspect of the CMS is that it allows content creators to add and edit information in a live environment, thus there is no time delay in publishing new and important information. Being a web-based system, all information becomes live at the time of publishing. This characteristic removes any application version ambiguities and ensures users are viewing the most recently updated content.

Significant investment was made by all three projects to upgrade the user and mobile interfaces of LUCID, which has added to its ease of use. Based on feedback from northern grains region researchers, advisers and extension officers, who reviewed the wheat diagnostic key developed by the Department of Agriculture and Food in Western Australia (DAFWA), the northern project team developed a wheat and chickpea diagnostic key more suited to the northern region. Industry professionals and experts volunteered significant time and resources to ensure the key was sufficiently accurate to make a correct diagnosis.

Unlike the western diagnostic key for wheat and canola that uses a set pathway to diagnose, the northern wheat and chickpea keys allow users to select from either crop symptoms, individual plant symptoms, grain abnormalities or insect pests observed in the paddock. Each item in the LUCID key links to a corresponding fact sheet that contains detailed information on the constraint. In addition, a table of similar constraints is provided on many fact sheets to assist in reaching the correct diagnosis. This design allows many access points, ensuring it is a resource for a greater range of users.

Also unique to the northern project are two yield calculators, named CropARM and Your CropARM. CropARM predicts crop yield for your location based on a number of parameters which you set including time of sowing, nitrogen (N) inputs, and plant available water capacity (PAWC). CropARM can be used post-season to reflect on the difference between achieved and potential yield, accounting for in-crop rainfall between sowing and flowering.

The project engaged industry experts and personnel located across the northern region to review and guide the development of CropIT throughout this work. This was done online and through several face-to-face meetings. Many key researchers working for the Department of Agriculture, Fisheries and Forestry (DAFF) in Queensland (QLD) and the New South Wales Department of Primary Industries (NSW DPI), as well as private advisers (herbicide and nutrition), were engaged to ensure content was accurate and appropriate for the current farming system. An example of this would be chickpea sowing decisions, where historically chickpeas were sown on wide rows, but recent research has meant there is an industry shift back to narrow rows.

The type of soil used to grow crops can influence prevalence of constraints. There are very few references available that make the link between soil type properties and what this means for possible crop constraints. Unique to CropIT is a synopsis of soil types found across the northern grains region. Soil properties and characteristics have been interpreted and contextualised for what these may mean for wheat and chickpea production.

The search engine was built as part of a legacy strategy. Once the project was completed, the search engine would ensure users of CropIT were able to source up-to-date information. Content contained in CropIT information pages is unlikely to date, however emerging information published on the internet will not be linked to CropIT without a curator managing the site. The search engine has been customised to search the internet for specific information in relevant and credible locations, such as journals, QLD DAFF and GRDC. Numerous information sites were identified and indexed during this project. When relevant content is added to these external websites, the engine identifies them and directs users to them. The search engine also removes broken hyperlinks, which may occur if resources are moved or updated, thus improving user experience.

Feedback from potential users indicated that identifying the cost and benefit of amelioration decisions was vital to assist with making sustainable and profitable decisions within risky environments. The northern team developed an easy to use back-of-envelope risk analysis tool called RiskIT. Once an in-crop constraint has been identified, an amelioration decision needs to be made with respect to the potential yields with and without control, crop prices, likely control efficacies and costs of each option. RiskIT provides the expected net benefits, returns on investment (ROI), best and worst case results, and the likelihood of breaking even, making a loss, as well as achieving a minimum ROI, in a Table format and various graphical forms, based on a user's preference. In a similar vein to the development of other elements of CropIT, this was achieved through extensive engagement with industry stakeholders throughout the project. To further support industry decision makers, three video tutorials were drafted on how to use and understand RiskIT and other economic consideration not captured by RiskIT was provided. The end product has been extensively road tested with a range of potential users, including university students, experienced advisers, and growers with very positive feedback on increasing the understanding of economic returns and risk when making amelioration decisions.

## **Intellectual Property Summary**

GRDC has a contract with Federation University to ensure ongoing (2-3 years) hosting of CropIT.