FINAL REPORT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

UQ00069

Best practice cereal production information audit and cereal agronomy literature reviews in the Northern Grains Region

PROJECT DETAILS

PROJECT CODE:	UQ00069
PROJECT TITLE:	BEST PRACTICE CEREAL PRODUCTION INFORMATION AUDIT AND CEREAL AGRONOMY LITERATURE REVIEWS IN THE NORTHERN GRAINS REGION
START DATE:	03.02.2014
END DATE:	03.02.2015
SUPERVISOR:	DOUG GEORGE
ORGANISATION:	UNIVERSITY OF QUEENSLAND
CONTACT NAME:	DOUG GEORGE

Summary

The information audit and literature reviews were completed on 15 crops; lupins, maize, sunflower, durum wheat, wheat, barley, canola, linseed, faba beans, soybeans, sorghum, barley, chickpeas, field peas and maize.

The audit indicates the year of release and relevant region for each publication as well as evaluating its currency, availability, quality and suitability. The audit was supplied incrementally (every two months)to GRDC over the 12 month project period feeding reference sources and copies of all accessible materials to the GRDC Northern Region science writer and Regional Grower Services Manager - North.

Report Disclaimer

This document has been prepared in good faith on the basis of information available at the date of publication without any independent verification. Grains Research & Development Corporation (GRDC) does not guarantee or warrant the accuracy, reliability, completeness or currency of the information in this publication nor its usefulness in achieving any purpose.

Readers are responsible for assessing the relevance and accuracy of the content of this publication. GRDC will not be liable for 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.

Copyright

Grains Research and Development Corporation. This publication is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced in any form without written permission from the GRDC.

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 audit revealed that there were major differences in the number of publications for different crops. As expected, there were fewer for minor crops with the lowest number for faba beans followed by lupins. A large number was reported for sunflowers and, to a lesser extent, for soybeans, for example, compared with major crops such as wheat, barley and sorghum. As many publications had already been listed for these crops in GRDC GrowNotes before this study was completed, to do so would have been repetitive.

Many of the minor winter crop varieties are suited to higher moisture growing conditions of southern growing areas. Hence, they may not be as well suited to growing conditions in the Northern Region where drought stress is more likely and indicates the need for varieties adapted for terminal moisture stress resistance.

Recent research has indicated the value of new traits such as root architecture in row crops for crop physiology and these need to be examined in the context of crop improvement programs. Some crops have been genetically modified (GM) from food to industrial use or modified to change the value of the food product.

Some aspects of management for some crops are based on research conducted many years ago on old varieties and conventional farming systems. There is a need for more recent work. Older varieties may perform differently in modern farming systems and need modification, for example, in population and nutrition. In some crops, the pest spectrum has changed due to changes in environmental conditions.

There is valuable research done overseas which may have implications for Australia. This needs to be followed up with local research.

Recommendations

If winter minor crops such as faba beans and field peas are seen to have potential as alternative crops in the Northern Region, there is evidence provided by this project that more research especially on drought stress, may be needed to better understand their management needs and aid in selection of more suitable varieties.

For some crops, their management was determined for the most part by research undertaken decades ago. These practices may now be no longer relevant in conservation farming systems of new varieties. New research is needed to update or validate the original research in a modern day context. The audit indicated examples where specific pests and beneficial insects need further investigation, some pests have increased as a result of increased stubble loads.

More recent research in wheat and sorghum, such as the work on root architecture, indicates root traits which have potential to improve yield. Such traits may be useful to incorporate in crop breeding programs. Other crops, such as safflower have been genetically modified to change from food to industrial use. Further research will be needed to make this a success commercially.

For some crops, improvement in nutrition is necessary. For mungbeans, investigation of boron deficiency and benefits of adding nitrogen (N) at planting as well as selection of more efficient rhizobium strains is needed. More research is needed on phosphorous (P) fertiliser in view of its rising cost and low recovery rates.

There were publications reviewed, which showed promising results either overseas or in other regions of Australia. This work needs to be conducted in the Northern Region to verify its effectiveness.

A significant number of publications came from conference proceedings, some of which may not have been reviewed or were not reviewed as exhaustively as journal papers. Care needs to be taken in assuming the validity of all findings from this source and, in some cases, additional research may be required for verification. Notwithstanding this issue, most publications can be included in GRDC GrowNotes and Research Notes.

Outcomes

Economic Benefits
Improved crop yields and quality from improved management practices including fertiliser practices, sowing rates and dates, plant protection and varietal selection resulting in higher net returns.
Reduced costs where inputs are reduced to optimum levels.
Improved land values from weed education.

Environmental Benefits
Improved soil fertility and structure resulting from improved fertiliser and tillage practices, crop rotations and cover crops providing soil protection leading to reduced erosion.
Better weed management resulting in reduction in certain crop diseases.
Reduced risk of overuse and poor timing of fertiliser and pesticide applications, both of which can result in long term detrimental effects.

Social Benefits
Improved crop nutrition will increase mineral content of grains with potential benefits to human health.
Reduced weed and disease populations in some cases will reduce health issues for humans.
Higher incomes may encourage sons and daughters to remain on properties and stimulate regional centres.

Achievements/Benefits

Grain growers have been overwhelmed in recent years with a flood of information on crop management. This has stemmed from many sources, including GRDC and other project reports, reports from seed, chemical and fertiliser companies, crop notes and guides, crop accreditation manuals, agnotes, agfact sheets and decision support tools. In some areas, such as crop sowing rates and times, row spacing, fertiliser strategies and disease control methods, new information is available that has not been incorporated in best management practice (BMP) guides.

The aim of this project was to undertake a comprehensive literature capture, literature survey and information audit on fifteen crops (wheat, barley, canola, sorghum, chickpeas, lupins, mungbeans, sunflowers, maize, faba beans, safflower, linseed, durum wheat, soybeans and field peas).

Information was accessed from as wide a variety of sources as possible. These included the University of Queensland's (UQ) library databases, state and commonwealth government departments, conference proceedings, companies, as well as internet sources.

The information on two to three crops at two-monthly intervals was supplied to the Regional Grower Services Manager - North and the science writer for GRDC. Information supplied consisted of research and extension articles (with copyright indicated where applicable). The audit for each article consisted of the title, author, organisation, year and place of

publication, currency, availability, quality, suitability, rank, comment (main topic) and analysis.

A large number of topics were found in the audit, but several major themes were discovered:

There is a need for greater drought resistance in winter crops such as faba beans, lupins and field peas, which have been mainly grown in southern states on winter rainfall. In the Northern Region where winter crops rely mainly on stored moisture and often endure moisture stress during flowering and grain fill, there is a need to develop varieties with greater drought resistance. There is a need to evaluate the determinacy of current varieties of faba beans as this can affect plant population and is related to water use. Trials to show the potential advantages in the northern grain belt of *Lupinus albus* varieties are needed following long fallow studies in Western Australia (WA). Areas where additional information on field peas could be added are on comparative water use efficiencies compared with other crops. In contrast to the minor crops, there have been a number of studies in water use efficiency (WUE) in major crops, like wheat.

There were examples where useful varietal characters were identified and these could be incorporated into a crop breeding program. This is especially the case for new technology, which has revealed traits such as root architecture, for row crops such as sorghum, which was not previously considered for selection. Improved root architecture would enable the crop to better exploit the nutrient and water reserves in the inter-row space. There is also evidence for root diversity in wheat and sunflowers, which could also prove useful in selection. The advance in grain yield in South African sunflower varieties over the past 40 years ranged between 18-32kg/ha/year with a mean of 24kg/ha/year. It would be useful to obtain a similar comparison for the advances in variety yields in Australia.

The audit indicated examples where specific pests and beneficial insects need further investigation. For soybeans, more investigation is needed on aphid (*Aphis glycines*) and further studies on effect of insect pollination as yield increase as high as 40% has been found. The impact of *Riptortus serripes* on yield in mungbeans needs further investigation. For lupins, research on aphids (and associated viruses) and anthracnose is needed for the Northern Region, if these are likely to be important. Silverleaf whitefly has become a serious problem on some crops, including sunflowers.

Some diseases (e.g.fusarium) have increased under conservation farming practices, thus highlighting the need for changes in the way these types of disease are managed. These diseases may not have been important under conventional systems, but heavier stubble loads have increased the opportunity for survival of fungal spores with subsequent infection of a following crop. Investigation into the importance of ascochyta blight in field peas in the Northern Region is needed.

New industrial uses have been proposed for some crops. CSIRO is testing GM safflower with high oleic oil levels for the production of various biomaterials. To increase productivity, length of the growing season (6-8 weeks longer than canola) needs to be shortened to increase WUE as well as development of spineless varieties and weathering resistance in the head.

For some crops, improvement in nutrition is necessary. For mungbeans, investigation of boron deficiency and benefits of adding N at planting as well as selection of more efficient rhizobium strains is needed. Specific nutritional requirements are needed for field peas and its value in crop rotations. Accurate information on the P requirement of sorghum and other grain crops is warranted in view of increasing costs and poor recovery.

The information supplied could then be used in GRDC GrowNotes to provide more comprehensive and up to date sources of information to grain growers and agronomists in areas of crop management. The audit revealed instances where work overseas or in other regions of Australia may need to be verified for the Northern Region to determine its usefulness. The audit also indicated areas of research for some crops where very few trials had been undertaken.

Other research

The comprehensive literature capture, survey and information audit on 15 crops (wheat, barley, canola, sorghum, chickpeas, lupins, mungbeans, sunflowers, maize, faba beans, safflower, linseed, durum wheat, soybean and field peas) has enabled information to be fed into GRDC's GrowNotes and has potential to be used for literature reviews on each crop. The audit has revealed gaps in research findings and a need for more recent work to understand crop performance under more recently developed cropping systems.