# GRDC INVESTMENTS ADDRESSING A SELECTION OF ISSUES – HIGH RAINFALL ZONE RCSN – December 2017



**Issue No. 1 - Identify and develop high value grain crops to complement existing common crops**

Most traditional crops grown in the HRZ are bulk commodities which compete with other high volume suppliers around the world. The introduction of new high value grain crops, including pulses (e.g. chickpeas, soybeans peanuts etc.), oilseeds (linseed, safflower, evening primrose and sunflower etc.) and other options would have a positive impact and be applicable to most growers across the HRZ. The direct benefit would be increased profit, with wider gains through diversification of rotations potentially enabling alternative options for weed control, nitrogen accumulation, disease break, soil amelioration and water use. Depending on the crop, new beyond farm gate industries may emerge in handling and processing.

GRDC investments addressing this issue –

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| Collection, phenotyping and exploitation of wild Cicer genetic resources for chickpea improvement (CSP00185) | While chickpea production has expanded dramatically over the last decade to become Australia's most valuable pulse export, the Mediterranean regions in the south and west have not recovered their earlier position as the dominant production areas for this crop. In addition to Ascochyta, Mediterranean production regions pose specific adaptive challenges such as terminal drought, low temperatures during flower and podset, salinity and low pH (particularly in WA). Genetic solutions to these constraints will accelerate the spread of chickpea throughout Mediterranean Australia and address grower demands for more diverse rotations incorporating a profitable grain legume. Chickpea improvement is constrained by limited genetic and adaptive diversity, and there is a need to increase the pool of germplasm that breeders can draw on in order to develop improved varieties adapted to Southern and Western cropping regions. This project seeks to strengthen chickpea breeding efforts and act as model for the exploitation of wild genetic resources by:<br>1. Targeted collection to widen the habitat range and genetic diversity of existing collections<br>2. Extensive phenotyping of traits prioritized as limiting Mediterranean adaptation<br>3. Coordinating wild Cicer-based phenotyping and population development projects in Australia and Turkey, linking these with international collaborations involving the USA, Canada, Ethiopia and India. |
| Waterlogging and Acid soil screening of Pulses (UT00021) | To assess a diverse range of grain legume germplasm (lentil, faba bean and pea) for tolerance to waterlogging and soil acidity. |
| N fixing break-crops and pastures for high rainfall zone acid soils (DAN00191) | There is a lack of reliable nitrogen fixing break-crop options for low pH soils in the southern high rainfall zone (HRZ). Consequently a pressing need to develop reliable legume crop and forage rotation option exists<br>The three key issues driving this project are : |

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| | 1) To reduce reliance on fertiliser nitrogen;<br>2) To improve management of herbicide resistance in the important weeds of cropping systems; and<br>3) To improve integration of livestock into the local farming systems. |
| Southern Pulse Agronomy (DAV00150) | Building on previous projects through targeted research and development activities, this project will continue to contribute to the understanding of pulse growth and performance under changing environmental and management conditions. This will lead to improved yield and yield stability of pulses, ultimately leading to increased profitability and adoption of new varieties by growers. |
| Improving the profitability of pulse production through local validation of research outcomes in the Southern Region | A targeted validation trial program of significant scale to deliver local data and knowledge for the development of pulse crops suitable to areas across the southern region where research and development is limited. In collaboration with the Southern Pulse Agronomy project (DAV00150), pulse crops and constraints will be prioritised for each agro-ecological zone to develop the focus of the validation program. For example, it is envisaged that up to four of the most important pulse crops and up to four constraints will be examined in each zone where gaps exist. Local biophysical data from the validation trials and their impact on crop management, farming systems and farm economics will be made publicly available. The validation trial data will feed back into research and development activities of the Southern Pulse Agronomy project, and new knowledge will flow into the pulse extension project (PROC 9175825). In partnership with these and other GRDC projects, this three and a half year investment, starting early 2018, will deliver greater knowledge of the pulse phenotypes suited to each agro-ecological zone and management practices to optimise their production and profitability.<br><br>Expected outcome, by June 2021, grain growers, advisers and industry will have access to local trial data that address the main constraints to the production of key pulse crops in each agro-ecological zone across the southern region. These data will quantify the adaptation and performance of key pulse crops in each zone, and the benefits of traits and management practices providing adaptation to local environments and farming systems, and enduring profit. These data and supporting economic analyses will contribute to grower and advisor confidence in pulse production, and will inform optimum agronomic practices for specific pulse phenotypes through evaluation of their applicability, profitability and risk in local environments. |
| Building capacity, skills and knowledge for the pulse industry in the Southern Region: Supporting expansion of high value pulses into new areas and ensuring sustained profitability of all key pulse crops in existing areas. | Pulse crops have long been recognised as providing numerous economic and farming system benefits including: biological nitrogen fixation; providing a disease break for some foliar and soil-borne pathogens; enabling increased diversity in weed management; and providing agronomic and economic diversity in enterprise mix.<br><br>Whilst immediate opportunities for expansion in pulse area in the Southern Region may be apparent, and are in-fact occurring, the willingness of growers to adopt is often limited due to a range of factors including: perception of risk and complexity in production; concerns over the longer-term sustainability of pricing as Australian production increases; lack of local agronomic knowledge and support; agronomic challenges relating to disease, weed and pest management; seed-cleaning, storage and marketing issues; and required investments in plant and infrastructure. Pulses are considered by many to be complex to manage and poor agronomy subsequently poses a risk to the profitability of inexperienced growers.<br><br>The present shortage of specialised knowledge and skills relating to pulse crop agronomy within industry necessitates targeted investment in capacity building within the advisory sector to build future industry leaders and provide agronomic support to growers through the multiplier effect. In building this capacity special consideration needs to be given to the demand on existing recognised experts within the pulse industry, specifically key personnel within the research community.<br><br>In addition, a targeted program to directly build the skills, knowledge and confidence of growers in the production of high value pulse crops, focusing upon lentil and chickpea, is required to hasten the successful expansion in area planted to these crops in the Southern Region. It is proposed that a participatory approach to knowledge transfer is implemented, targeted to identified geographical areas for expansion where these crops may be well adapted.<br><br>This investment involves delivery of discussion groups, training, workshops and communication materials to realise long-term farming system and financial benefits to build capacity, skills and knowledge for the pulse industry in the Southern Region. |

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| Increasing the effectiveness of nitrogen fixation in pulse crops through development of improved rhizobial strains, inoculation and crop management practices | As well as generating useful income, pulses provide significant benefits to following crops, including nitrogen (N) fixation boosting N supplies to following crops. Pulses are estimated to fix about 120 kg N/ha or more than 220,000 tonnes N across Australia, worth about $220 M each year. However, not all pulses are well nodulated and fix N to their potential, especially on acidic soils. It was recently estimated that N fixation could be increased by 25%.<br><br>The aim of this investment is to enhance nitrogen (N) fixation of winter pulse crops through improved rhizobial strains for hostile soils and enhanced inoculation practices that minimise the potential impact of fertiliser and crop protection applications, and maximise rhizobial survival, nodulation and nodule function. These improvements will broaden the adaptation of pulses onto soil types and areas where they are currently not widely cultivated. This three year R&D investment, starting early 2018, will be supported by a separate extension and communication investment to promote awareness of nodulation and N fixation in pulses, and adoption of best inoculation practices.<br><br>Expected outcome - by June 2022, growers in the southern region have access to improved rhizobial strains compared to the current commercial inoculums for winter pulse crops, plus best management practices for optimising nodulation and nitrogen (N) fixation, including minimising the impact of fertiliser and crop protection applications.<br><br>These innovations will enhance N fixation and production of pulse crops with flow on benefits to following crops, and enable expansion of pulses onto soil types and in agro-ecological zones where they are currently not widely grown. |
| The potential of the pearl lupin (Lupinus mutabilis) for southern Australia (UWA00043) | Develop a range of domesticated breeding material with appropriate grain quality and agronomic characteristics that could form the basis of the first pearl lupin cultivar release for Australia. Research data on pearl lupin genotype performance on a range of soil-types, waterlogging, pH and herbicide tolerances, and reaction to the major lupin diseases and pests. Conduct whole grain and kernel proximate analysis on a range of genotypes grown in a range of environments; protein concentrate yields and feed performance data for fish (salmonid - rainbow trout). |
| Identifying low pH tolerance and effective rhizobia for wild Cicer to improve adaptation to acid sandy soils (UMU00044) | Identifying low pH tolerance and effective rhizobia for wild Cicer to improve adaptation to acid sandy soils (UMU00044)<br>The objective of research undertaken in this project is to determine if there are wild relatives of chickpea (C. arietinum L.) that could grow on acid sandy soils (pH CaCl2 below 5.5 - the current recommended soil acidity threshold for successful chickpea production). These accessions then have potential to be included in the chickpea breeding program specifically to target acid soils in Western and Southern cropping regions.<br>Consideration is currently being made to vary to the existing UMU00044 project to expand the range of soils targeted to include more moderately acidic soil types. Specifically, the variation would enable the project to evaluate the suitability of existing wild Cicer germplasm for loam to clay-loam textured soils where cropping practices have led to moderate surface acidification. |

**Issue No. 4 - Poor harvester efficiency (including grain loss) is impacting on profitability.**

The set up and operation of the header can have an impact on throughput and how much grain is 'lost' during harvest. Variability in machines, operator skill, crop moisture, canopy structure and weather conditions all impact of harvest efficiency. Setting and adjusting machinery to maximise grain capture while operating at optimum machine performance is a skill. Providing expert advice to growers and contractors would enhance profit by ensuring the maximum amount of grain is captured for the costs incurred, both in expenditure to grow the crop but also to get the crop off in a timely manner.

<u>GRDC investments addressing this issue –</u>

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| GRDC Stubble Initiative | Eight commercial harvesters were tested between 2014 and 2016 on farm scale strips across the South West Slopes and Riverina to examine the effect of cutting height (15 to 60cm) on harvest efficiency and grain yield. The harvesters included a Case 7240, Case 8240, John Deere 5680, Case IH1920, John Deere 9770, Case 8230 and New Holland 8090. A prototype Integrated Harrington Seed Destructor (iHSD) was also tested in Temora, NSW in December 2015, Inverleigh in December 2015 and Furner, SA in January 2016. |

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| | Using a stripper front or harvesting high is the quickest and most efficient method that should result in less residue that needs to be threshed, chopped and spread by the harvester. Harvesting high (40 to 60cm) compared to 15cm increased grain yield and harvester efficiency by reducing bulk material going through the header and reduced harvests costs by 37 to 40%. As a general rule, there is a 10% reduction in harvest speed for each 10cm reduction in harvest height. Slower harvest speed across a farm also exposes more unharvested crop to the risk of weather losses (sprouting, head/pod loss, lodging) during the harvest period.<br><br>There is substantial evidence indicating wide spread resistance or partial resistance of ARG to a wide range of herbicide groups across south eastern Australia (Broster et al. 2011). Harvest weed seed control (HWSC) which includes narrow windrow burning, chaff carts, chaff lining, direct baling, and mechanical weed seed destruction is an essential component of integrated management to keep weed populations at low levels and thus slow the evolution and spread of herbicide resistant ARG. HWSC requires crops to be harvested low in order for weed seeds to be captured in the chaff fraction from the harvester, and if practiced provides an additional reason to harvest low. The prototype Integrated Harrington Seed Destructor (iHSD) was tested at a constant speed of 4km/hr to compare the efficiency and cost with non-weed seed destruction methods. No significant difference was found in grain yield when harvesting at 15cm compared with 30cm at 4km/hr, but there a 9% increase in engine load and 11% reduction in fuel efficiency. However, when the weed seed destructor was activated, there was a 33% increase in engine load which resulted in a 40% reduction in the fuel efficiency of the header. |

**Issue No. 7 - Methods to reduce reliance on foliar and in furrow fungicides**

Description: The reliance, prophylactic and repeated use of a limited number of fungicide groups has increased the risk and rate of development of fungicide resistance. The development and adoption of integrated approaches to disease management are required to reduce the reliance and over-use of fungicides. Genetic resistance is essential to reduce the reliance on fungicides to manage diseases. The development of new varieties which provide improved resistance to a range of important diseases is required. The adoption of non-chemical control strategies which reduce inoculum levels prior to fungicide applications are also critical to reducing selection pressure and fungicide resistance.

GRDC investments addressing this issue -

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| Centre for Crop and Disease Management (CUR00023) | CCDM Program 1 - Project A - Early detection and management strategies for fungal diseases<br>CCDM Program 1 - Project B - Best management practices for fungal disease control<br>CCDM Program 1 - Project C - Economics of disease management and capacity development.<br>CCDM Program 2 - Extension and engagement<br>CCDM Program 3 - Septoria nodorum blotch biology<br>CCDM Program 4 - Tan (yellow) spot<br>CCDM Program 5 - Net form of Net Blotch Functional Genomics<br>CCDM Program 6 - Sclerotinia Stem Rot of Canola and lupins<br>CCDM Program 6 - Ascochyta blight of pulses<br>CCDM Program 8 - Durable Resistance to Powdery Mildew<br>CCDM Program 9 – fungicide resistance |
| Benchmarking resistance and managing Septoria tritici Blotch and Leaf Rust (FAR00004A) | The research will combine field research on fungicide performance with laboratory testing of the fungal populations pre and post fungicide application in the regions where these diseases are most problematic. It will also give an early warning system across the prevalent regions for detection of resistant mutants following SDHI and strobilurin application. |
| Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in New South | Objectives of this investment –<br>1. characterisation of the frequency of insensitivity in Septoria tritici blotch populations to azole fungicides, and develop and communicate information to sustain the effectiveness of fungicides against this pathogen;<br>2. survey of high risk regions;<br>3. annual monitoring of STB monitor for further evolution of mutations in response to changed fungicide use patterns and determine geographical distribution patterns of phenotype sensitivity |

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| Wales(DAN00177) | groups against key fungicides;<br>4. phenotype isolates to define sensitivity baselines for STB across a range of fungicide dose rates against a minimum of two registered modes of action;<br>5. sequence genes known to be implicated with fungicide resistance in STB;<br>6. measure efficacy of currently registered fungicides and new actives for the treatment of Septoria tritici blotch against known mutations using glasshouse pot assays;<br>7. deliver up-to-date knowledge on fungicide resistance management strategies and molecular tools for each disease;<br>8. develop a rapid molecular assay for the known fungicide resistance mutations |
| Crown Rot Resistance – a range of investments | 1. Genetic solution to crown rot in barley (CFF00010)<br>2. Identification and Utilization of Novel Sources of Resistance to Crown rot and the Root Lesion Nematodes in Adapted Spring and Durum Wheat (CIM00018)<br>3. Integrated Genetic Solutions to Crown Rot in Wheat (US00075)<br>4. Managing crop diseases - Improving crown rot resistance in durum (USQ00013) |
| Rust Resistance – a range of investments | 1. ACRCP- CIMMYT delivery of resistant germplasm and surveillance for resistance in Australian cultivars (CIM00017)<br>2. Triple Rust Resistance Project – ACRCP (CSP00161)<br>3. ACRCP- Molecular marker program CSIRO/University of Sydney/CIMMYT collaborative project (CSP00164)<br>4. Advancement of new genes for stem and leaf rust resistance from uncultivated relatives of wheat -continuation (UA00141)<br>5. Australian Cereal Rust Control Program - Durable genes (US00063)<br>6. Australian Cereal Rust Control Program - National breeding support (US00064)<br>7. Accelerating the utilisation and deployment of durable adult plant resistance to leaf rust in barley (US00070)<br>8. Development of genetic tools for Australian barley crops against leaf rust (US00074) |
| Nematode Resistance – a range of investments | 1. Genetic control of nematode species affecting major crops - Germplasm enhancement for nematode control in cereals and pulses (USQ00019)<br>2. Assessing collections of wild chickpea relatives for resistance to root-lesion nematodes (USQ00017)<br>3. Collection, phenotyping and exploitation of wild Cicer genetic resources for chickpea improvement (CSP00185)<br>4. Genetics of wild germplasm, gene-pool expansion and integrated ASSD approach to enhance adaptive potential in chickpea (CUR00024) |
| Multiple Resistances - a range of investments | 1. Focused Improvement of Durum Wheat Germplasm from CIMMYT for Yield Potential, Drought and Biotic Constraints (CIM00020)<br>2. Reverse genetics for the development of wheat cultivars with improved resistance to necrotrophic pathogens (CSP00155)<br>3. Managing on-farm biosecurity risk in wheat through pre-emptive breeding (DAN00174)<br>4. National Barley Foliar Pathogen Variety Improvement Program (DAQ00187)<br>5. Improved resistance to oat pathogens and abiotic stress management (DAS00133)<br>6. Mining the ICARDA germplasm collection for biotic and abiotic priority traits (ICA00010)<br>7. Pre-emptive chickpea pre-breeding for biotic stresses and germplasm enhancement for abiotic stresses (ICA00011)<br>8. Managing on-farm biosecurity risk through pre-emptive breeding: the case of rust in field pea and lentil (CUR00020) |
| Virus Resistance – multiple investments | 1. New tools and germplasm for Australian pulse and oil seeds breeding programs to respond to changing virus threats (DAN00202)<br>2. Effective control of barley yellow dwarf virus (BYDV) in wheat (UT00030) |

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| Septoria Resistance | Effective genetic control of Septoria tritici blotch (DAN00203) |
| Stagonospora Resistance | Effective genetic control of Stagonospora nodorum blotch (DAW00248) |
| Phytophthora root rot Resistance | Managing Crop Disease - Improving chickpea pathogen resistance (DAN00172) |

**Issue 8 - Disease management package for sclerotinia, blackleg and powdery mildew in canola**

Foliar diseases are considered to be a significant factor limiting yield potential of canola crops in the high rainfall zone. The main foliar diseases include blackleg flower, stem and pod infections, sclerotinia and powdery mildew. Conditions in high rainfall environments favour the infection and spread of these diseases in canola crops. In recent years, there has been an increase in the range of diseases and levels of infection in canola crops across the high rainfall zone. An improved understanding of the epidemiology, yield loss and economic impact is essential to the development of cost-effective disease management strategies.

GRDC investments addressing this issue -

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| National canola pathology program (UM00051) | The National Brassica Germplasm Improvement Program (NBGIP) has defined priority traits for germplasm enhancement to support and improve the Australian canola industry. These are alternative sources of blackleg resistance, drought and heat tolerance, pod shatter resistance and improved oil content and stability. This project provides Australian Canola breeders with new or improved sources of open-pollinated germplasm, an improved understanding of the genetics underlying these key priority traits together with appropriate breeding tools.<br><br>Research undertaken within the NBGIP will focus on:<br>Blackleg<br>The genetics underlying blackleg resistance, especially for adult plant resistance, are poorly understood. Moreover, no new sources of seedling resistance are available for breeding use. As the pathogen has the ability to overcome resistance in canola varieties, several seedling resistance genes present in the current Australian canola varieties have become ineffective in providing resistance under field conditions. Therefore, new sources of resistance are constantly required. NBGIP will identify new sources of resistance in diverse canola germplasm accessed from overseas as well as in relatives of canola such as turnips and cabbages. Quantitative (adult plant) resistance conferred by a number of minor genes is likely to be a more sustainable approach to maintaining resistance and prolonging the effectiveness of major genes. Therefore, this project will optimise methods to readily screen for the presence of minor genes.<br><br>Drought and Heat<br>These are the major environmental stresses limiting canola plant growth and productivity in Australia. Extended period of drought and high temperatures especially at flowering and pod-filling stages can lead to significant crop losses. The NBGIP project will investigate genetic variation for various component traits implicated in drought and heat tolerance such as grain yield, above- ground biomass production, early seedling vigour, pollen abortion and physiological traits.<br><br>Shattering<br>Despite extensive breeding by canola breeding programs, high levels of pod shattering still occur and significantly impact grower profitability. This project will evaluate diverse canola germplasm accessed from overseas including turnips and Ethiopian mustard and develop genetic solutions to reduce yield losses due to pod shattering.<br><br>Oil yield<br>Canola has the potential to deliver farming systems benefits in the Northern region (as a break crop for controlling take-all, crown rot and nematodes). However, it is not widely grown since many growers regularly have problems meeting minimum oil content (42%) with currently available cultivars. NBGIP will evaluate diverse germplasm accessed from Germany and elite varieties from Australia for improved oil content and stability attributes for target environments across Northern NSW. |

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| Upper Canopy Blackleg Infection (SFS00034-B) | Four trial sites will be established in each of SA and Victoria and two experiments will be conducted at each site.<br><br>**Experiment 1** will evaluate the effect of Prosaro® at a range of growth stages (after the recommended 4-6 leaf stage) on blackleg control, yield and oil content –<br>• various timings up until bud emergence growth stage for normal crown canker control<br>• plant elongation/flowering (to protect the flowers, stems and pods)<br>• understand economic threshold for spraying<br><br>**Experiment 2** after consultation with crop protection companies proof-of-concept studies will be undertaken to screen the potential of a range of alternative and cost-effective chemical control options that will provide protection against late blackleg infection control and crown canker. The scope of this work is limited to evaluation of products which are planned for registration and commercial launch within a maximum of 24 months from project initiation. |
| Centre for Crop and Disease Management (CUR00023) – research program 6 - Sclerotinia stem rot of canola | To identify opportunities to create canola varieties that have increased resistance to Sclerotinia stem rot.<br><br>Canola varieties with different disease ratings were screened with 11 genetically distinct WA Sclerotinia sclerotiorum isolates. No significant difference were observed in the response to the 11 isolates. Screened a subset of 100 spring varieties for its resistance to SSR under controlled conditions and in the field. Preliminary analysis indicate different response to SSR across the 100 varieties tested in this population. We will repeat these experiments in controlled and field conditions in 2017 to confirm the presence of genetic resistance in canola germplasm and to establish a set of differentially responding canola lines.<br><br>A complete Sclerotinia sclerotiorum genome assembly and annotation has been completed. 12 Western Australian SSR isolates were re-sequenced and comparative whole genome analysis to the reference genome and isolates from overseas is underway.<br><br>Research investigating reports that hybrid varieties of canola are more susceptible to SSR development than OP varieties have commenced. An initial controlled environment experiment has been conducted to determine whether hybrids are more susceptible than OP varieties and this did not show a correlation. In 2017, we aim to repeat these experiments in controlled conditions and in the field. |
| Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease **(**DAW00229) | In lupins investigated the potential benefit from fungicide application for reduction of sclerotinia, using products and timings known to be effective in canola. Responses in disease incidence, severity and yield were recorded, indicating potential for this approach to be beneficial in high disease pressure scenarios. |
| Emerging foliar diseases of canola (UWA00170) | A mixture of surveys, glasshouse and field experiments are being undertaken to address the objectives above and to produce the outcomes below. An Australia-wide survey of all four foliar diseases plus blackleg leaf disease has been completed in 2015, repeated for 2016, and will again occur in the 2018 season. Molecular studies suggest that there may be variations in each of the four different pathogen populations across Australia and that there may be the need to identify canola resistances that are effective across this pathogen variation. Australian canola varieties with best resistances to the populations of the white leaf spot and powdery mildew pathogens have now been identified in field and/or glasshouse studies and the same is now being done for downy mildew and will be done later for Alternaria to provide canola growers choice in using more resistant varieties in situations where any one or more of these diseases are considered a significant issue. Alternaria appears to be a complex of different species and studies to define the relative importance of the different species are now underway. New understanding on the environmental and plant age influences for the first time can explain the restriction of severe powdery mildew epidemics to northern NSW and WA and similar studies are planned for the other diseases so that we can understand why the incidence and severity of each disease varies across Australia. |

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| Blackleg NVT ratings (MGP00004) | Annual provision of canola blackleg ratings to industry<br>Provide a service to private seed companies for the testing of their lines with the addition of seed dressing fungicide (fluquinconazole).<br>Updating the National Blackleg Management Guide<br>Establish 34 blackleg population monitoring sites across all canola growing regions in Australia 3) to track changes in frequency of virulence towards specific resistance genes (resistance groups). Sites will be sown alongside NVT yield sites |

**Issue No. 8 - Develop new traits for improved canola varieties (including non-GM varieties)**

Identified traits of new and improved canola varieties for the high rainfall zone include –

- Physiology and phenology
  - long season spring types
  - range of flowering times
  - winter types
  - early vigour
  - lodging resistance
  - yield
  - specialty oils
  - shattering resistance
  - pollen abortion resistance
- Herbicide tolerance
  - Imi + triazine Herbicide tolerance
  - Imi herbicide tolerance
  - Triazine + glyphosate herbicide tolerance
  - Glyphosate + imi Herbicide tolerance
  - Imi + triazine + glyphosate Herbicide tolerance
  - Clethodim tolerance
- Pest resistance
  - RLEM, Lucerne Flea, Green peach aphid, false wireworm, slaters and slugs
  - Diamondback moth, Native budworm
- Disease resistance
  - Blackleg
  - Sclerotinia
  - White leaf spot
  - Viruses – Beet Western Yellow Virus and Turnip Mosaic Virus
  - Abiotic stresses
  - Heat, frost, drought
- Sub soil constraints
  - acidity, salinity and sodicity

<u>GRDC investments addressing this issue -</u>

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| National Brassica Germplasm Improvement Program | The National Brassica Germplasm Improvement Program (NBGIP) has defined priority traits for germplasm enhancement to support and improve the Australian canola industry. These are alternative sources of blackleg resistance, drought and heat tolerance, pod shatter resistance and improved oil content and stability. This project provides Australian Canola breeders with new or improved sources of open-pollinated germplasm, an improved understanding of the genetics underlying these key priority traits together with appropriate breeding tools.<br><br>Research undertaken within the NBGIP will focus on:<br><u>Blackleg</u><br>The genetics underlying blackleg resistance, especially for adult plant resistance, are poorly understood. Moreover, no new sources of seedling resistance are available for breeding use. As the |

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| | pathogen has the ability to overcome resistance in canola varieties, several seedling resistance genes present in the current Australian canola varieties have become ineffective in providing resistance under field conditions. Therefore, new sources of resistance are constantly required. NBGIP will identify new sources of resistance in diverse canola germplasm accessed from overseas as well as in relatives of canola such as turnips and cabbages. Quantitative (adult plant) resistance conferred by a number of minor genes is likely to be a more sustainable approach to maintaining resistance and prolonging the effectiveness of major genes. Therefore, this project will optimise methods to readily screen for the presence of minor genes.<br><br>Drought and Heat<br>These are the major environmental stresses limiting canola plant growth and productivity in Australia. Extended period of drought and high temperatures especially at flowering and pod-filling stages can lead to significant crop losses. The NBGIP project will investigate genetic variation for various component traits implicated in drought and heat tolerance such as grain yield, above-ground biomass production, early seedling vigour, pollen abortion and physiological traits.<br><br>Shattering<br>Despite extensive breeding by canola breeding programs, high levels of pod shattering still occur and significantly impact grower profitability. This project will evaluate diverse canola germplasm accessed from overseas including turnips and Ethiopian mustard and develop genetic solutions to reduce yield losses due to pod shattering.<br><br>Oil yield<br>Canola has the potential to deliver farming systems benefits in the Northern region (as a break crop for controlling take-all, crown rot and nematodes). However, it is not widely grown since many growers regularly have problems meeting minimum oil content (42%) with currently available cultivars. NBGIP will evaluate diverse germplasm accessed from Germany and elite varieties from Australia for improved oil content and stability attributes for target environments across Northern NSW. |

**Issue No. 11 - More accurate weather forecasts**

Seasonal conditions are the greatest determinant of yield which has a significant impact on profit. Improved skill of weather forecasts and seasonal outlook forecasts would provide growers with the powerful tools that would enable growers to make better informed plans and decisions which will increase profits.

GRDC investments addressing this issue -

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| Improving forecast accuracy, especially with improved Indian Ocean Initialisation (MCV00008) | Overview Sea surface temperature (SST) variations in the tropical Indian Ocean are a prominent source of climate variability for Western Australia through to south-eastern Australia. Much of the climate anomalies that develop over south-eastern Australia during El Nino Southern Oscillation (ENSO) events are a result of the co-variance with SST in the Indian Ocean. The forecast skill of tropical Indian Ocean SST with the POAMA1.5 and POAMA2 seasonal forecast systems is much less than for that in the Pacific Ocean. The main purpose of this project was to investigate the reasons for the lower skill in the Indian Ocean, to what extent this has improved in POAMA-2 which utilises a new ocean data assimilation scheme and to what extent further improvements in the ocean initialisation can lead to increased skill. During the project there were two upgrades to the operational version of POAMA. POAMA- 2P replaced POAMA-1.5 as the Bureau's seasonal prediction system. POAMA-2P included the new ocean data assimilation system called PEODAS. Evaluation of the impact of PEODAS was carried out as part of this project. There was also a second upgrade to POAMA-2M, a version more suitable for multi-week prediction. POAMA-2M included some enhancements developed as part of the MCV-Multiweek project. In May 2013 the Bureau decided to start using POAMA forecasts for its official seasonal climate outlook, the first time that dynamical based forecasts have been used at the Bureau for regional temperature and rainfall. This is a major step for the Bureau as it shifts from basing its climate outlooks on statistical models to basing the outlooks on a dynamical model, POAMA.<br>The main outputs of this project were threefold:<br>(a) Increased understanding of the use of ocean observations by the POAMA model, the performance of the assimilation technique, and the impact of the systems on the forecast performance, including benchmarking against other international systems |

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| | (b) Development and evaluation of improvements to the initialisation strategy, and recommendations for which should be included in the next version of POAMA<br>(c) Science papers and research reports that document the project discoveries |
| Rural R&D for Profit — Seasonal forecasting | The purpose of the program is to bridge the gap between seasonal climate forecasts and farm business decisions, and to improve productivity and profitability.<br><br>The program will:<br><br>• define the critical seasonal climate risk information needed by Australian farmers<br>• improve understanding of the usefulness of seasonal climate forecasts and how to incorporate these into business decision making<br>• provide seasonal climate information which can be tailored to individual needs<br>• improve seasonal climate forecast skill in agricultural areas.<br><br>The program plan addresses the following three priorities:<br><br>Valuing the forecast. It is very difficult to assess how to use a forecast in a meaningful way if a person doesn't know how useful (valuable) a forecast is for a certain region at a given time. This is particularly true because forecasts are usually presented in probabilities, which are difficult to understand, especially for on-farm decision-making.<br><br>Using the forecast. We know that farmers have higher profits if they better understand what a forecast actually means, and how to use that forecast to manage risk. This is achieved when farmers minimise losses in bad years and maximise returns in good years.<br><br>Improve the ACCESS-S forecasting model. It's fundamental that any improved use of forecasts must be accompanied by improved forecasts. This area of the project aims to correct biases within Australia's seasonal forecasting model, ACCESS-S, in relation to atmospheric convection. Fixing the biases will deliver forecasting benefits across Australia, particularly in regional areas. |
| Assessing and managing heat stress in cereals (MCV00006) | As part of the large Managing Climate Variability Initiative (GRDC, MLA, BoM), this project investigated the damage to wheat yield caused by hot spring days, the likelihood of these hot days and strategies to manage the risk. When the likelihood of a hot day is considered in the context of flowering time, flowering in October and early November in some of the high rainfall regions have similar or higher risks of a hot day than low rainfall regions flowering in September. Through discussions with grain growers and agronomists, a spread-sheet and interactive workshop has been developed which explores the trade-offs between the heat and frost risk. The most likely use of the risk management information is tactically in a season that the break is late (hence heat stress dominates over frost risk) and a grain grower is weighing up the risks on whether it is worth sowing marginal paddocks. |
| Using seasonal forecast information and tools to manage risk and increase profitability in the Southern Region. | Climate remains the single most important driver of farm productivity and profitability. While it is important that growers and advisors take a strategic approach and have robust farming systems that allow them to manage our variable climate, there may be an opportunity for more appropriate use of seasonal climate forecast information to inform tactical decisions by limiting downside risk and maximising upside opportunity.<br><br>Understanding the probabilities of rainfall and temperatures (i.e. very much below, below, average, above or very much above average) is essential to use seasonal forecasts to effectively inform farm decisions. Identifying any past years which are similar to the forecast outlook can provide users with a reference to understand the likely outcomes based on past experiences and learnings. However, it is recognised that for some forecasts it is either not possible or too simplistic to identify previous years which are similar. In addition to weather forecasts, measurable or predictable factors such as soil moisture or agronomic constraints are a major consideration for growers and advisors.<br><br>The aim of this investment is to –<br>1. deliver a functional tool that provides a summary forecast and "expert" interpretation of rainfall and temperature outlook and the impact on soil moisture and other relevant information would provide growers and advisors with a practical resource to make better informed decisions;<br>2. establish a participatory pilot program to develop and promote tools to better use Bureau of |

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| | Meteorology weather data and seasonal outlook forecasts and up-skill participating advisors to better understand the implications of seasonal forecasts and strategies to manage risk and increase profitability.<br><br>Expected outcome - by February 2020, all growers, advisors and industry stakeholders in the GRDC Southern Region will have regular access to improved seasonal forecast information, emphasising the skill of the forecast and implications for farm management. A pilot program will up-skill a small group of advisors to identify, test and develop a framework to use seasonal forecast information to better manage risk and increase enduring profitability of grain growers. |

**Issue No.13 - Improved establishment of canola**

Poor establishment of canola crops in high rainfall environments, particularly when sown into heavy stubble loads limit yield and profit of growing canola. Key opportunities which could improve the establishment of canola crop include stubble management starting with prior harvest, sowing systems (tyne and discs), row spacing, seed row placement, seeding rates, soil ameliorants and fertiliser inputs and placement.

GRDC investments addressing this issue -

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| Optimised Canola Profitability (CSP00187) | This project has undertaken physiological and agronomic research across 9 regions from southern QLD to the Eyre Peninsula designed to increase canola profitability and reduce production risk with tactical agronomy advice underpinned by crop physiology insights. In Phase 1 of the project (2014-2016), we have focussed on 3 main strategies to increase canola productivity and profitability<br><br>(i) develop robust, higher-yielding early sowing systems<br>(ii) reduce canola production risk in low rainfall areas<br>(iii) better manage the harvest process to reduce loss and maximise profit<br><br>The key to (i) and (ii) during Phase 1 has been to firstly identify the optimum flowering window to minimise heat and frost risk at specific sites and to identify the variety x sowing date combinations that achieve the optimum flowering window. In Phase 2 we will seek ways to manage the trajectory of biomass accumulation (of specific varieties) to maximise water-use efficiency, optimise N-use efficiency and minimise the risk of high input costs (e.g. seed costs, N, herbicide types, harvest strategies). Understanding crop development and physiology is also the key to (iii) coupled with the most cost-effective harvest strategies to avoid yield/oil trade-offs.<br><br>In Phase 2 (2017-2019) we will also conduct further investigations of specific varietal adaptations under specific stress (heat, drought, frost) to further refine further G x E x M synergies that can be captured. We are liaising closely with similar projects in the Western and Southern HRZ regions, the National Canola Pathology Initiative along with breeding companies and NVT outcomes to ensure we capture benefits from other research activities. |
| GRDC Stubble Initiative Participating Farming systems groups including<br>• BCG<br>• Central West<br>• Mackillop Group<br>• Riverine Plains<br>• Yeruga Crop Research | *An individual output as part of the investment*<br><br>This output will produce outcomes that will contribute to canola establishment in farm systems with retained stubble equivalent to systems where stubble is not retained. Extension of information around different seeding systems, any modifications that are required to make it more suited to seeding canola in the South-East region and KI regions. This will be done by utilising farmer and advisor experiences in sourcing what systems are successfully working, and receiving 'good' canola establishment levels across the region. |
| Optimising the yield and economic potential of high input cropping systems in the HRZ (DAV00141) | This investment will provide knowledge and tools to increase the profitability of canola in the HRZs of the Southern and Western grains regions. An increased understanding of Genotype by Environment by Management (GxExM) interactions will help identify superior, better adapted wheat and canola plant types for the region. This will increase the speed at which new varieties are available to growers either through direct importation from overseas breeding programs or through the incorporation of traits into breeding material specifically suited to the HRZ. Modelling will help quantify the value of new traits to industry. Tools that help understand the risks and opportunities |

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| | associated with applying costly inputs to crops with high yield potential will be developed through close consultation with growers and advisors. |
| Optimising plant establishment, density and spacings to maximise crop yield and profit in the southern and western regions | The aim of this investment is to understand crop establishment, density and spacings to maximise canola and pulse yield and profit in the southern and western regions. It aims to determine the typical rates of crop establishment achieved by growers and factors influencing these. This proposed three and a half year investment, starting early 2018, will deliver a survey of crop establishment, a number of seeder demonstration and comparison trials, and small plot field experimental data over three seasons exploring the opportunity of improved sowing, in terms of reduced seed rates and costs, and increased crop uniformity, yield and profit. The concept of more precise seeding will be tested in three crops with contrasting seed size, canopy development and growth patterns – canola, lentil and faba bean in the south and canola, wheat and lupin in the west. The project also includes development and implementation of an extension and communication plan.<br><br>Expected outcome - by June 2022, growers and advisers have access to sound agronomic knowledge and supporting data allowing them to improve crop establishment and decrease seed costs with conventional air-seeders for canola, lentil and faba bean in the southern region, and canola, wheat and lupin in the western region, and consider the costs and benefits of precision planters. The initial target of this project is a 30% improvement in establishment of relevant crops and a 5% yield increase over 200,000 ha across the southern and western regions. |

**Issue No. 14 - Knowledge and application of economic analysis to make decisions around scale, capital and inputs**

Whole farm business management knowledge and skills are fundamental to making good, timely and financially sound decisions. Farm business knowledge and skills are regularly identified as a gap or weakness that limits the profitability of grain growing businesses.

<u>GRDC investments addressing this issue -</u>

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| GRDC Farm Business Updates – Southern Region (ORM00015) | The GRDC Farm Business Updates (FBU) for advisers and growers provides a unique forum to learn from and network with leading growers and industry professionals. The program has a broad range of topics delivered by an outstanding selection of expert speakers. It provides topical and practical advice and information on the key issues facing grain growers and their advisers, including managing risk and business resilience.<br><br>This three-year project provides:<br>• FBU for Advisers (One day program; four per annum): to be held in strategic locations to maximise accessibility by advisers;<br>• FBU for Growers (One day program; four per annum): at locations maximising accessibility of events to growers, to be reviewed annually with assistance of the Update Planning Committees and local grower groups;<br>• Adviser FBU Newsletter (Four page – A4; six per annum): Targeted and distributed directly to advisers;<br>• Farm Business Management Fact Sheets (four per annum);<br>• FBM Ground Cover Articles (One page; six per annum);<br>• Coordination and facilitation of the production of crop enterprise gross margin guide for the GRDC southern region by relevant agriculture agencies in each State<br><br>Activities/products accessible via the GRDC website to extend the impact of the Updates across the entire year include event planning; schedules; registration (via link to ORM website); papers as included in proceedings; presentation slides; integrated presentations (video + slides; social media and direct e-mail to event attendees (past and current). |
| The integration of technical data and profit drivers for more informed decisions (RDP00013) | This national project is being delivered across the 14 major grain zones in Australia through the collection of more than 300 benchmarking datasets in collaboration with five consulting organisations. These benchmarking datasets have been analysed to identify the key management affected profit drivers by agro-ecological zone. The quantitative benchmarking analysis has also been complemented by a qualitative survey process with grain growers across each region. A consistent message from the results is that there is a large gap in financial performance between the |

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| | top 20% businesses and the average business in each zone and there is abundant opportunity to increase profit from the resources that growers have available to them.<br><br>Adapting to manage key production and business risks is an important characteristic of successful and sustainable farm businesses. To quantify differences in risk profile between the top 20% producer and the average business in each dataset the project undertook some modelling using @Risk software. This quantified that the top 20% businesses have a lower risk profile and a lower probability of incurring operational losses in comparison to average businesses. There are a range of management affected profit drivers that can be influenced to increase profit in cropping businesses across both the SA Mid North, Lower Yorke Eyre and the SA – Vic Mallee agro-ecological zones. Most of these profit drivers are within the control of the farm manager providing significant opportunity for increased productivity. Proactively influencing the identified profit drivers will enable businesses to increase financial performance and reduce risk. |
| Practical financial figures for farm business management – aka Ag Profit (APR00001) | Continuing increases in volatility in key areas of the farm business sector exposes farmers to greater challenges in managing the financial risk to their business. Currently there are limited resources available to both farmers and Industry to assist farmers in improving their farm business management capability. The objectives of this project are to:<br>1. Increase awareness of the need for sound farm business management practices;<br>2. Facilitate the integration of business advisers (including regional accountants) into the development of industry farm business management strategies and initiatives;<br>3. Maintain innovative data analysis reporting outputs through input from well-regarded contributors from diverse geographic, rainfall and irrigation areas;<br>4. Provide a farm business data collection, storage, analysis, reporting and training service at a commercially accepted quality so that accountants are sufficiently enthused about 'partnering' with Ag Profit to promote this service to their clients;<br>5. Increase the number of growers participating in the project database application so that data analysis reporting can be of an increasing statistical quality; and<br>6. Securely manage all business data so as to avoid any breach of privacy. |
| Grain and Graze III – Extension and deliver on mixed farm benefits in the Southern Region (SFS00028) | Grain and Graze 3 is the third phase of mixed farming investment by the GRDC. While farming systems and enterprise mixes vary across the low, medium and high rainfall zones, there are common issues addressed by this investment. They are:<br><br>1. <u>Smarter grazing of crops and stubbles to optimise business and production risk and increase profit -</u> The Grazing Cropped Land booklet has drawn together all results funded through the Grain and Graze program since 2003 and provides the most up to date material on grazing crops. Results from the many grazing crop demonstrations conducted in 2015 are supported by findings in the booklet.<br><br>2. <u>Better manage crop and pastures (within) a rotation to improve crop and livestock production -</u> Trialling and demonstrations have shown the potential to sow canola and wheat with strong vernalisation requirements as a fodder and grain crop. The practice involves spring or opportunistic summer sowing of the crop, using the early growth for grazing and then taking the crop through for grain. A second area is around the best choice of a fodder rotation option to manage emerging issues of weeds, nitrogen depletion and soil conditions through continuous cropping. The project has shown there are options around what can be sown, with varying benefits for weed control, nitrogen and soil however the complexity of the decision means many growers and advisors avoid trying something different. While the project is extending this knowledge, we are recognising an emerging need to develop a support tool to help work though the complexity of the rotation decision.<br><br>3. <u>Farmers making informed decisions about farm business mix that best meets their needs -</u> The Farm Decision Making booklet has provided an extremely valuable resource to discuss farm decision making. A facilitation guide has also been created to assist people who wish to try the exercises with their clients or in a discussion group or workshop.<br><br>Aspects of risk assessment have also been advanced, with @risk training of 25 consultants and the development of the agprice guide. Other tools have been developed to assist in this area. The whole farm decision model provides an excellent resource to discuss decision making and the |

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| | materials on farm boards is being sought by growers and advisors. The focus of risk and decision making has made many growers and advisors more aware of what influences their decisions and how this can be improved. Facets of the decision making theme are being used in other GRDC projects e.g. WA frost initiative. Risk analysis developed in the Grain and Graze program is now being used by private consultants throughout the country. |
| Grain and Graze II – Farm business logic application (NR00009) | The desired outcome of this project was to enable Australian grain growers to manage farming systems that are able to respond and adapt to changing environmental and market conditions to optimise risk and deliver an increase in profitability. This was achieved through:<br><br>1. Knowing the important business drivers - an improved understanding by growers and advisors of the risks within key farming practices in each agro-ecological zone.<br><br>2. Managing systems risk - Increased business profit (above the five year rolling average) by managing risk across seasons, between enterprises and major crops within the farming system<br><br>3. Managing individual crop agronomy - Optimise profit from the major crops grown in each agro-ecological zone by managing risk within crops.<br><br>Three practice changes were identified to achieve the outcomes.<br>1. Identify and quantify the current risk in the business, the farmer's position on risk and the key risky business drivers.<br><br>2. Application of the knowledge about the risk position of the business and the farmer to shape the business direction both in the long term and short term.<br><br>3. Make/advise on tactical (operational) decisions that take into account the risk profile of the business, farmer, markets and the season. |
| National Paddock Survey Initiative (BWD00025) | Consultants and grower groups are working with grain producers in all grain growing regions to quantify the yield gap between actual and water-limited potential yield. Detailed monitoring of 250 paddocks over a four year rotation will identify the main yield constraints and develop amelioration practices to profitably close the yield gap.<br><br>Annual paddock monitoring includes:<br>• Soil water and soil chemistry at sowing and harvest<br>• Soil borne disease monitoring using PredictaB<br>• Paddock history (crop types, inputs, yield)<br>• In-crop monitoring of crop growth, weeds, insects and diseases<br>• Paddock management – sowing date, cultivar, inputs, in paddock temperature during flowering/grain filling<br>• Yield mapping to identify low and higher yielding parts of the paddock<br><br>CSIRO are responsible for analysing monitoring data and undertake the yield gap analysis. Results will increase the understanding of interactions between different constraints limiting yield and help optimise agronomic decisions to assess production potential and manage risk. |
| Rural R&D for Profit — Seasonal forecasting | The purpose of the program is to bridge the gap between seasonal climate forecasts and farm business decisions, and to improve productivity and profitability.<br><br>The program will:<br>• define the critical seasonal climate risk information needed by Australian farmers<br>• improve understanding of the usefulness of seasonal climate forecasts and how to incorporate these into business decision making<br>• provide seasonal climate information which can be tailored to individual needs<br>• improve seasonal climate forecast skill in agricultural areas.<br><br>The program plan addresses the following three priorities: |

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| | Valuing the forecast. It is very difficult to assess how to use a forecast in a meaningful way if a person doesn't know how useful (valuable) a forecast is for a certain region at a given time. This is particularly true because forecasts are usually presented in probabilities, which are difficult to understand, especially for on-farm decision-making.<br><br>Using the forecast. We know that farmers have higher profits if they better understand what a forecast actually means, and how to use that forecast to manage risk. This is achieved when farmers minimise losses in bad years and maximise returns in good years.<br><br>Improve the ACCESS-S forecasting model. It's fundamental that any improved use of forecasts must be accompanied by improved forecasts. This area of the project aims to correct biases within Australia's seasonal forecasting model, ACCESS-S, in relation to atmospheric convection. Fixing the biases will deliver forecasting benefits across Australia, particularly in regional areas. |
| Development of a grower and industry based GRDC Farm Business Management Manual in hard copy and e-Book format (PTP00001) | The FBM 'Farming the Business' manual wan developed by Mike Krause in 2016 an e-Book format and published using the i-Book Apple platform in three modules and can be accessed by users via the iTunes bookstore.<br><br>Module 1: This first module provides an overview of the business of farming, covering the economic environment, people management and the basics of sound farm business management. The aim of this section is to provide an overview to highlight areas to improve users' farm business management skills.<br><br>Module 2: This module covers the 'how to' of sound farm business management. It goes through how to develop a business vision, the essential farm business budgets, and financial and performance ratios. It provides detail on what financial reports should be generated to help users have greater control of their farm business management and improve business sustainability.<br><br>Module 3: This module covers more advanced topics to extend and refine farm business management. Topics include risk management, succession planning and what analytical tools should be used to answer those important 'what-if' questions for scenario analysis. |
| Assessing the economic value of precision agricultural tools for grain farming businesses in the Southern Region | Precision Agriculture (PA) has considerable potential to increase the efficiency and profitability of grain production systems in the Southern Region, in particular to better target crop inputs to productive capacity and likely return on investment. Despite a generally high awareness of the potential benefits of PA technologies in cropping systems, adoption by growers in the Southern Region is generally low.<br><br>Given the net impact on profitability is highly variable based on individual circumstance, it is essential that the application and adoption of a PA technology is carefully considered prior to any investment. It is suggested that building knowledge, skills and capacity would assist growers to objectively assess the operational, farming system and economic impact of the adoption of specific PA technologies to individual farm businesses. Access to robust and practical guidelines and decision support tools to assess the impact of PA technologies on the profitability of individual farm businesses is needed.<br><br>The aim of this investment is to provide growers and advisers in the southern region with enhanced capacity and skills to assess the economic impact of the adoption of various precision agriculture (PA) technologies in order to make informed business decisions. This will be achieved by identifying key technologies and situations where PA has been proven to consistently improve the profitability of cropping systems; developing a simple decision matrix and related tools to support PA decision making; producing relevant high impact communications and extension activities to promote awareness and build the skills, knowledge and confidence to motivate growers and advisers to realise the profitability opportunities presented by the broader adoption of PA in the GRDC Southern region.<br><br>Expected outcome - by December 2019, growers and advisers will have enhanced knowledge, capacity, skills and confidence to make informed and objective economic decisions relating to the adoption of PA technologies aimed to increase the profitability of grain growers in the GRDC Southern Region. |

**Issue No. 14 - Enable quicker access to long season, Northern Hemisphere varieties with superior leaf resistance**

Improved genetic resistance for leaf diseases are an important tool to managing new mutations and reducing the use of fungicide resistance. Fast tracking access to varieties with improved leaf disease resistance from overseas is a suggested strategy which would enable growers to manage leaf diseases.

GRDC investments addressing this issue -

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| Hyperyielding cereals - a feed grain initiative (FAR00003) | Whilst not focussed on new grain crops for the HRZ, this project seeks to improve grower profit through step change improvements in yield of cereals grown in the HRZ. The objective of the project is the delivery of higher yields of quality feed grains in HRZ through genetic improvement, management and recognition of quality. Specific outputs are:<br>1. Engagement between breeders, researchers, growers and advisers to evaluate and better manage new feed wheat and barley cultivars with the target of increasing average red feed wheat yields from 4.4 t/ha to 7t/ha by 2020.<br>2. Delivery of commercial wheat crops yielding 14t/ha by 2020.<br><br>Through engaging and collaborating with the dairy industry the project also seeks to identify and endorse the value of metabolisable and digestible energy in feed grain cereals and:<br>1. Create an independent testing and reference system whereby high yielding cereals can be reliably described in terms of energy content and value to the end user (particularly dairy industry).<br>2. Create a positive environment based on trading feed cultivars with quality attributes for better milk solid production in order to create the stimulus for further investment in improved variety development. |