2015-16 ANNUAL REPORT

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Southern Region

Annual Report: Regional Cropping Solutions Networks, 2015-16

This report outlines some of the local research, development and extension (RD&E) priorities identified by the grain grower, adviser, agribusiness representative and researcher members of the GRDC Regional Cropping Solutions Network (RCSN), operating across the southern grain growing region of Australia.

Acknowledgements
Grateful acknowledgement is made for the ideas and time committed to this initiative by the members and facilitators who are part of the GRDC's Southern Regional Cropping Solutions Network.

Note
The information presented in this document was current and correct as at September 2015. Currency of information relating to each of the issues discussed may have changed since this date as a result of more recent GRDC investments. This report aims to provide an indicative view of RD&E priorities in the southern grain growing region, rather than absolute information.

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1. Foreword

Since its launch in 2012, the Regional Cropping Solutions Networks (RCSN) initiative of the Grains Research and Development Corporation (GRDC) has enabled growers and industry stakeholders to influence the GRDC's investment portfolio and enhance the local delivery of research, development and extension (RD&E) activities in the Southern Region.

The RCSNs were established to provide advice to GRDC staff and regional panels and they have been successful in enhancing the GRDC's appreciation of region-specific challenges and its ability to subsequently respond in a timely and appropriate manner.

The GRDC footprint of engagement within the industry is now the largest it has ever been, giving the Southern Regional Panel a much greater insight into the most important constraints and opportunities to grower profitability and allowing it to make the right investments that will best address these issues – facilitating the adoption of improved farming practices.

As of June 2016, the Southern Region RCSNs consisted of 42 growers, agronomists, consultants, agribusiness personnel and researchers who have strong connections with growers and other grains industry stakeholders and are supported by skilled and experienced facilitators. The Southern Regional Panel is also represented on the RCSNs.

Each RCSN is focused on farming systems in a particular production zone – low-rainfall, medium-rainfall, high-rainfall – and members liaise with the wider grower community in their respective zone.

From July 2016, in alignment with GRDC's regional boundary and operational changes, irrigation priorities will be identified and captured through each of the three remaining Southern RCSNs. As the geographical area affected may be small in relation to rainfed (non-irrigated) agriculture, any constraints or opportunities to irrigated grains production in the Southern Region will therefore be considered and prioritised separately by GRDC staff and Southern Panel.

The composition of the 2017-19 low, medium and high-rainfall RCSNs will reflect the new GRDC boundaries. The three southern RCSNs will comprise members from Victoria, South Australia and Tasmania – the three states which now make up the GRDC Southern Region.

The input provided by the RCSN is invaluable. The RCSN acts as a check and balance mechanism to support GRDC staff and the Southern Regional Panel and ensure investments made are of greatest need to industry and focus on issues that will facilitate the adoption of new technologies and strategies which will ultimately increase the profitability of growers.

This document is the third annual report of the GRDC Southern Region RCSNs. Its purpose is to present the priority issues that the RCSNs identified during 2015-16 and outlines new and current GRDC investments that address each issue.

For 2015-16, the Southern Region RCSNs identified 52 priority issues they believed required RD&E investment.

It is rewarding for RCSN members to now see their efforts result in funded projects with on-farm impact. Members will also have the opportunity in the future to monitor and evaluate the progress and outputs from these projects.

On behalf of the Southern Regional Panel and the GRDC, I thank members of the Southern Region RCSNs for their ongoing enthusiasm, commitment and contribution.

Keith Pengilley
Chair, GRDC Southern Regional Panel

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2. Executive summary

The Grains Research and Development Corporation (GRDC) is committed to investing in research, development and extension (RD&E) to create enduring profitability for Australian grain growers. To assist the GRDC in maintaining strong connections with growers and identify locally specific RD&E priorities, Regional Cropping Solutions Networks (RCSNs) were established in the southern grain growing region of Australia in 2012.

There are three RCSNs within the GRDC Southern Region, representing key grain production zones: low-rainfall, medium-rainfall and high-rainfall. Each network comprises growers, researchers, advisors/consultants, members of agribusiness and other grains industry stakeholders. The networks are led by facilitators and supported by the GRDC's Southern Regional Panel and the GRDC Regional Manager Grower Services – South.

The RCSNs meet several times each year to identify the priority issues facing growers in the southern grain growing region and to provide the GRDC with detailed information about each of these constraints or opportunities to grower profitability. This information helps the GRDC to prioritise, plan and respond via RD&E investments to achieve maximum impact, with a focus upon economic return to levy payers.

With hundreds of issues identified annually, the RCSNs play a critical first step in 'sorting the wheat from the chaff'. Each RCSN identifies, describes and reviews the issues arising in its zone, taking into account the regional impact and significance of the issue to local growers and the practice change(s) required to address the issue. After consideration of each issue, using a formal 'program logic' process, the RCSN identifies the priority issues to be presented to GRDC staff and the Southern Regional Panel. Staff and panel are then able to conduct a more thorough GAP analysis, considering issue importance at a regional level and current GRDC investments, to determine the need for further investment and any appropriate RD&E response required to address the issue.

In 2015-16, the Southern RCSN identified fifty two priority issues that were considered to be not currently addressed through existing investments but having a significant impact on the profitability and sustainability of growers in the Southern Region. The resulting information was presented to GRDC staff and the Southern Regional Panel. Each of the 52 priority issues are described in Sections 5, 6 and 7 of this report, along with a summary of the actions required to address each issue and subsequent list of relevant GRDC investment/s addressing each issue.

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3. Managing grains RD&E

The Grains Research and Development Corporation (GRDC) was established under an Act of Parliament in 1990. Its charter is to plan, facilitate and oversee the investment of funds in research, development and extension (RD&E) to improve the production, sustainability and, ultimately, the profitability of the Australian grains industry. The GRDC manages more than $195 million investment in grains RD&E[1], which is the combined research investment of grain growers and the Australian Government.

The investment of funds into grains RD&E is a complex process driven by the needs of grain growers and the regional communities in which they live and work. At the ground level, the grower can contribute to the development of grains RD&E by:

- Participating in and contributing to discussions at GRDC grower events and grower updates;
- Discussing issues and making suggestions and comments directly to representatives of the GRDC Regional Cropping Solutions Networks (RCSNs) and Grower Solutions Groups (GSGs);
- Discussing issues and making suggestions and comments directly to representatives on the GRDC regional panels;
- Making comments and suggestions about RD&E on the GRDC website (www.grdc.com.au/About-Us/Contribute); and
- Making comments and suggestions about RD&E through social media by following the GRDC on Facebook and Twitter (@theGRDC).

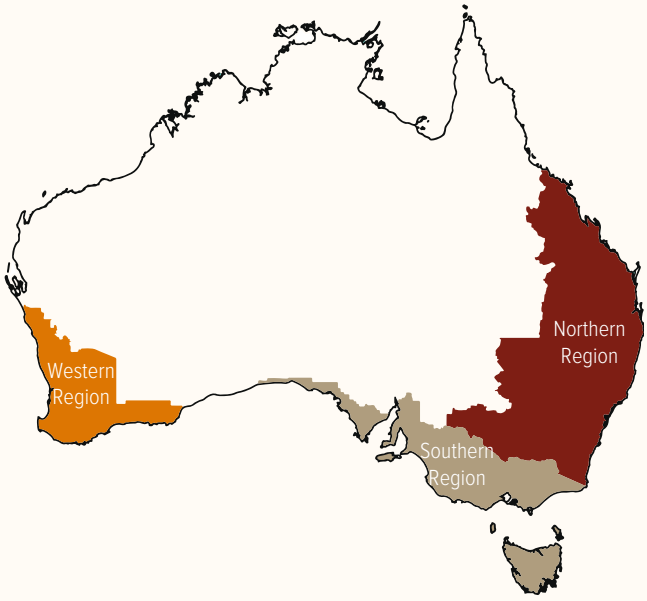
At the decision-making level, grain growers have the opportunity to represent their industry as members of RCSNs, GSGs or as appointed members of regional panels on the board of GRDC.

The GRDC has a rigorous investment planning process designed to ensure the GRDC levy is managed so it can be the best investment a grower can make to improve the profitability of their business.

Local networks

The GRDC engages extensively with the grains industry and uses a wide variety of information sources to guide its investment in RD&E. Regional Cropping Solutions Network or Grower Solutions Groups have been established in each of the three GRDC regions: Northern, Southern and Western (Figure 1).

FIGURE 1 The GRDC organises its operations and functions based on three regions, reflecting the distinct grain-growing zones within Australia



These groups or networks play a critical role in supporting GRDC staff and regional panels to help set priorities for RD&E. The groups or networks assist to identify and develop investments to address important profitability constraints and opportunities.

The format of each group or network differs between regions, based on historical RD&E management, industry structures and grower needs.

1 GRDC Stakeholder Report 2015-16: available from www.grdc.com.au, search report name.

GRDC WESTERN AND SOUTHERN REGIONS

There are nine GRDC RCSNs across the Western and Southern grain-growing regions of Australia. Each network comprises between 12 to 16 members representing growers, consultants, agronomists, agribusiness, researchers and representatives from the relevant GRDC regional panel, and is coordinated by an independent facilitator/s. The RCSNs were established in the Western region in 2011 and the Southern Region in 2012.

The RCSN initiative grew out of feedback from major stakeholders of the GRDC, indicating that:

- Growers want more effective delivery of RD&E that drives growth in their productivity, profitability and sustainability;
- Growers continue to face a broad spectrum of demands on their time and resources;
- The grains industry operates in the context of increasing consolidation of public sector resources, most critically in development and extension services;
- Australia's competitiveness in global grain markets will increase if the time between development, field testing and ultimate adoption is accelerated; and
- The GRDC's delivery of development and extension must continue to adapt to changing physical and operational environments to meet the priorities of stakeholders.

The development of the RCSN initiative was aligned closely with the vision of the Primary Industries Ministerial Council. This vision included a national restructuring of RD&E resources, which aimed to foster greater cooperation between the Commonwealth and the states, avoiding unnecessary duplication, and maximising benefits from the investment in RD&E.

The objectives of the RCSN initiative are to:

- Create and manage knowledge;
- Build regional development and extension capacity among growers and advisers;
- Proactively respond to regional industry issues in a timely manner; and
- Provide enduring links between growers, advisers and the GRDC.

The primary goal of the Southern and Western RCSNs is to provide feedback to GRDC staff and regional panels on local issues affecting growers, which are specific to production zones, and to assist the GRDC in prioritising issues for investment in RD&E. The RCSNs enable the GRDC to develop a detailed understanding of what is important to growers and determine where there are gaps in current RD&E, with a specific focus on issues affecting grower profitability. The local knowledge of the RCSNs helps build essential on-ground linkages between growers, farming systems groups, agribusiness representatives and researchers.

As well as influencing investment at a regional and national scale, the RCSNs are able to determine and initiate Fast Track projects, where significant local issues can be addressed in a short timeframe with a relatively small budget.

The RCSN initiative complements the National Grains Industry RD&E Strategy (2011). The strategy is focused on coordination and collaboration to improve the continuity of investment and improvement of the efficacy and efficiency of investment in RD&E. The RCSNs play a role in ensuring greater industry engagement in setting priorities for RD&E and ensuring that outputs from national research programs are adapted and delivered into the regions with local development and extension activities of greatest benefit to growers.

Regional panels

Recognising the variations in environment, conditions and issues across the nation, when the GRDC was established in 1990 it implemented three advisory panels based on the grain-growing regions of Northern, Southern and Western Australia (Figure 1). The regional panels ensure that different market and production realities are considered and reflected in the RD&E investment program. Each region has distinctive features that warrant focused planning and research management in plant breeding, farming systems and agronomy, soils, grain storage and handling, product development, market opportunities and technology marketing.

The regional panels are composed of grain growers, agribusiness representatives, researchers and the GRDC's executive managers. Each panel:

- Identifies and monitors regional and national grains industry issues relevant to the region;
- Interacts with grower groups, research advisory committees and other interested parties in the region to exchange information;
- Identifies and develops priorities for RD&E investment and recommends these to the GRDC National Panel;
- Keeps growers and advisers in the region informed about the GRDC's strategic direction, investment portfolio and research projects; and
- Assists staff in monitoring the effectiveness of the investment portfolio.

The Grower Solutions Groups and RCSNs provide information on priority issues to the GRDC's regional panels. The regional panels also consider information provided by less formal structures such as direct communication with growers, grower groups, government research and extension agencies, private research and extension organisations, agribusiness and industry organisations.

The regional panels work with GRDC staff and the GRDC National Panel to ensure GRDC investments are directed towards the interests of all grain industry stakeholders and to deliver relevant products and services in each grain-growing region.

The GRDC National Panel is made up of the chairs of the three regional panels, the managing director of GRDC and the GRDC's executive managers. The National Panel:

- Addresses national RD&E priorities across the GRDC's investment portfolio and makes recommendations to the Board; and
- Assists the Board of GRDC to maintain links with grain growers, the Australian Government, state and territory governments and research partners.

The GRDC is guided by constant two-way communication with growers through its panels and grower networks.

4. Grower-driven decision-making

Three Regional Cropping Solutions Networks (RCSNs) currently exist in the southern grain growing region of Australia to help guide the GRDC investment planning process by providing an on-ground and local perspective of grower issues. The members of the RCSNs have contributed to the RD&E investment planning process by working together to:

- Identify and track regional issues facing growers in the southern grain-growing region of Australia – issues identification can be through the networks, feedback, observation or experience;
- Provide on-the-ground insights into priority issues requiring industry research and development attention;
- Gather intelligence on regional grain production constraints and opportunities;
- Provide support and advice to GRDC staff and the Southern Regional Panel on regional issues; and
- Identify Fast Track projects that require a time critical response to address in-season tactical issues.

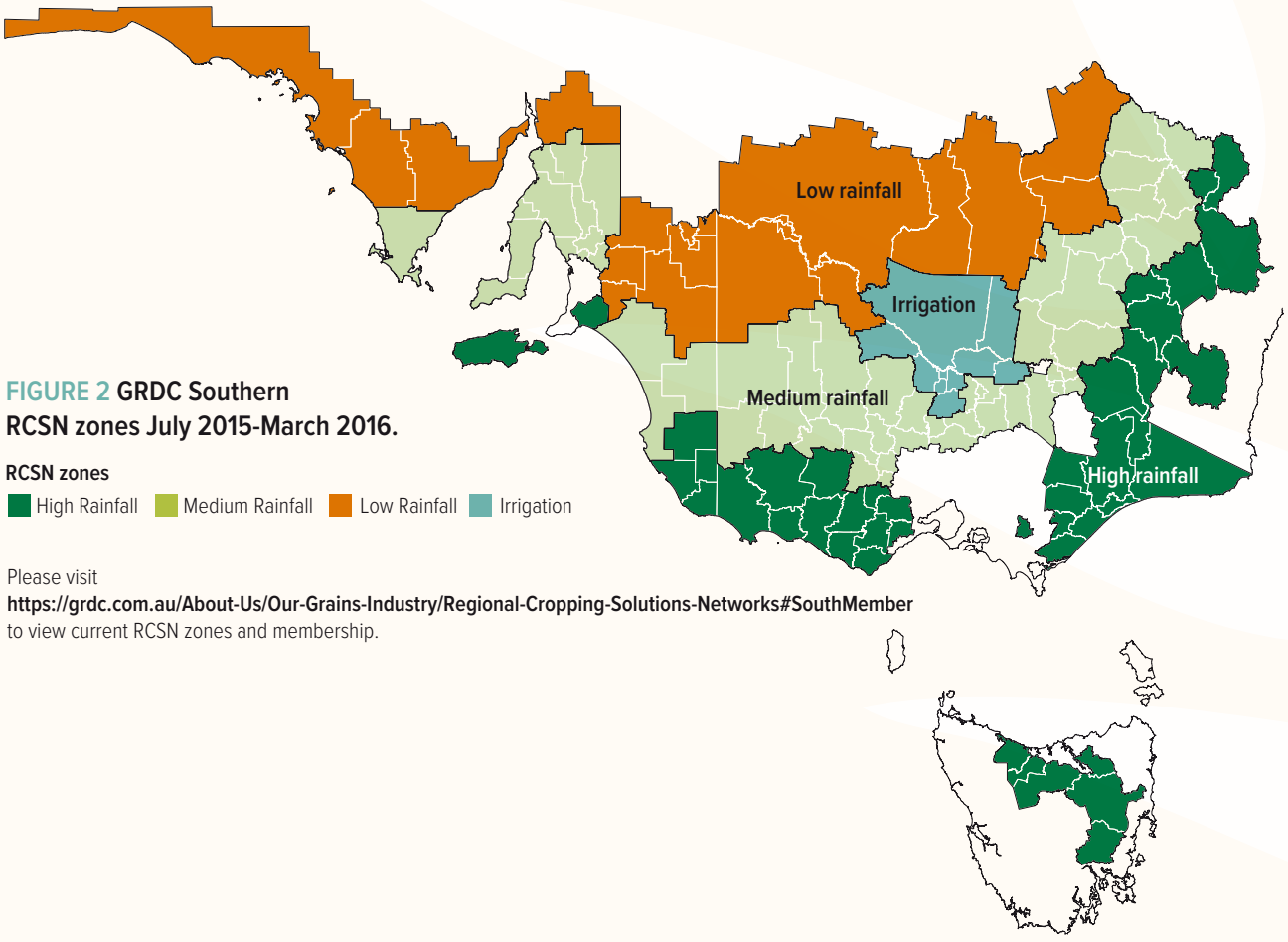


FIGURE 2 GRDC Southern RCSN zones July 2015-March 2016.

Please visit **https://grdc.com.au/About-Us/Our-Grains-Industry/Regional-Cropping-Solutions-Networks#SouthMember** to view current RCSN zones and membership.

Local representatives

The members of the southern RCSNs are growers, advisers, agribusiness representatives and researchers. The membership of each network is listed in Table 1 (low), Table 6 (medium) and Table 30 (high).

A specific network that represented irrigation cropping operated in the Southern Region until March 2016. Irrigation cropping issues are captured via the three rainfall zones.

The members of each RCSN are selected to contribute the range of skills, experience and regional knowledge required for the successful operation of the network and to provide geographic coverage of the zone.

The members of each network work together to:

- Identify and prioritise local crop-production issues;
- Identify the appropriate response or practice change required to address issues;
- Liaise with industry partners and other growers to provide direction and ideas to ensure regional priorities are addressed;
- Support the GRDC in delivering the desired outcomes to growers and the GRDC;
- Represent the RCSN at industry events and stakeholder meetings to collect information on issues impacting growers and share information on RD&E priorities and investments; and
- Provide feedback to the GRDC, the Southern Regional Panel and the Regional Manager on emerging issues and current attitudes and activities within the region relevant to local production issues and the needs of the networks.

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5. Low-rainfall zone RCSN

The low-rainfall zone RCSN has 13 members with eight growers, one researcher and four advisers who have now completed the first four years of this initiative. All members have strong farming, advisory and/or research backgrounds, extensive networks in their district or profession, and are located throughout the zone from Streaky Bay on the West Coast of South Australia to West Wyalong in southern New South Wales. The network is facilitated by Dr Nigel Wilhelm and Naomi Scholz.

The membership of the low-rainfall zone RCSN at the end of June 2016 is shown in Table 1. There has been little change in membership since the inception of the RCSNs, reflecting the commitment of members despite their heavy workloads and multiple roles within the grains industry. Replacement members for the network have been appointed as required.

The low-rainfall zone RCSN met face-to-face twice during 2015-16 to review issues, their relative priorities and to discuss new problems affecting grain growers. The high level issues for the low-rainfall zone included the need for management packages to reduce financial risk and improve benefits of break crops within the farming system, strategies to manage Russian Wheat Aphid, a better understanding of nitrogen cycling for improved nitrogen management, and management skills and strategies to manage seasonal variability.

Specific issues raised as a priority for the low-rainfall zone RCSN included:

- Better adapted and improved agronomy for legumes;
- Understanding and developing strategies to manage the Russian Wheat Aphid;
- Better rules of thumb for nitrogen mineralisation; and
- Minimising the downside and maximising the upside of variable seasons.

Many of these issues have been developed for investment in a range of GRDC programs and contracted research agreements with RD&E partners.

TABLE 1 Members of the low-rainfall zone Regional Cropping Solutions Network (at June 30, 2016).

Member	Occupation	Location
Russell Amery	Grower	Wycheproof, Victoria
Andy Bates	Adviser (consultant)	Streaky Bay, SA
Roger Bolte	Grower	West Wyalong, NSW
Danny Conlan	Adviser (consultant)	Sea Lake, Victoria
Barry Haskins	Adviser (consultant)	Griffith, NSW
Bruce Heddle	Grower	Minnipa, SA
Chris Kelly	Grower	Woomelang, Victoria
Peter Kuhlmann*	Grower	Mudamuckla, SA
Rick Llewellyn	Researcher (CSIRO)	Adelaide, SA
Michael Moodie	Adviser (consultant)	Mildura, Victoria
Rohan Mott*	Grower	Ninda, Victoria
Barry Mudge	Grower	Pt Germein, SA
Keith Pengilley*	Grower	Conara, Tasmania

* GRDC Southern Panel member

PHOTO: REBECCA BARR

The LRZ RCSN from left: Peter Kuhlmann, Chris Kelly, Barry Mudge, Michael Moodie, Nigel Wilhelm, Rohan Mott, Rick Llewellyn, Andy Bates, Roger Bolte, Naomi Scholz, Bruce Heddle and Keith Pengilley. Absent: Russell Amery, Danny Conlan, Barry Haskins.

Low-rainfall zone 2015-16 priorities

The identified priority issues and RD&E needs to address the priorities identified by the low-rainfall zone RCSN in 2015-16, and current and recent GRDC investments which are addressing these issues are described below.

TABLE 2 Issue 1: Legume agronomy and management.

The issue	There are challenges to reliable production of legume crops in the low-rainfall zone due to shorter and more unreliable seasons, different soil types and lower yield potentials when compared with the medium-rainfall and high-rainfall zones. There are also challenges with pest and disease control methods which cannot be easily transferred from the medium-rainfall and high-rainfall zones. Lower rates of development, thresholds for damage and economic return to control strategies can all be substantially different in the low-rainfall zone and can interact.
RCSN prioritising this issue	Low-rainfall zone
RD&E actions to address this issue	To increase legume production, there needs to be better adapted genotypes developed for the low-rainfall zone as well as management packages suited to the environment. RD&E should focus on minimising costs and genetic evaluation. In particular, the LRZ RCSN recommended investigating the cost-benefit analysis of lower sowing rates, fungicides, low cost disease management strategies and inoculation in the LRZ as opposed to 'standard' management approaches.
GRDC projects addressing this issue	*Optimising nitrogen fixation of grain legumes – Southern Region* (DAS00128) *Expanding the use of pulses in the Southern Region* (DAV00113) *Understanding the implications of new traits on adaptation, crop physiology and management of pulses in the Southern Region* (DAV00150)

TABLE 3 Issue 2: Russian Wheat Aphid.

The issue	Low-rainfall zones are at specific risk of damage from the Russian Wheat Aphid (RWA) because they are early sowing environments, have higher reliance on cereals and pesticide usage is currently low.
RCSN prioritising this issue	Low-rainfall zone
RD&E actions to address this issue	Little is known about economic thresholds for pests or beneficials, especially for low-rainfall systems. Other questions raised by the low-rainfall zone RCSN for potential research include: • Determining the best approach for chemical management, for example, which active ingredients, when and how much? • Investigating the use of seed treatments; • Understanding the experiences from South Africa and if there is value in transferring them to Australia; • Developing a decision support tool for likely risk; • Defining South Australia's ecology; • Identifying tolerant and resistant cereal varieties; and • Understanding genetic variability in crops.
GRDC projects addressing this issue	*Russian Wheat Aphid: Tactics for future control guide and monologue* (ACO00020-B) *Evaluation of insecticide options for the control of Russian Wheat Aphid (RWA) in Wheat and Barley* (PPL00001-A) *Spring research in response to Russian Wheat Aphid incursion 2016* (9174817) *Insecticide options for the management of Russian Wheat Aphid in establishing crops for the 2017-18 season* (9175062) *Cultivar/varietal screening and biotype determination for Russian Wheat Aphid Resistance* (9174815)

TABLE 4 Issue 3: Better rules of thumb for nitrogen mineralisation.	
The issue	The low-rainfall RCSN has identified a knowledge and confidence gap among growers and advisers in the low-rainfall zone when it comes to mineralisation of nitrogen during the growing season. Very few of the studies conducted in this area have been undertaken in low-rainfall environments so there is little relevant existing data. Further research is recommended to ensure more refined nitrogen management strategies for higher profitability.
RCSN prioritising this issue	Low-rainfall zone
RD&E actions to address this issue	High frequencies of drying soils during the growing season in the low-rainfall zone raise concern about rates of mineralisation during the season. Many LRZ environments are also characterised by extreme soil changes and different environments. Nitrogen management guidelines must accommodate these changes. For example, do surface residues and soil organic matter cycle differently, especially since the LRZ has long periods of dry surface soils? How important are fluctuations throughout the season and the timing of supply? With increased nitrogen tie up in retained stubbles, how important is it in low-rainfall environments where stubble levels are low but so are fertiliser nitrogen rates? Reliable estimates of likely nitrogen mineralisation rates during the season would greatly increase confidence in fertiliser nitrogen strategies.
GRDC projects addressing this issue	*Real time evaluation of soil nitrate using ion exchange technology* (EPF00002-A) (UA00165) *Managing legume and fertiliser nitrogen in the Southern Region* (UA00165) *More Profit from Crop Nutrition Initiative phase II* (MPCN II)

TABLE 5 Issue 4: Minimum downside/maximum upside.	
The issue	Low-rainfall environments and farming businesses are characterised by wide and unpredictable extremes of seasons. Generally, the bulk of farm income is derived in a few good years and for the rest, the business needs to minimise losses to remain viable. These extremes have become even wider as the cost of cropping has increased, and hence the risk of large losses in poor years, but improved agronomy is increasing the potential in good years. There is increasing recognition that maximising returns in good years may be more important to the viability of low-rainfall farming businesses than minimising losses during the poor years. Obviously achieving both would result in a very strong business.
RCSN prioritising this issue	Low-rainfall zone
RD&E actions to address this issue	A paper entitled *Unreliable doesn't necessarily mean Unviable – How leading growers in low-rainfall regions are responding currently to maintain viability under their variable and sometimes extreme climatic conditions* (Mudge and Hayman 2015) is highly relevant to this issue and may form the basis of a more detailed GAP anlaysis to inform any potential future investment. The report outlines the six pillars underpinning the resilience of low rainfall farming systems. Recommendation areas to consider investment moving forward include: • Financial analysis; • Pool of resources/intellectual capacity that is ready for use when it is required, e.g. the demand is not there when things are going well, right timing/window; • Capacity building for deliverers and participants; • J curve to minimise bottom damage, preserve/improve upside; and • Marginal return/cost.
GRDC projects addressing this issue	*GRDC Farm Business Updates – Southern Region* (ORM00015) *The integration of technical data and profit drivers for more informed decisions* (RDP00013) *Farming after the drought* (BWD00028-A)

6. Medium-rainfall zone RCSN

The medium-rainfall zone RCSN comprises seven growers, two researchers and five advisers, located from Port Lincoln on the Eyre Peninsula of South Australia to Wagga Wagga in southern New South Wales. The medium-rainfall zone RCSN has been co-facilitated by Tony Craddock and Jen Lillecrapp.

The membership of the medium-rainfall zone RCSN at June 2016 is shown in Table 6. Richard Konzag retired from the GRDC Southern Regional Panel in August 2015. John Bennett was appointed to the GRDC Southern Regional Panel in September 2015 and serves as a member of the medium-rainfall zone RCSN. Julia Hausler, a grower member from Warracknabeal, retired from this RCSN in March 2015.

The issues identified as requiring RD&E investment by members of the medium-rainfall zone RCSN in 2015 were:

- Capacity building – mentoring the development for growers and advisers in the early stages of their careers;
- Nitrogen decision-making – technology to measure nitrogen in real-time and improved nitrogen budgeting tools;
- Realising the genetic potential of pulse crops;
- Quantifying the effects and interactions between time of sowing, plant density, cultivar and nitrogen in cereals to optimise the use of plant available water;
- Evaluating the effectiveness of liquid systems to deliver crop inputs, e.g. trace elements, fungicides and insecticides;
- Understanding how to manipulate the interactions between competitive cultivars, times of sowing, seedbed utilisation and canopy management to effectively manage weed seedbanks;
- Pests in retained stubble systems – slugs, snails, millipedes, slaters, earwigs and wireworms;
- Understanding and extending knowledge about the ecology and control strategies for emerging weed species which are difficult to control;
- Reduced sensitivity of chemicals, including herbicide, insecticide and fungicide resistance;
- Plant growth regulators (PGRs) – when to use;
- Identifying potential uses of tools that can be employed using robotic platforms for the grains industry;
- Crop-topping of cereals – sharing knowledge and experience to build confidence and increase use; and
- Protocols and guidelines for off-label chemical use, e.g. trials, communications and advice.

The high level issues for RD&E needs identified by the medium-rainfall zone RCSN in 2016 were:

- Using the data collected and using precision agriculture (PA) tools to manage variability and increase profits;
- Whole farm business management;
- Glyphosate replacement – new modes of action/chemistry and novel solutions;
- Physiology and canopy management – especially for pulses and cereals;
- Eyespot management;
- Biological sources and amounts of nitrogen, e.g. bacteria and termites;
- Sowing seed hygiene to avoid sowing weed seeds – seedbox survey;
- Plant growth regulators (PGRs) – cereals and other crops;
- Improved harvest management of barley – agronomy, spray-topping, machinery set-up, and windrowing; and
- Vetch as a pulse – identifying markets.

Soil moisture management, improving tools and the use of soil moisture information over the whole production system for better decision making, was continually identified as a high priority issue by the medium-rainfall RCSN. This network reviewed the key outcomes of the GRDC's investment in the measuring and managing soil water in Australian agriculture (CSP00170) project and reviewed the experience and opportunities to improve yield forecasting. The purpose of this review was to better understand key outcomes from investment and identify future opportunities for RD&E to ensure that the outcomes of this investment will deliver on-farm benefits for growers.

TABLE 6 Members of the medium-rainfall zone Regional Cropping Solutions Network (at 30 June 2016).

Member	Occupation	Location
John Bennett*	Grower	Lawloit, SA
Rohan Brill	Research Agronomist (NSW DPI)	Wagga Wagga, NSW
Matt Dare	Grower	Clare, SA
Mick Faulkner	Adviser (consultant)	Watervale, SA
Roy Hamilton	Grower	Rand, NSW
Mark Harris	Adviser (consultant)	Wagga Wagga, NSW
Julia Hausler (Feb 2012 - March 2016)	Grower	Warracknabeal, Victoria
Jeff Hoffmann	Grower	Lockhart, NSW
Grant Hollaway	Researcher (Victorian Department Of Economic Development, Jobs, Transport And Resources)	Horsham, Victoria
Richard Konzag** (Feb 2012 - August 2015)	Grower	Mallala, SA
Bill Long*	Adviser (consultant)	Ardrossan, SA
Glenn McDonald	Researcher (University of Adelaide)	Glen Osmond, SA
Mark Modra	Grower	Port Lincoln, SA
Andrew Russell	Grower	Browns Plains, Victoria
Rob Sonogan*	Adviser (consultant)	Swan Hill, Victoria
Peter Taylor	Grower	Lubeck, Victoria

* GRDC Southern Regional Panel member 2015-17
** GRDC Southern Regional Panel member until 2015

PHOTO: JEN LILLECRAPP

The MRZ RCSN members L-R (back row) – Roy Hamilton, Tony Craddock, Matt Dare, Rob Sonogan, Jeff Hoffmann, Peter Taylor, Glenn McDonald, Mick Faulkner, Peter Taylor and Mark Harris. L-R (front row) – Andrew Russell, Mark Modra, Julia Hausler, Bill Long, Rohan Brill. Absent – Grant Hollaway and Richard Konzag.

Medium-rainfall zone 2015 priorities

The identified priority issues and RD&E needs to address the priorities identified by the medium-rainfall zone RCSN in 2015, and current and recent GRDC investments which are addressing these issues are described below.

TABLE 7 2015 Issue 1: Capacity building – mentoring the development of growers and advisers in the early stages of their careers.

The issue	**Growers:** In the early stages of their farming careers, growers lack the foundational scientific knowledge of farming systems and the ability to critically analyse and interpret information. An improved understanding of the principles and applied knowledge of soil and plant processes would lead to improved productivity and profitability. **Advisers:** The transition from formal study to skilled agronomic adviser takes up to 10 years. Training and support in the first two years after graduation is crucial for the development and retention of quality advisers within the grains industry. However the limited availability or lack of established and available support and mentoring programs is constraining the number of graduates successfully making the transition. Currently, mentoring occurs on an ad hoc basis and its importance and value is not widely recognised. The reduction in public advisory services in the grains industry and its replacement with private extension providers has considerably diminished the opportunities and processes for mentoring.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	**Growers:** A desirable outcome is to have industry approved training and eventually national industry accreditation. Two specific strategies include small peer group self-directed learning and a series of stand-alone or accumulated workshops and modules that, when combined, could achieve levels of accreditation. A range of pathways and approaches to learning should be provided remotely and at a diversity of regional locations. This would also include facilitation of small, peer focus groups to undertake activities based upon self-directed needs which build the skills and capacity of growers through applied learning. Training modules for growers to be delivered through a series of half day workshops (modules), would include but not be limited to: • Basic science and agronomy e.g. soils and nutrition, weed management, integrated pest management, disease management, soil moisture and water use efficiency; • Business management; • Risk management; and • Marketing. **Advisers – three to five years post university stage:** • Base level technical skills and core set of competencies; • Require an identified development pathway for these advisers to map and achieve their technical skills requirements. The skill set needs to be of value to the individual adviser and of value to the market, e.g. the wider grains industry; and • Attendance at key events, e.g. GRDC Adviser Research Updates to recognise professional development. **Existing/more experienced advisers:** • Require a higher level of skills development that can be applied to improving and/or evolving the knowledge and services provided to their clients; and • Skill development to enable movement of individuals along a clear career path. A motivation for on-going training would be to enable advisers to become a member of a professional club or association.
GRDC projects addressing this issue	*Improving practices & adoption through strengthening D & E capability & delivery in the Southern Region – Regional Research Agronomists* (DAV00143) *GRDC Research Updates – Southern Region* (ORM00005) *GRDC Farm Business Updates – Southern Region* (ORM00015) GRDC Capacity Building for Growers and Advisors: Conference attendance awards, Training Awards, Domestic study Tours, International Study Tours. GRDC Technical Workshops

TABLE 8 2015 Issue 2: Nitrogen decision-making – technology to measure nitrogen in real-time and improved nitrogen budgeting tools.	
The issue	There are a range of issues which limit a grower's ability to make well-informed decisions on nitrogen. This includes access to technology to enable real-time measurement and regionally specific information, as well as guidelines for growers and advisers on using, interpreting and implanting data from a range of tools including nitrogen rich strips and normalised difference vegetation index (NDVI). In addition, there is not a clear understanding of nitrogen contributions from mineralisation from a range of sources, which, if improved, could enable growers to more accurately and confidently estimate this factor when calculating nitrogen budgets. Seasonal conditions and forecasts are key parameters in the nitrogen decision-making process and there is a lack of confidence in accuracy of seasonal weather forecasts. Adjusting nitrogen timing and rates to manage these seasonal conditions and risk can be improved upon, as can an understanding of nitrogen management after a legume in the rotation. An opportunity to increase the power of nitrogen decision-making would be to include soil water information, along with the collation and validation of information on the use and cost-benefit of mid-row banding of urea ammonium nitrate (UAN) in high-rainfall areas.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Establish a working group of key researchers and advisers to: • Collate and capture collective current knowledge for predicting nitrogen mineralisation, including identifying situations and potential causes of limitations and discrepancies of models and rules of thumb. In addition, determine requirements to more accurately and reliably predict nitrogen mineralisation. This would result in guidelines and dependable tools that growers and advisers can use to guide nitrogen budgeting and management decisions; • Understand how a range of variables, including organic matter, season, rotation and soil type affect mineralisation including the amount and timing of availability throughout the season; • Validate and customise information for a range of environments; • Develop guidelines for using and interpreting nitrogen rich strips as a decision-making tool; • Validate and adapt nitrogen sensor tools and models that provide the basis for interpretation e.g. green area index; • Collate and validate information on the use of mid-row banding of nitrogen; and • Field validation of technologies and tools to enable the rapid, accurate and cost-effective measurement of nitrogen status.
GRDC projects addressing this issue	**Current investments:** • *Real time evaluation of soil nitrate using ion exchange technology* (EPF00002-A) (UA00165); • *Managing legume and fertiliser nitrogen in the Southern Region* (UA00165); • *Optimising nitrogen fixation of grain legumes – Southern Region* (DAS00128); • *More Profit from Crop Nutrition Initiative phase II* (MPCN II); • *Benchmarking wheat yield against nitrogen use* (DAS00147 - MCPN II); • *Soil Spectroscopy Capability* (CSO00045); and • *Proximal Soil Sensing for Profitable & Sustainable Farming* (CSA00048). **Previous investments:** • *Improving nitrous oxide abatement in higher rainfall cropping systems and developing nitrogen response curves* (DAV00125); • *Reassessing the value and use of fixed nitrogen* (CSA00037); and • *Evaluation of late nitrogen applications to achieve yield potential and increased protein in wheat* (SFS00025).

TABLE 9 2015 Issue 3: Realising the genetic potential of pulse crops.

The issue	Pulse yields and prices are highly volatile which means that in many regions outside key pulse production areas, pulses are considered unprofitable and high risk, which in turn, limits successful production areas. Issues the RCSN felt needed to be addressed as a matter of priority include the weed implications, e.g. lack of competitiveness which results in lack of control options, risk of breakout in population or an increased weed seedbank and herbicide resistant weeds. There is also a reduced uptake because pasture legumes are considered a low risk, inexpensive and reliable break crop option. The RCSN also felt there were knowledge gaps in the foundational physiological information among growers and current agronomic practices could be limiting the genetic potential of new varieties. Other issues include the use of pulses as brown and green manure crops; the maturity of bean varieties for earlier finishing environments and seasons; the use of crop-topping, blackspot and bacterial blight management in peas, harvest fires in lentils, adaptation of pulses to acidic soils prone to waterlogging, lack of investment in lupin breeding resulting in limited advances in varieties and yields, and the sudden death of lupin crops in southern NSW as a consequence of subsoil constraints.
RCSN prioritising this issue	Medium-rainfall zone

RD&E actions to address this issue	The MRZ RCSN recommends RD&E activities to:
	• Identify and evaluate strategies to increase yield, including opportunities and strategies to improve nodulation, increase flowering, pod set and harvest index;
	• Develop variety-specific agronomic packages (VSAPs) for new pulse varieties;
	• Evaluate a range of agronomic issues including:
	  • The effect of plant growth regulators on bean crops;
	  • Chemical options for broadleaf control in beans;
	  • The effect of sowing direction; and
	  • Harvest fires in lentils.
	• Identify needs for genetic development including:
	  • Earlier maturing bean varieties;
	  • Improved disease (black spot and bacterial blight) resistance in peas; and
	  • Improved lupin varieties adapted to acid soils which are prone to subsoil constraints and/or waterlogging.
	• Develop guidelines for growers and harvest contractors to reduce harvest fires in lentils.

GRDC projects addressing this issue	*Expanding the use of pulses in the Southern Region* (DAV00113) Specific projects through the GRDC and SARDI Bilateral Agreement *Understanding the implications of new traits on adaptation, crop physiology and management of pulses in the Southern Region* (DAV00150) *The role of legume break crops in mobilising soil P for wheat* (UA00119) *Pulse breeding Australia: Field Pea Breeding Program* (DAV00118) *Pulse breeding Australia: Faba Bean Breeding* (UA00163) *Pulse breeding Australia: Chickpea Breeding* (DAN00212) *Pulse breeding Australia: Lentil Breeding Program* (DAV00119)

TABLE 10 2015 Issue 4: Quantify the effects and interactions between time of sowing, plant density, cultivar and nitrogen in cereals to optimise the use of plant available water.	
The issue	With a changing climate, making optimal use of plant available water and responding tactically to seasonal opportunities will become increasingly important in managing crops in southern Australia. The evolution of better adapted winter-type and long-season spring wheat cultivars will broaden grower options to capitalise on early sowing or stored pre-season soil moisture opportunities in some seasons, together with shorter-season spring wheats in a later seasonal break. Current and past research on tactical management of wheat and barley varieties is mostly two dimensional and focuses on either sowing time vs variety or plant density vs time of sowing, or nitrogen rates and/or timing vs variety. While this will improve grower understanding of management aspects associated with cultivars with different phenologies, no research has been undertaken on interactions between all four key drivers of yield and water use efficiency. As a consequence there is a lack of knowledge on integrated, phenology-specific management strategies. There is an opportunity to conduct research on interactions between phenotype, time of sowing, plant density and nitrogen strategies and their influence on grain yield to create phenology-specific management packages for adoption by growers to capitalise on seasonal opportunities.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	The desired outcome through RD&E activities would be for grower adoption of tactical crop management strategies in relation to time of sowing, plant density and nitrogen applications for cereal cultivar phenotypes to improve yield and yield stability of cereal crops. This could be achieved through: • Block trials to assess the interactions between phenotype, time of sowing, plant density, nitrogen rates and timing across a range of environments and seasons for wheat and barley; • Developing phenology-specific management packages; and • Extension of those packages to ensure uptake by growers.
GRDC projects addressing this issue	Existing GRDC investments providing partial coverage: *Understanding the implications of new traits on adaptation, crop physiology and management of pulses in the Southern Region* (DAV00150) *Management of barley and barley cultivars for the Southern Region* (DAN00173)

TABLE 11 2015 Issue 5: Evaluate the effectiveness of liquid systems to deliver crop inputs (trace elements, fungicides and insecticides).	
The issue	Grower adoption of in-furrow liquid delivery systems associated with seeding equipment is increasing significantly within Australia's cropping zones. This technology is currently utilised to apply a range of products including fungicides, insecticides, trace elements and rhizobia inoculants into the seed row. Prior research has been conducted into liquid delivery of liquid forms of nitrogen and phosphorus into the seeding furrow. SARDI have conducted field trials in the Southern Region to generate efficacy data to support approval by the Australian Pesticide and Veterinary Medicines Authority (APVMA) of products for use in-furrow to minimise yield loss caused by Rhizoctonia. The University of Adelaide has undertaken preliminary work to evaluate the effectiveness of rhizobia products when delivered via liquid systems as well as preliminary trials to investigate the effects of mixing a limited number of liquid plant protection and fertiliser products with rhizobia-based products on crop nodulation. There is currently no available data to support the efficacy of most products commercially applied using liquid delivery systems in controlling target pests, diseases or supplying crop nutrients. In addition, in-furrow liquid delivery use patterns are not registered for most fungicide and insecticide products and information on whether these delivery methods risk exceeding maximum residue limits in treated crops is not available.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	The MRZ RCSN recommends RD&E to identify key products delivered by liquid systems followed by an evaluation of the performance of these products applied via these systems. The initial step would be to identify how liquid in-furrow delivery systems are currently being used by growers. This information could be derived from a survey of growers and agronomists/advisers within the Southern Region. This would provide detail on key products applied, e.g. fungicides, insecticides and crop nutrients, rates of application, and perceived effectiveness. The survey results would also identify priority products for evaluation in field trials. It is envisaged that during the survey process, grower experiences in delivering nutrient and crop protection products via liquid systems would be captured, e.g. tips, traps, product compatibility issues. The secondary stage would include replicated field trials to evaluate the efficacy of key products when applied using in-furrow liquid delivery systems. The key findings and messages would be communicated and extended to growers and agronomists/advisers.
GRDC projects addressing this issue	**Current investments providing partial coverage of this issue:** *Plant Health Australia – Pathways to Registration* (PH00012) *Optimising nitrogen fixation of grain legumes – Southern Region* (DAS00128) **Recent GRDC investments that provided partial coverage of this issue:** *Alternative insect management strategies to maintain and increase beneficial species, avoid insecticide resistance and reduce personal exposure to insecticides* (HFG00007) *Evaluating the use of precision agriculture technology to increase the efficacy of slug baiting systems in no-till cropping systems* (SAM00001) **Joint GRDC-SAGIT investment:** *Quantifying productivity and profitability gains with liquid injection systems on clayed sands* (ELD215)

TABLE 12 2015 Issue 6: Understand how to manipulate the interactions between competitive cultivars, times of sowing, seedbed utilisation and canopy management to effectively manage weed seedbanks.

The issue	New and innovative management packages that better incorporate a range of non-chemical management strategies are required to enable growers to more effectively manage the major weed species of annual ryegrass, brome grass, barley grass, wild oats and wild radish. Post-emergent herbicide options are often inadequate for controlling these major weed species. The management of weed seedbanks is a key consideration for growers and advisers in planning rotation and agronomic management. Growers and advisers recognise that crop competition, including the use of more competitive cultivars is a useful element in a more holistic weed management package. Manipulating the interactions between competitive cultivars, time of sowing, seedbed utilisation and canopy management are non-chemical strategies that can be employed in combination with herbicide and/or harvest seedbank treatments to improve the management of these key weed species. Genetic material selected for competitiveness has not been adopted and recognised in breeding priorities. There is currently a lack of information and knowledge to compare the relative competitiveness of varieties at different periods during the growing season. Past research into competitive crops has been undertaken in isolation of other tactical agronomy practices to build upon and maximise the advantages of crop competition. There is also a lack of available information that quantifies the effect of different canopy management strategies on weed seed set of the identified weed species. The management of weed seedbanks is the most important consideration for growers and advisers in planning rotation and agronomic management. Individual paddock yields and annual profit are only short-term indicators. There is a need to consider the long term benefits from integrated weed management strategies from a whole of farm business perspective. Advisers and growers acknowledge that not achieving maximum yield is a necessary compromise to achieve long-term effective weed management.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	A desired practice change would be for growers and advisers to adopt agronomy packages that employ non-chemical strategies manipulating a range of factors and interactions to manage the major weed species. A research response in the first instance is required to determine the relative contributions that a range of variables and interactions have on weed seedbanks over a number of seasons. Proposed research activities would include a multi-factorial trial with a minimum of two representative trial sites. It is suggested the scope of this proposed investment is initially limited to wheat and barley to establish the key principles before including a wider range of crops and pastures. It would, however, be desirable to include canola plots using best management practice to understand the effects on seedbank and weed population dynamics in the subsequent cereal crops. Variables would include time of sowing, varieties including CSIRO-selected competitive cultivars, seeding rates, seedbed utilisation (not just row spacing), row orientation (north-south verses east-west) and canopy management including nitrogen rates and timing of application. It would be useful to also include herbicide and harvest weed seed treatments to quantify how crop competition can improve the effectiveness of these management practices. It is essential that meaningful data is collected to quantify the impacts of the specific treatments as well as the combined package. The required measurements should include plant population, tiller numbers, soil moisture at key timings and growth stages, yield, grain quality and weed seedbank, e.g. viable seed numbers for each of the five identified weed species. It is also critical that extension is an integral component of this investment.
GRDC projects addressing this issue	*Management of barley and barley cultivars for the Southern Region* (DAN00173) *Development and evaluation of weed competitive wheat cultivars* (UA00061, UA00112) Numerous investments via the Australian Herbicide Resistance Initiative *Genetically improving wheat's ability to outcompete weeds* (CSP00182) *Improving IWM practice on emerging weeds in the Southern and Western regions* (UA00149) *Weedsmart* (UWA00172)

TABLE 13 2015 Issue 7: Pests in retained stubble systems – slugs, snails, millipedes, slaters, earwigs and wireworms.	
The issue	The extent, severity and frequency of damage in crops during early crop establishment is increasing due to a range of emerging invertebrate pests including earwigs, millipedes and slaters. While these invertebrates have been present in crop systems for some time, they have not traditionally been considered pests. Broadleaf crops such as canola and pulses are especially prone to damage from these emerging pests. Impacts are primarily on crop establishment, however some issues have arisen with earwig contamination of canola at harvest. There is some existing knowledge and control options available for wireworms. There have also been knowledge gaps identified and effective control strategies developed for the small conical snail. Slugs are an intermittent pest in the medium-rainfall zone. Growers and advisers require tools that are able to detect, estimate numbers and monitor activity of slugs to avoid damage to establishing crops. On the other hand, earwigs, millipedes and slaters have emerged as significant invertebrate pests in minimum and no-till farming systems with high stubble loads. Stubble retention, reduced tillage and increased soil organic matter are thought to have provided a more favourable environment for these pests to survive and reproduce and therefore the size of these populations has continued to increase. There is a need to understand the interaction between stubble load and stubble management strategies on pest numbers. Currently there are no effective target-specific chemical control options to manage these pests. Current management generally relies upon the application or repeated applications of non-specific insecticides while these pests are thought to be feeding on crops. The effectiveness of this practice is highly variable and is not considered sustainable given the impact on beneficial species and the potential development of insecticide resistance.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Research is required to gain an improved understanding of the specific biology, life cycle and breeding and feeding behaviours of the *Prietocella barbara* conical snail. Specific knowledge gaps include understanding the environmental conditions that trigger feeding activity and favour breeding and egg-laying of this species. Developing and evaluating strategies that will improve the effectiveness of current control strategies is also required. It is critical to understand why current management, particularly chemical (baiting) control, is ineffective and to investigate opportunities to increase the effectiveness of baiting. Further research and development is also required to identify and evaluate new and alternative control options. Extension to share knowledge and experiences in harvest and post-harvest strategies to exclude and remove *P. barbara* from grain is required in those areas where the small pointed conical snail is a relatively new pest. The development of an integrated pest management (IPM) strategy specifically designed for emerging pests, e.g. slaters, earwigs and millipedes, is needed. The strategy should enable or include: • An understanding of the specific biology, life cycle and behaviour of each pest. Currently this is a key knowledge gap limiting the development of effective IPM strategies; • Monitoring tools for growers and advisers to correctly identify presence of pests in crops, quantify pest numbers and the level of crop damage. Monitoring tools that are currently available include pitfall and refuges traps. Catches in these traps have not been correlated to pest densities feeding on crops and levels of crop damage. These pests regularly occur in combination and it is often difficult to identify and attribute crop damage to an individual pest or the combinations of these pests and other invertebrates such as slugs. Hence, the development of monitoring tools is required to enable an accurate identification of the damage caused by each of the individual pest species and an assessment of the relative levels of damage; • Development of economic thresholds for pest species to guide growers and advisers with decisions on pest control; • A suite of cultural control tactics to manage pest populations to limit crop damage and economic losses to growers. For example burning and tillage which reduce stubble loads and available refuges are considered to be effective strategies that can reduce the numbers of these pests. It is therefore important to better understand and evaluate how stubble retention and other cultural control strategies influence the population dynamics of these pests and the level of damage caused to establishing crops; and • The development of a suite of chemical control tactics to manage pest populations to limit crop damage and economic losses to growers by identifying, evaluating and, if applicable, registering target-specific options for emerging pests. Ideas for RD&E to address the issue of slugs include: • Quantifying and validating the relationship between slug activity and soil moisture for a range of soil types; • Using the existing network of soil moisture probes and available tools to quantify the relationship between soil moisture and slug activity. This will provide an early warning system to enable growers and advisers to enact strategies to proactively manage slug populations; • Building sources of locally relevant data to validate research findings; • Collecting data to calculate a cost-benefit analysis of a range of approaches and management strategies;

TABLE 13 CONTINUED PAGE 25

TABLE 13 (CONTINUED) 2015 Issue 7: Pests in retained stubble systems – slugs, snails, millipedes, slaters, earwigs and wireworms.	

	• Developing and producing a decision-support tree and specific integrated slug management guidelines for growers and advisers to:
	  • Assess the level of risk for crop damage at a paddock level based upon parameters including paddock history, soil moisture, stubble load, paddock preparation and sowing intention;
	  • Determine slug activity and breeding;
	  • Identify cultural and chemical management strategies required to avoid damage to crops caused by slugs; and
	  • Access best management practice guidelines to implement an effective integrated package of cultural and chemical strategies.
	• Local extension activities using a range of communication and extension tools and via a range of networks; and
	• Identifying and developing enduring mechanisms, e.g. GRDC Push Notifications to enable an early warning system for slug activity to be communicated to grower and adviser networks.

GRDC projects addressing this issue	*Stubble Initiative – maintaining profitable farming systems with retained stubble, comprising research support* (CSP00186), coordination and communication support (DAS00145) and component farming systems projects with specific focus on pests (EPF00001, CSP000174, LEA00002, MFM00006, MSF00003, RPI00009, UNF00002 and YCR00003) *Current invertebrate pest management options risk matrix* (ICN00020) *New knowledge to improve the timing of pest management decisions in grain crops* (CSE00059) *Improved management of snails and slugs* (DAS00134)

TABLE 14 2015 Issue 8: Understanding and extending knowledge about the ecology and control strategies for emerging weed species which are difficult to control.	
The issue	Over time, GRDC's Southern Region has seen an emergence of challenging and difficult to manage weed species. Climate change may be a factor in the emergence of new weed species. Changes in rainfall patterns and warmer temperatures may provide conditions for some species to proliferate. Herbicide resistance development in weed species is also a factor that contributes to the potential proliferation of existing weed species.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Understanding weed ecology is foundational knowledge in predicting which species may emerge as potential threats and is the first step in developing effective weed management strategies. Research is required to evaluate and develop effective control strategies for a range of identified new and emerging weed species. Extension is required to enable growers and advisers to effectively identify, predict and manage a range of emerging and challenging weed species. The identified weed species include marshmallow, sow thistle, fleabane, statice, wild lettuce, hogweed, hairy panic/fairy grass and Feathertop Rhodes grass.
GRDC projects addressing this issue	*Locally important weeds* (DAW00257) *Improving IWM practice in the Southern Region – Emerging Weed Issues (UA00134) Improving IWM practice on emerging weeds in the Southern and Western regions* (UA00149) *Emerging weeds – Seed-bank biology of emerging weeds* (UA00156) *Weed management in Southern Region mixed farming systems – strategies to combat herbicide resistance* (UCS00020)

TABLE 15 2015 Issue 9: Reduced sensitivity of chemicals, including herbicide, insecticide and fungicide resistance.

The issue	**Herbicide resistance:** This is a major issue that challenges productivity and profitability. There is already significant RD&E investment tackling this issue. **Fungicide resistance:** Crop diseases are a major constraint to production and profitability of farming systems. Fungicides are an effective tool for controlling fungal crop diseases and the use of fungicides has dramatically increased over the past 15 years. The reliance and repeated use of a limited number of fungicide groups has increased the risk and rate of development of fungicide resistance. Growing susceptible varieties has exacerbated this risk. It is critical there is industry stewardship to ensure a consistent coordinated approach to manage fungicide resistance and prolong the efficacy of new and existing chemical compounds. The mechanism and development of fungicide resistance is predictable and it is expected that fungicide resistance in Australia will continue to replicate the experiences from the United States and Europe. Fungal pathogens and mutations have the propensity to rapidly disperse across large geographical areas. Hence, the principles, strategies and key messages need to be communicated widely. Identified knowledge gaps for growers and advisers and the industry more generally include a lack of awareness about the current extent and identified threats of fungicide resistance, a lack of knowledge, tools and communication and extension to enable growers and advisers to implement integrated disease management (IDM) strategies, and limited RD&E effort across the Southern Region. Attitudinal change is required as advisers and growers use fungicides prophylactically based on crop growth stage. New varieties are not meeting expectations or benchmarks for disease resistance. **Insecticide resistance:** The damage, consequences, losses and control of insect pests represent significant costs for growers and the grains industry more generally. The occurrence, size of populations and levels of damage caused by insect pests is often intermittent and highly variable depending upon seasonal conditions and is continually evolving in response to new farming systems and practices. The rapid and increasing development of insecticide resistance is limiting the ability of growers and advisers to effectively control a range of important insect pests. Insecticide resistance in green peach aphid (GPA) is widespread and includes a number of insecticide groups. Resistance to a number of key insecticide groups has also become common to widespread in diamondback moth (DBM), an important insect pest of canola across the Southern Region. In addition redlegged earth mite (RLEM) has acquired resistance in Western Australia to the two insecticide groups that are registered as foliar sprays for this pest. It is essential there is a coordinated approach to predict, test and monitor the extent of insecticide resistance and develop and implement integrated strategies and guidelines to manage and abate the impacts of insecticide resistance. The development of integrated strategies that are adapted to provide locally specific and practical guidelines would provide growers and their advisers with the necessary tools to use a range of integrated tactics to manage insecticide resistance. Extension of consistent messages and information on how to apply the guidelines to manage important insect pests is required to support growers and advisers to achieve on-farm adoption. Extension is also required to shift attitudes and provide the motivation to reduce the reliance on chemical control solutions and the prophylactic use of insecticides which is fundamental for managing insecticide resistance. The Grains Pest Advisory Committee (GPAC) and its National Insecticide Resistance Management (NIRM) working group have developed two Insecticide Resistance Management Strategies (IRMS). GPAC has prepared a report for GRDC and other stakeholders entitled A Status Report on Insecticide Resistance in the Australian Grains Industry. Independent Consultants Australia Network (ICAN) prepared a report on the chemical vulnerabilities.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	**Fungicide resistance:** A coordinated approach that includes the Centre for Crop and Disease Management (CCDM), key pathology groups, RD&E providers and a network of growers and advisers would improve the capacity of the industry to predict, identify and monitor the development and extent of fungicide resistance at the regional and local level. This would include preparing a situation analysis detailing the current status and extent of fungicide resistance for the important diseases of the major crops and undertaking a risk assessment to identify the threats, risks and impact/cost of predicted fungicide resistance. Integrated Disease Management guidelines which detail the principles and strategies to manage key diseases and fungicide resistance for growers and advisers would be developed. These guidelines will include customised messages and guidelines specific to the agro-ecological zones. These guidelines will include a range of key diseases (not individual diseases in isolation) given local environments, farming systems, genetics and the risk or level of insensitivity and resistance. Communication and extension is required to raise the awareness among growers and advisers of the risks and cost of fungicide resistance and then deliver a range of activities and products to ensure growers use IDM strategies to manage key diseases.

TABLE 15 CONTINUED PAGE 27

TABLE 15 (CONTINUED) 2015 Issue 9: Reduced sensitivity of chemicals, including herbicide, insecticide and fungicide resistance.	
	Insecticide resistance: Collaboration between the Grains Pest Advisory Committee (GPAC) and its National Insecticide Resistance Management (NIRM) working group, agro-chemical companies and the grower, agronomist and consultant sectors is required. This would include identifying and prioritising locally important insect pest species by insecticide resistance combinations based on the current situation and identified risks. Work would develop or adapt industry agreed, regionally-specific best management practice guidelines for the integrated management of insect species and resistance. It is essential that guidelines are customised for local environments and farming systems. Guidelines must be simple, practical and detail how a grower or agronomist can implement the tools on-farm. New or additional resources required, e.g. decision-support tools for growers, agronomists, advisers and consultants would be developed and distributed. Research should also aim to build the skills and capacity of the grains industry RD&E sector to monitor, adapt, refine and implement integrated strategies to manage and reduce the impacts of insecticide resistance.
GRDC projects addressing this issue	**Fungicide resistance current investments:** GRDC – Curtin University Bilateral Agreement – Centre for Crop and Disease Management (CCDM) *Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in southern NSW* (DAN00177) **Insecticide resistance current investments:** GRDC Grains Pest Advisory Committee (GPAC) and National Insecticide Resistance Management (NIRM) working group *Diamondback moth (Plutella xylostella) control and insecticide resistance management* (DAS00094) *Insecticide resistance management in RLEM and chemical sensitivities of other grain pests* (UM00057)

TABLE 16 2015 Issue 10: Plant growth regulators (PGRs) – when to use.	
The issue	PGRs and various fungicides have traditionally been considered tools that can reduce the risk of lodging in cereal crops with a high yield potential. Reducing lodging has the potential to increase yield, improve grain quality and the efficiency of harvest. However, the effects and results of PGR application have been highly variable and not well understood, often being attributed to a range of complex genetic x environment x management (GxExM) interactions. The use of PGRs may offer a range of other potential benefits including increased water use efficiency and harvest index, the ability to manipulate crop architecture to enhance disease and weed management, extended green leaf area retention, and increased dry matter partitioning to improve potential grain yield and quality. It is also suggested that the application of gibberellic acid, which promotes the elongation of cells and plant growth, has the potential to increase plant height and water use efficiency of crops in low-rainfall environments. The range of potential benefits combined with an increased availability and range of PGR products and declining prices have provided further motivation to better understand and evaluate the future role of PGRs. The current lack of knowledge and unreliable results has meant that growers and advisers are not confident that the application of PGRs is a sound investment given additional input cost and risk. A significant amount of RD&E has generated a wealth of information, knowledge and experience in the use of PGRs within the agro-chemical companies, RD&E organisations, and retail agronomy and advisory/consultancy sectors. However, this prior RD&E has been undertaken on an ad hoc basis. The consequence is that there is not a collective source of current knowledge and the causes for the variability in responses remains unclear.
RCSN prioritising this issue	Medium-rainfall zone

RD&E actions to address this issue	It is suggested that the primary knowledge gap is the ability to understand the complex GxExM interactions. An improved understanding of these complex interactions could explain the variable crop responses to applications of PGRs. It is thought that this knowledge would also assist to identify the situations and conditions where the application of a PGR could be expected to provide a return on the investment and refine the rates and timing of applications. Given the complexity of these interactions, the broader range of available products and potential benefits of PGRs, it is suggested that specific knowledge is required for a wider selection of cereal, canola and pulse crops and varieties across a range of diverse environments. It would be useful to first collate existing scientific and grey literature to inform and design future RD&E investment. Research could include:
	• A cost-benefit analysis that includes benefits other than yield economics, e.g. risk versus rewards;
	• Evaluation on the impact of PGR active ingredients, rates and timing on:
	  • Yield and grain quality;
	  • Harvest index;
	  • Canopy management and effects on disease and weed management;
	  • Improved green leaf area retention;
	  • Timeliness of harvest – timing and sequence of varieties/crops; and
	  • Harvestability/harvesting costs and stubble management.
	• Validation of effects of PGRs across a range of environments; and
	• Variety-specific agronomy packages (VSAPs) to include the use of PGRs supported by evidence.

GRDC projects addressing this issue	**Partial coverage within current investment:** *Understanding the implications of new traits on adaptation, crop physiology and management of pulses in the Southern Region* (DAV00150)

TABLE 17 2015 Issue 11: Identifying potential uses of tools to be developed that can be employed using robotic platforms for the grains industry.	
The issue	The use of robotic and automation technology, including the use of drones, is being developed in other agricultural industries, but it appears not to be widely utilised in the Australian grains industry. Farm robotics and automation has the potential to reduce labour costs, provide labour equivalent units where there is a limited workforce and improve the capability and capacity for data collection and management. There is considerable potential for automation of repetitive and laborious tasks, such as soil sampling and scouting for pests, weeds and diseases. Currently in Australia there is limited use of drones by a small number of growers and advisers to survey paddocks to assist in the management of weeds. In North America, drones are being used to manage nitrogen in corn crops. This technology has the potential to provide a platform for the use of alternative non-chemical pest, weed and disease control measures. The development of drones is more advanced than other types of robotic and automation technologies within the grains industry. However, growers and advisers are unaware of technological developments and applications, and their lack of knowledge and skills is an identified barrier to the development and adoption of this technology. The medium-rainfall zone RCSN would like to see the identification and cost-effective adaption of robotic technology for use in broadacre agriculture in the medium to longer-term. The GRDC Southern Regional Panel has also had input into the development of this issue.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Robotic technology and automation for use in broadacre agriculture needs to be identified and cost-effectively adapted. Growers and their advisers need to be provided with the knowledge and tools to understand and identify the opportunities and risks associated with adopting these technologies. Opportunities are required for growers, advisers and researchers to bring together existing ideas and developments through seeking out overseas technology, identifying who is developing it and possibly employing a key driver to identify the opportunities and risks associated with adopting this technology.
GRDC projects addressing this issue	There are a range of GRDC investments linked to this issue. Some investments in crop protection (pest, weed and disease) and nutrition have key elements that are linked to the development of potential robotic and automation technology. *Active implements for precision seed and fertiliser placement* (UNS00002) *Detection of crop establishment issues using Unmanned Aerial Vehicles (UAVs) for timely interventions and resowing decisions in canola* (SFS00030) GRDC partnership with Cooperative Research Centre for National Plant Biosecurity (CRCNPB) for development of lightweight, on-the-go sampling devices e.g. fungal spore traps that could be mounted on autonomously controlled aircraft or unmanned aerial vehicles (UAVs).

TABLE 18 2015 Issue 12: Crop-topping of cereals – sharing knowledge and experience to build confidence and increase use.

The issue	Crop-topping with non-selective herbicides is an extremely useful weed management tool. Crop-topping in cereals offers an in-crop management strategy to prevent seed set of herbicide resistant annual ryegrass which is particularly desirable given the poor effectiveness of post-emergent selective herbicide options. Crop-topping is being successfully used by advisers and growers in a number of districts, particularly the Mid North and Yorke Peninsula districts of SA. Despite these successes, the wider adoption of this technique in other cropping districts in SA, Victoria and NSW has been limited by the skills and confidence of advisers and growers to successfully apply this weed management tool. Correct timing of the crop-topping operation is of crucial importance to avoid yield losses and reduced grain quality. The optimal timing for crop-topping requires the measurement of wheat head moisture using a robust sampling, oven drying and weighing procedure. Given the perceived complexity in determining the appropriate timing for crop-topping and risks of incorrect application, the uptake of the technique is likely to be limited by the confidence and skills of advisers and growers.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Extension is required to increase the knowledge, skills and confidence of advisers that will support growers to adopt the use of crop-topping in cereals. Key messages include the choice of herbicide product, appropriate application rates, suitable cereal varieties, identifying the correct time of application to prevent weed seed set and avoid/minimise and yield and grain quality losses and application, e.g. spray quality, water rates, adjuvants and environmental conditions. Strategies include targeted adviser training in the southern Mallee, Upper South East and Eyre Peninsula districts of SA, as well as key cropping districts across the medium-rainfall zones of Victoria and southern NSW. Training is to be delivered by advisers who are experienced in the practice of crop-topping in cereal crops and work with a client base which has widely adopted the technique. Decision support material such as a how-to guide to support the workshops together with a YouTube video and technical articles to be developed.

TABLE 19 2015 Issue 13: Protocols and guidelines for off-label chemical use (trials, communications and advice).

The issue	The off-label use of plant protection products is a major issue and potential threat for the Australian grains industry. Off-label chemical use is often a consequence of either gaps in chemical use patterns or a lack of chemical options approved by the Australian Pesticides and Veterinary Medicines Authority (APVMA) for specific pests, weeds and diseases. Pursuing new options or uses is the role of the agro-chemical company registrants. Gaps in approved options are generally a result of registrants not seeking additional use patterns for their product labels. Changes in farming systems and practices evolve more rapidly than APVMA approval and label registrations. Often this lack of registration is the result of reluctance or delays by companies to develop appropriate supporting data. The significant cost of registration for new use patterns for plant protection products given the relative size of the Australian market and therefore the potential return on investment for approval means that agricultural chemical companies will often not seek registration of products for particular use patterns. The availability of generic, off-patent products in the marketplace provides little incentive for agro-chemical companies to invest in the registration of a minor use for an off-patent product. Growers demand that agronomists and consultants provide relevant and cost effective information and solutions to address agronomic challenges. Often these may only be achieved by off-label chemical use. Some agronomists/consultants will, on occasion, provide information and advice to clients which involves off-label chemical use. When off-label information is provided, most agronomists/consultants will maintain a stewardship mindset to avoid exceeding maximum residue limits in produce, damage to crops and minimising any potential impact on the environment. The regulations which govern the advice or recommendation of unregistered and off-label use patterns are often misinterpreted by advisers or are confused by conflicting legal opinions. This confusion is further complicated by variations in regulations which are ultimately the responsibility of state governments. It is also important to recognise that the terms and conditions of liability insurance policies are the instrument which determine the advice and recommendations that are provided. It is also recognised that there is confusion and a lack of information among grower groups and other RD&E providers around the guidelines and protocols for undertaking and communicating results of unregistered and off-label and chemical use trials. It is also suggested there is a lack of awareness and knowledge among growers, agronomists, advisers/consultants and RD&E providers about GRDC's Pathways to Registration program and the range of mechanisms that enable an increased number of farm chemical options to be approved by the APVMA (e.g. Category 25 applications). Furthermore, these sectors do not understand the available processes which enable them to nominate chemical use patterns to be considered via Plant Health Australia. It is worthy to note that it remains unclear what further mechanisms could be developed to address this issue. Hence a communication and extension is considered to be the most appropriate response to address this issue.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Guidelines and protocols for RD&E providers including grower groups to undertake off-label and/or unregistered chemical use trials to include: • Required APVMA permits; • Trial design, methodologies and reporting; and • Parameters for communicating trial results. Guidelines for agronomists, consultants and advisers in providing off-label and unregistered chemical information and advice to include: • Definitive (legal) interpretations of the relevant regulations; • Variations within state-based regulations; and • Implications for professional liability insurance. Promotion of the GRDC Pathways to Registration program and mechanisms to facilitate APVMA approval of farm chemical options: • Target audiences include growers, agronomists/advisers/consultants and RD&E organisations; • Mechanisms for industry participants to nominate chemical use patterns; • Update on APVMA approvals and priorities for GRDC Pathways to Registration project; and • Update on the progress of pathways and minor use.
GRDC projects addressing this issue	*Pathways to Registration* (AKC00005)

The identified priority issues and RD&E needs to address the priorities identified by the medium-rainfall zone RCSN in 2016, and current and recent GRDC investments which are addressing these issues are described below.

TABLE 20 2016 Issue 1: Using the data I have collected and using Precision Agriculture (PA) tools to manage variability and increase profits.

The issue	An enormous amount of data is being collected by growers, however, Precision Agriculture (PA) often seems too hard or complex for the average grower to put into practice. This would include combining the key facets including soil, plant and water data while maintaining a simple and straightforward approach. The RCSN sees potential opportunities and uses for PA including: • Managing variability by identifying management zones and use to customise management and inputs using variable rate technology (VRT); • Better matching crop inputs such as varieties and nutrition to predicted yield based upon plant available water; • Extending a cost-benefit analysis of PA, including VRT and controlled traffic farming (CTF); and • Promoting PA as a source of data to be used as a benchmarking and learning tool. There is also a need to clarify access and ownership of information given privacy laws.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	The desired outcome of RD&E would be to have increased yields and reduced inputs, ultimately resulting in increased profits. Growers and advisers need to identify exactly what is wanted from a PA system and explore existing platforms to identify and make a judgement of the best operating systems to meet identified needs. Work also needs to identify gaps in current systems/platforms that prevent a multi-faceted approach with an aim to investigate and facilitate collaboration between the major providers. This would include providing feedback to PA providers to make improvements to products and services. There is also a need for specialists with the skills to assist on-farm adoption. The RCSN recommends a one year scoping study to identify opportunities and best available systems and identify enablers for adoption. This could include a focus paddock program exploring putting PA into action, demonstrating how to use PA on farms, discussion groups and quantifying the dollar value from using PA.
GRDC projects addressing this issue	*Future Farm Investment – Theme 1: Intelligent sensing* (CSP00201) *Future Farm Investment – Theme 2: Intelligent decisions* (US000709) *Future Fam Investment – Theme 3: Intelligent infrastructure* (USQ00022)

TABLE 21 2016 Issue 2: Whole farm business management.	
The issue	There is a diversity of farming systems and farm businesses and therefore general information and generic advice has limited value. There is a need for whole farm management skills including how to make good, timely and financially sound decisions. It is important to recognise that each individual has strengths and weaknesses and there are benefits in bringing in specialist skills and knowledge. It is also important for advisers to identify gaps in the knowledge of their grower clients and their existing team, including service providers. The next step is knowing how to seek out the right third party to assist, e.g. agronomy, accounting, employment, marketing, and knowing what knowledge, skills, services and value they will bring to the business.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	There exists an opportunity for the GRDC to support capacity building and skills in farm businesses. It is essential that activities/products move to a higher level of adoption and move beyond awareness. A desired outcome is having a resilient farm business which knows where they want to be in the future, where they are now and a vision of how to get there. Improving the competency of growers to make good, timely and financially sound decisions will result from skill development and support for growers to develop business plans and help implementing the plan. A network of regional facilitators could be a key resource alongside small discussion groups to facilitate peer to peer learning. A syllabus would be developed with content, learning outcomes and competencies, with an aim of addressing six key issues. This program would be delivered through workshops, focus groups, short courses and training modules. It would deliver 101 messages and value-add and further extend learnings and key messages from the Plan to Profit (P2P) program. There is also potential to build on outcomes and experiences gained through Grain & Gaze III.
GRDC projects addressing this issue	*Grain and Graze III – Extension and deliver on mixed farm benefits in the Southern Region* (SFS00028) *Farm business logic application through Grain and Graze 2* (NRS00009) *GRDC Farm Business Updates – Southern Region* (ORM00015) *The integration of technical data and profit drivers for more informed decisions* (RDP00013)

TABLE 22 2016 Issue 3: Glyphosate replacement – new modes of action/chemistry and novel solutions.	
The issue	The extent and number of weed species developing glyphosate resistance is rapidly increasing. Glyphosate resistance threatens the viability of no-till systems. It is the key tool for managing fallow periods and non-selective weed control. The grains industry requires alternative options as the efficacy and longevity of glyphosate rapidly diminishes. Alternative options should include alternative chemical options and novel and non-chemical options.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Research is required to develop new chemistry and blue sky research to identify and undertake proof-of-concept for new and novel non-chemical solutions.
GRDC projects addressing this issue	GRDC Australian Glyphosate Sustainability Working Group GRDC-Bayer Agreement Australian Herbicide Resistance Initiative (AHRI)

TABLE 23 2016 Issue 4: Physiology and canopy management especially for pulses and cereals.	
The issue	There is a gap in the foundational knowledge relating to physiology (the individual plant) and canopy (the community of plants) which is required to improve and predict yield. This enables inputs to be matched to predicted yield and therefore improves profitability. Identified knowledge gaps include an understanding of how plants grow; how plants react to environmental conditions, why plants respond the way they do, what the key drivers or factors are that affect reactions, and an understanding of plant communities as opposed to individual plants. These relate to all crops although information for canola is being developed as part of current investments. There are still significant gaps in knowledge for cereals but the opportunity for the biggest gains is in pulses.
RCSN prioritising this issue	Medium-rainfall zone

RD&E actions to address this issue	The desired outcome of research would be growers making better decisions because they better understand crop physiology and how they can respond and manage the crop canopy. Ideas for RD&E include:
	• Identifying the factors and key drivers that affect a plant's reaction to environmental conditions;
	• Understanding the interactions between canopy management and environments and how this influences water use and other issues such as disease and nutrition;
	• Modelling capability to enable exploration of a range of scenarios and understand the likely outcome and predicted yield; and
	• Improved knowledge for pulses to:
	  • Understand the dynamics of nitrogen fixation relative to phenological development;
	  • Understand how environmental conditions and management affect nitrogen fixation; and
	  • Quantify nitrogen inputs and dollar value from pulses.

GRDC projects addressing this issue	*Understanding the implications of new traits on adaptation, crop physiology and management of pulses in the Southern Region* (DAV00150)

TABLE 24 2016 Issue 5: Eyespot.	
The issue	Eyespot is now an established disease and its extent and prevalence is increasing. Farming systems we now have such as stubble retention and intensive cereal rotations favour this disease. While the potential yield loss has not been quantified, trial data has shown up to 20 per cent yield response to fungicide applications. Current short-term GRDC investment finishes 30 June 2016 but there is a need for new or on-going investment to address this issue. Questions raised by the RCSN include whether barley is affected by eyespot, what effect barley has on disease levels, whether barley is a break or host crop, and how to identify which paddocks are at risk. Current fungicide strategies for eyespot are specific and differ to those for stripe rust. However, there is uncertainty around the timing and number of fungicide applications required. There is also a need for further varietal information with screening of more and new varieties.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Research needs to: • Map and quantify the impact (area x yield) and cost of this disease; • Develop a predictive tool to assess level of risk for individual paddocks. This would including assessing the potential for existing predictive research tool/test to become a commercial service; • Understand the implications and effects of barley; • Include screening of varieties to provide susceptibility ratings; and • Develop and refine an Integrated Disease Management strategy and guidelines for growers and advisers.
GRDC projects addressing this issue	*Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in South Australia* (DAS00139)

TABLE 25 2016 Issue 6: Biological sources and amounts of nitrogen, e.g. bacteria and termites.	
The issue	The current understanding of biological nitrogen in farming systems is limited to impacts of legumes in the rotation. We don't have a solid understanding of how changes in our farming systems have affected biological processes, however, these changes could be affecting the nitrogen pool and availability. Examples cited include the observation that termite populations are higher under no-till farming systems. New information has identified a range of different types of organic nitrogen that are contributing to the nitrogen pool, availability and uptake including nitrogen fixing microbes, algae, amino acids and peptides. Fixing nitrogen and building sources of organic nitrogen is desirable given the relative agronomic and financial benefits of organic versus synthetic nitrogen.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Research would include: • A literature review to understand current knowledge and its relevance to current farming systems; • A review of information and investments to inform recommendations for further RD&E and investment; • Quantification of the contributions and availability of alternative sources of organic nitrogen to the pool and nitrogen economy; and • Investigation of the potential application of alternative types of biological nitrogen to supply organic nitrogen.
GRDC projects addressing this issue	GRDC Soil Biology Initiative *Manipulating biological processes that improve nitrogen supply to cereal crops: free-living nitrogen fixing bacteria* (CSP00138)

TABLE 26 2016 Issue 7: Sowing seed hygiene to avoid sowing weed seeds – seedbox survey.	
The issue	Grower attitudes to weeds have changed with more importance on weed management and understanding chemical resistance. Sowing seed hygiene is undefined and less recognised by growers. It is expected there will be a greater emphasis on this issue as seed destruction technology is adopted. Currently, we don't know how many weed seeds are getting through the different types of seed cleaners as the seed certification process is not focused on weed seeds but ensuring seed is true to type. We also don't know what level of soil-borne viruses are being introduced from seed including weed seeds.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	An awareness and education campaign, including a farm biosecurity extension program, is needed including collecting evidence to reinforce messages, encourage attitude change and motivate practice change. Data will be gathered through seedbox surveys of commercial and certified seed and grower-retained seed. Research will evaluate the effectiveness of different seed cleaners in removing weed seeds including species and percentages.
GRDC projects addressing this issue	Australian Herbicide Resistance Initiative (AHRI)

TABLE 27 2016 Issue 8: PGRs in cereals and other crops.

The issue	The use of plant growth regulators (PGRs) is expanding across a wider range of crops and environments, however, results have been highly variable. The RCSN would like to see further work on this to ensure growers and advisers understand when to use PGRs. Current information is largely anecdotal or based on ad hoc trials and there remains the question of economics and whether the risks outweigh the rewards. The financial benefits of PGRs, besides yield, have not been quantified. This includes benefits from improved harvest index, improved harvestability or reduced harvest costs, enhanced stubble characteristics and improved stubble management; improved disease control, competitiveness of crops for improved weed management, timeliness of harvest, canopy management, and improved green leaf area retention. Key knowledge gaps exist for canola, lentils and beans. There is also a lack of knowledge about growth promoting effects and the influence and impact of PGRs on partitioning of carbohydrates and yield or grain quality.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	A review of current knowledge to identify gaps and future RD&E is required. Research would: • Evaluate the effects of PGRs across a range of environments; • Include the use of PGRs, as supported by evidence, in variety-specific agronomy packages; • Evaluate and quantify the economic effects of PGRs, e.g. tiller numbers, harvestability, grain quality, stubble characteristics; • Evaluate the use of PGRs to manipulate phenological development e.g. flowering dates; • Understand how application timing impacts yield in a range of crops including canola and pulses; • Explore the use of PGRs as part of an integrated weed management strategy investigating competitiveness and shading; • Determine compatibility of PGR products with other products for tank mixing; • Define yield thresholds; • Assist in understanding the interaction between plant physiology and environment; • Provide knowledge of the specific phenological development of the range of varieties; • Provide knowledge around growth promoting effects and not just growth suppression; • Explore use of PGRs to increase the opportunity for direct heading of crops given the reduced risk of lodging, head loss and more even maturity of crops; • Explore effects of PGRs on gibberellic acid (GA) response important for crops to overcome stress; • Assist in understanding the effect of PGRs on water soluble carbohydrates and how this can be manipulated for improved grain filling; • Better understand the bounce-back response and if reduced rates can reduce or limit this response; and • Assist in understanding if PGR products are a tool to extend the green leaf area retention of crops through grain filling and maturing development phases.
GRDC projects addressing this issue	**Partial coverage within current investment:** *Understanding the implications of new traits on adaptation, crop physiology and management of pulses in the Southern Region* (DAV00150) *Management of barley and barley cultivars for the Southern Region* (DAN00173)

TABLE 28 2016 Issue 9: Improved harvest management of barley – agronomy, spray-topping, machinery set-up, and windrowing.	
The issue	The RCSN believes growers are failing to capture the full yield potential of barley. There is restricted ability to control weed seed set through spray-topping, which becomes particularly important in higher rainfall seasons and when severe weather events occur. The potential yield loss has not been fully quantified however anecdotal evidence suggests that losses also increase the cost of fallows.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	Research is needed to: • Fully quantify potential yield loss by variety; • Understand and quantify losses due to both mechanical and physical effects, e.g. plant and climate; • Provide evidence to support registration of glyphosate for crop-topping; • Improve agronomic management with regards to variety choice, lodging and head retention, nitrogen management and PGRs; • Explore the potential of windrowing to reduce harvest losses and increase weed seed capture; and • Draw upon existing information and practical experiences from the Yorke Peninsula.
GRDC projects addressing this issue	**Partial coverage within current investment:** *Management of barley and barley cultivars for the Southern Region* (DAN00173)

TABLE 29 2016 Issue 10: Vetch as a pulse – identifying markets.	
The issue	Vetch is a widely adapted legume break crop in the medium-rainfall zone and is a versatile crop that can be used for grain or hay, fodder, forage or manure. Globally there is an increasing demand for protein. Pulses are the dominant source of protein in developing countries and there is an opportunity to develop vetch as a pulse. Correct preparation of vetch is critical to remove bitterness, with some countries using vetch for human consumption. In the late 1990s, there were export bans as vetch was mislabelled as a split lentil. Not only was this damaging for the Australian lentil industry but also created a mindset that vetch cannot be used for human consumption. Now, there is an opportunity for a new and higher value market with further value-add opportunities.
RCSN prioritising this issue	Medium-rainfall zone
RD&E actions to address this issue	With a desired outcome of having vetch grown as a high-value pulse crop, research would identify potential markets and develop markets for the human consumption of vetch.
GRDC projects addressing this issue	No current investments due to lack of identified pathway to market.

7. High-rainfall zone RCSN

The high-rainfall zone RCSN has 15 members, including four GRDC Southern Regional Panel members, five growers, two researchers and eight advisers, who are located in an area from Lucindale in south-east South Australia to Cootamundra in southern New South Wales and Carrick in northern Tasmania. The high-rainfall zone RCSN is co-facilitated by Trent Potter and Jen Lillecrapp.

The membership of the high-rainfall zone RCSN at June 2016 is shown in Table 30. Two members, John Bennett and Jon Midwood, were appointed to the GRDC Southern Regional Panel in September 2015. Jon Midwood continued to serve on this RCSN in his capacity as a GRDC Southern Regional Panel member. An audit of skills, knowledge and networks of industry stakeholders was undertaken to guide the targeted recruitment of members to fill the vacancy. Rowan Paulet, a grower from Flynns Creek in the Victorian Gippsland district and Ben Leditschke, an agronomist from Huonville in Tasmania, were appointed to this RCSN in September 2015. GRDC Southern Regional Panel members Chris Blanchard and Susan Findlay-Tickner retired from the panel and this RCSN in August 2015.

The issues for RD&E needs identified by the high-rainfall zone RCSN in 2015 were:

- Sustainable farming systems that reduce costs but increase profitability;
- Integrated weed management – developing integrated cultural and chemical management packages to manage herbicide resistant weeds;
- Nitrogen management – developing and validating technologies and tools to improve budgeting and decisions;
- Sub-soil constraints – understanding how acidity, sodicity, nutrients and structure limit yield; and quantifying the economic impact of amelioration;
- Slugs – effective control packages in high stubble load situations;
- Evaluating the effectiveness of fungicide strategies to manage septoria tritici blotch and leaf rust;
- Genetic advancements, soil amelioration and drainage strategies to reduce the impact of waterlogging;
- Millipedes, slaters and earwigs – understanding these pests and impacts of chemical control options on these pests, beneficial species and population dynamics;
- Understanding the opportunities and impact of growing cover crops in rotations across the HRZ;
- Plant growth regulators – understanding key interactions, compiling data and filling gaps in registrations;
- Building the capacity of growers, grower groups advisers/ consultants and researchers;
- Fungicide resistance – awareness and growers and advisers understanding risks; and
- International knowledge – facilitating the transfer of knowledge of agronomic research and systems from overseas that can be adapted to local high-rainfall environments and farming systems.

The high level issues for RD&E needs identified by the high-rainfall zone RCSN in 2016 were:

- Growing the 6t/ha canola crop – variety-specific agronomy packages to maximise yield potential, reducing harvest losses and extension, including case studies;
- Managing sub-surface and subsoil acidity;
- Variety-specific agronomy packages for growing barley in irrigated and high yielding environments;
- Understanding nutrition (nitrogen, phosphorus, potassium, sulfur and trace elements) limitation for high-yielding cereals in the HRZ;
- Optimum (early) sowing time and management of early sown crops to optimise yield and maximise profitability;
- Millipedes, slaters and earwigs – understanding impacts of chemical control options on these pests, beneficial species and population dynamics;
- New or alternative nitrogen fixing (pulses and/or legume) crops and management packages for low pH soils which are prone to waterlogging;
- Quantifying the potential use of cover and/or summer crops to minimise winter waterlogging;
- Better use of the data that growers collect;
- Soil health – increasing organic matter to address declining levels and consequences;
- Controlled traffic farming in the HRZ – an economic study; and
- New crops in the rotation, including linseed, buckwheat, fodder beet, poppies and a range of summer crops.

The high-rainfall RCSN also reviewed progress and key outcomes of GRDC investment Optimising the yield and economic potential of high input cropping systems in the HRZ (DAV00141) to identify future opportunities for RD&E to ensure the outcomes of this investment will deliver on-farm benefits for growers.

TABLE 30 Members of the high-rainfall zone Regional Cropping Solutions Network (at 30 June 2016).

Member	Occupation	Location
John Bennett** (since September 2015)	Grower	Lawloit, Victoria
Chris Blanchard*	Researcher (Charles Sturt University)	Wagga Wagga, NSW
Phil Bowden	Adviser (consultant)	Cootamundra, NSW
Mark Branson	Grower	Stockport, SA
Michael Chilvers	Grower	Nile, Tasmania
Tony Geddes	Grower	Holbrook, NSW
Philip Hawker	Adviser (agribusiness)	Derrinallum, Victoria
Terry Horan	Adviser (agribusiness)	Carrick, Tasmania
Ben Leditschke (appointed October 2015)	Adviser (agribusiness)	Huonville, Tasmania
Mike McLaughlin**	Researcher (University of Adelaide)	Glen Osmond, SA
Jon Midwood**	Adviser (grower group)	Inverleigh, Victoria
Rob Norton	Researcher (International Plant Nutrition Institute)	Horsham, Victoria
Rowan Paulet (appointed October 2015)	Grower	Flynns Creek, Victoria
Lawrence Richmond	Adviser (consultant)	Ballarat, Victoria
Lachlan Seears	Grower	Lucindale, SA
Mark Stanley**	Adviser (consultant)	Port Lincoln, SA
Susan Findlay-Tickner*	Grower	Horsam, Victoria
Kate Wilson**	Adviser (consultant)	Hopetoun, SA

* GRDC Southern Regional Panel member until August 2015

** Current GRDC Southern Regional Panel member as at 30 June 2016

PHOTO: GRDC

The HRZ RCSN members. L-R (back row) – Ben Leditschke, Michael Chilvers, Trent Potter, Rob Norton, Lawrence Richmond, Terry Horan, Mark Stanley. L-R (front row) – Rowan Paulett, Jon Midwood, Mark Branson, Jen Lillecrapp, Kate Wilson, Lachie Seears, Phil Bowden, Mike McLaughlin, Phil Hawker. Absent – Tony Geddes.

High-rainfall zone 2015-16 priorities

The identified priority issues and RD&E needs to address the priorities identified by the high-rainfall zone RCSN in 2015, and current and recent GRDC investments which are addressing these issues are described below.

TABLE 31 2015 Issue 1: Sustainable farming systems that reduce costs but increase profitability.

The issue	Farming systems are dynamic and must continually evolve to adapt to changing climatic and market conditions. Farm businesses in the HRZ are complex with a greater diversity of enterprises and diversity within enterprises. Rising costs and declining terms of trade in a volatile environment are continuing to increase the financial risks and reduce profits of the farm business. The major issues that challenge the management and performance of the farm business are a consequence of current farming practices and systems. Commodity price is the key driver of profit. However, growers have a limited ability to influence commodity prices. An achievable and realistic approach within the control of growers is to develop and implement tactical management strategies to both increase yields and reduce costs. Reducing cost structures is also a valid and effective strategy to mitigate the financial risk exposure of the farm business which is critical in a volatile climatic and market environment. The foundation information for applying this approach is to understand cost structures including fixed costs and comparative benchmark productivity. This knowledge will enable growers to critically analyse the farm business and develop plans and strategies, both strategic and tactical, for the most effective strategies to reduce costs and increase or optimise yields. The above mentioned information will also enable growers to assess the impacts of a range of scenarios, strategies, decisions and potential opportunities. This information will enable growers and advisers to more objectively examine and evaluate the basis for decision-making.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The combination of data sets derived from research and farm records would assist in building a better understanding of farm businesses. This information would then provide the foundation for an evidence-based approach to evaluate, quantify and compare the impact of farming systems on the economic potential and sustainability of the farm business in the HRZ. Ideas for RD&E include to: • Collate, analyse and interpret relevant RD&E data sets e.g. GRDC Water Use Efficiency Initiative, crop sequencing trialsand agronomic studies; • Interrogate existing farm business management data sets e.g. Plan to Profit and others to identify gaps to establish HRZ specific benchmarks, including enterprise performance, enterprise mix and income and cost structures; • Develop a single user-friendly mobile app farm record-keeping system for growers; • Develop skills and tools to enable growers and advisers to monitor trends and benchmark key performance indicators; • Identify common factors that limit the profitability of the farm business and opportunities or innovative strategies to overcome these limitations to inform future RD&E needs; • Investment to understand the economic potential of identified opportunities, including subsoil amelioration and new or alternative crop types and varieties, including long season crop options, cover crops and alternative legume crops and pastures; and • Quantify the implications of predicted changes in climatic conditions given a range of alternative farming systems.
GRDC projects addressing this issue	*Practical financial figures for farm business management; aka AgProfit* (APR00001) *N fixing break crops and pastures for high-rainfall zone acid soils* (DAN00191) *Understanding the implications of new traits on adaptation, crop physiology and management of pulses in the Southern Region* (DAV00150) *Understanding the amelioration processes of the subsoil application of amendments in the Southern Region* (DAV00149) *National paddock survey initiative* (BWD00025) *Optimising nitrogen fixation of grain legumes* (DAS00128) *Optimising yield/economic potential of high-input cropping systems in the HRZ* (DAV00141) *Spatial variability of sodic acidity and response to liming in the HRZ of Victoria* (DAV00152)

TABLE 32 2015 Issue 2: Integrated weed management – developing integrated cultural and chemical management packages to manage herbicide resistant weeds.

The issue	The HRZ RCSN has identified the need to develop integrated cultural and chemical management packages to manage herbicide resistant weeds. They identified the following issues specific to the HRZ:
	• Maximising the results and long term effectiveness of Sakura® and understanding what the best management practices are for use of this product under HRZ conditions;
	• Knowledge gaps exist in levels of herbicide resistance in ryegrass seed bought to be used in sown ryegrass pastures and the implications;
	• Brown manuring of crops and pastures can be a useful tool for managing weed seed banks, however, the effectiveness of this strategy is reliant upon the control of all weed seeds. Climatic conditions in the HRZ during spring frequently mean that weed seed set is compromised;
	• Intrusions into agricultural/cropping paddocks from roadside glyphosate resistant plants;
	• Lack of understanding about the specific variations in the ecology of wild radish in the HRZ given the unique environmental conditions and farming systems;
	• Opportunity to develop robotic technology including drones to map weeds, including species, distribution and densities to enable more targeted weed management strategies;
	• Limitations of windrow burning in the HRZ including the inability to contain burning to windrows given escapes and heavy stubble loads that lead to burning the whole paddock as well as the inability to effectively or efficiently burn windrows that are wet or have become moist and compacted;
	• Management of the staggered and late germination of weeds remains the major limitation to effectively managing major weed seed species. This issue is exacerbated by the lack of effective post emergent (in-crop) herbicide options as a consequence of the extent and level of herbicide resistance;
	• Increasing the use of baling for silage or hay to reduce weed seed set;
	• Ineffective weed control on waterlogged areas remains a significant challenge given the following issues:
	  • The effectiveness of herbicides is compromised when applied under waterlogged conditions;
	  • Reduced crop competition;
	  • Trafficability limits optimum herbicide application timings; and
	  • Late germinations of weeds following the conclusion of the waterlogging period.
	• Information is required to understand and quantify the effect of row spacing, sowing direction and soil disturbance on crop competition as a weed management strategy; and
	• Sowing crops, including fodder crops, as a strategy that allows alternative or additional control options.

RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The identified specific issues that require further RD&E include: • Maximising the results and long term effectiveness of Sakura®; • The effect of stubble management including grazing, burning and incorporation; • Cultivation and seedbed preparation; • Seeding systems; • Rates and mixes, including Avadex Xtra® to extend effectiveness and length of persistence; • Incorporation methods to provide a concentration of product where target weed species seeds are in the soil profile; • Effects of soil types, rainfall/moisture and organic carbon, rotation (frequency of use) to ensure longevity of this product extension is essential to support value of RD&E to ensure adoption of best management practices; • Extension to increase the adoption of best management practice packages for brown manuring and follow-up strategies in crops and pastures to ensure effectiveness of this tool; • Awareness and knowledge for managers of roadsides, e.g. growers and councils/shires, to recognise the problem of herbicide resistance and the need for practice changes and alternative strategies; • Research to understand the specific variations in the ecology of wild radish in the HRZ; • Develop technologies to map weeds including species, distribution and densities to enable more targeted weed management strategies; • Develop and/or refine effective management strategies and packages to enable growers to effectively manage staggered and later germinations of weeds; • Extension to promote adoption of cutting crops for silage and hay. It is important this focuses on cost-benefit analysis, the impact of silage or hay on driving down the weed seed bank and farmer case studies to provide motivations for adoption; and • Validate the effect of row spacing, sowing direction and soil disturbance on crop competition as a weed management strategy for the HRZ. Further RD&E is necessary to improve the ability to successfully and profitably include spring/summer crops to achieve greater adoption.

TABLE 32 CONTINUED PAGE 42

TABLE 32 (CONTINUED) 2015 Issue 2: Integrated weed management – developing integrated cultural and chemical management packages to manage herbicide resistant weeds.	
GRDC projects addressing this issue	*WeedSmart* (UWA00164) *GRDC support for the Australian Glyphosate Sustainability Working Group* (ARN00001) *Improved herbicide efficacy and longevity in southern no-till farming systems* (UA00144) Herbicide Resistance Management (2015.03.02) *Surveillance of herbicide resistant weeds in Australian grain cropping* (UCS00024) Farm hygiene – improve the uptake and regular practice of good farm hygiene to reduce the spread of herbicide resistant weed populations (GRDC Proposed Investment 2015.03.02B) *Management of Residual Herbicides in Broadacre Cropping (*THA00001) *New uses for existing chemistry* (UQ00080) *Harvest weed seed control for the Southern Region* (SFS00032) *Cultural management options for herbicide resistant weeds* (DAQ00197) *Weeds instructional videos, online version of the IWM manual, online web content updates and e-learning content, and 3 weeds webinars* (ICN00013) *Australian Herbicide Resistance Initiative phase 4* (UWA00146) *Weed management in Southern Region mixed farming systems-strategies to combat herbicide resistance* (UCS00020) *Improving IWM practice in the Southern Region – emerging weed issues* (UA00134) *Integrated weed management in the Southern Region* (UCS00020)

TABLE 33 2015 Issue 3: Nitrogen management – developing and validating technologies and tools to improve budgeting and decisions.

The issue	There are a range of issues which limit a grower's ability to make well-informed decisions on nitrogen. This includes access to technology to enable real-time measurement and regionally specific information, as well as guidelines for growers and advisers on using, interpreting and implanting data from a range of tools including nitrogen rich strips and normalised difference vegetation index (NDVI). In addition, there is not a clear understanding of nitrogen contributions from mineralisation from a range of sources, which, if improved, could enable growers to more accurately and confidently estimate this factor when calculating nitrogen budgets. Seasonal conditions and forecasts are key parameters in the nitrogen decision-making process and there is a lack of confidence in accuracy of seasonal weather forecasts. Adjusting nitrogen timing and rates to manage these seasonal conditions and risk can be improved upon, as can an understanding of nitrogen management after a legume in the rotation. An opportunity to increase the power of nitrogen decision-making would be to include soil water information, along with the collation and validation of information on the use and cost-benefit of mid-row banding of UAN in higher rainfall areas.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The RCSN recommends establishing a working group of key researchers and advisers to: • Collate and capture collective current knowledge for predicting nitrogen mineralisation including identifying situations and potential causes of limitations and discrepancies of models and rules of thumb. In addition, determine requirements to more accurately and reliably predict nitrogen mineralisation. This would result in guidelines and dependable tools that growers and advisers can use to guide nitrogen budgeting and management decisions; • Understand how a range of variables, including organic matter, season, rotation and soil type affect mineralisation including the amount and timing of availability throughout the season; • Validate and customise information for a range of environments; • Develop guidelines for using and interpreting nitrogen rich strips as a decision-making tool; • Validate and adapt nitrogen sensor tools and models that provide the basis for interpretation e.g. green area index; • Collate and validate information on the use of mid-row banding of nitrogen; and • Research and development and field validation of technologies and tools that will enable the rapid, accurate and cost-effective measurement of nitrogen status.
GRDC projects addressing this issue	*Real time evaluation of soil nitrate using ion exchange technology* (EPF00002-A) (UA00165) *Managing legume and fertiliser nitrogen in the Southern Region* (UA00165) *More Profit from Crop Nutrition Initiative phase II* (MPCN II) *Benchmarking wheat yield against nitrogen use* (DAS00147 - MCPN II) *Soil Spectroscopy Capability* (CSO00045) *Proximal Soil Sensing for Profitable & Sustainable Farming* (CSA00048) *Improving nitrous oxide abatement in higher rainfall cropping systems and developing nitrogen response curves* (DAV00125) *Reassessing the value and use of fixed nitrogen* (CSA00037) *Evaluation of late nitrogen applications to achieve yield potential and increased protein in wheat* (SFS00025) *Nutrient performance indicators* (IPN00003) *Strategies to better synchronise nutrient supply with crop demand* (UM00023)

TABLE 34 2015 Issue 4: Subsoil constraints – understanding how acidity, sodicity, nutrients and structure limit yield and quantifying the economic impact of amelioration of subsoil constraints.

The issue	Subsoil constraints such as acidity, sodicity, poor fertility and poor structure significantly limit the yield potential of crops across almost all regions of the high-rainfall zone. These constraints limit root development and therefore the ability of the crop to access the water and nutrients stored in the subsoil. The amelioration of subsoil constraints potentially provides a range of medium to long-term benefits that may contribute to increased yields. These benefits include physical breaking and/or shattering of dense and sodic clay subsoils, improved soil structure, increased subsoil porosity and increased water infiltration. In turn, there will be shorter and fewer periods of waterlogging and associated deleterious effects, increased soil water holding capacity, and increased rooting depth for crops to access more moisture and nutrients. A number of subsoil amelioration techniques and options have been developed to suit the variations within a range of specific soil characteristics. Experimental equipment has been developed and trialled by the Victorian Department of Economic Development, Jobs, Transport and Resources (DEDJTR) and La Trobe University since 2005 to enable the deep ripping incorporation of organic matter at depth. Southern Farming Systems has also established a trial to evaluate and demonstrate the effectiveness of a range of alternative organic (compost, stubble and green or brown manured crops) and inorganic (synthetic fertiliser) substrates and other less intrusive and expensive tillage (ripping and/or incorporation) systems. However, a lack of evidence and key knowledge gaps are limiting the ability to achieve consistent and reliable yield increases in response to subsoil amelioration and it remains unclear what factors are driving yield increases following subsoil amelioration. There is a lack of understanding of which soil types and characteristics will be most responsive and there is a lack of understanding of what is the most cost-effective amelioration technique given the large variation in subsoil characteristics. Engineering solutions exist for the amelioration of sodic and/or acid subsoils, however adoption is limited by the lack of cost-effectiveness on a broad scale. Current trial work is a start to addressing the problems but there is still much to understand in order for growers to effectively and economically manage subsoil constraints.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	Ideas for RD&E include: • Understanding the factors that influence yield responses; • Understanding soil types and characteristics that will be most responsive to the range of different amelioration techniques to underpin prescriptive recommendations of appropriate and effective subsoil amelioration based upon subsoil characteristics; • Development of diagnostic tests for specific subsoil constraints e.g. sodicity, density; • Development of subsoil mapping tools that are inexpensive and can accurately map subsoil characteristics on a paddock scale; • Quantification of the relative effects and costs of alternate organic substrates including a range of green or brown manure crops and nutrient enriched stubbles; • Evaluation of subsoil amelioration across a range of additional environments, locations and soil types across the HRZ of the Southern Region; • Measuring the longevity of the various amelioration techniques and organic substrates; • Evaluation of alternative and less aggressive tillage and therefore less expensive amelioration techniques; • Evaluation of alternative equipment options as identified by scoping study initiated by SFS and funded through Rural Industries grant; • More extensive cost-benefit analysis and return on investment of different amelioration techniques and substrates (organic and/or fertilisers); • Identification of best bet organic products for districts based upon cost, availability, consistency and supply; • Quantification of responses of variable rates and variable ripping depths for amelioration techniques and comparative costs; • Understanding and quantification of the effects of incorporating farming practices that reduce compaction including but not limited to controlled traffic farming into the subsoil amelioration package to maximise benefits; • Development of engineering options to enable variable rate and variable depth; and • Amelioration that can be applied on a broadacre scale.
GRDC projects addressing this issue	*Understanding the amelioration processes of the subsoil application of amendments in the Southern Region* (DAV00149)

TABLE 35 2015 Issue 5: Slugs – effective control packages in high stubble load situations	
The issue	Slugs are a significant invertebrate pest that are estimated to cost the Australian grains industry $25.9 million annually in lost production. Australian growers spend an average of $8.7 million annually on slug control. The two major species of slugs which cause damage to emerging and establishing crops are the grey field slug and the black keeled slug. Almost all crops and pasture species are susceptible to slug feeding during the establishment phase. The widespread adoption of minimum till and stubble retention has provided slugs with a more favourable habitat and has caused the extent, incidence and level of damage caused by this invertebrate pest to increase. Soil moisture is the key determinant of slug activity, feeding and breeding and therefore influences the potential risk to the crop. Slugs are a hermaphrodite which means that both individuals of a mating pair lay eggs and are opportunistic breeders that are capable of laying up to 100 eggs at a time and therefore enable populations to rapidly increase and explode when conditions are favourable. An integrated approach to pest management that includes chemical and cultural control strategies is required to effectively manage this pest. Effective cultural control strategies include controlling the green bridge to minimise feed source, cultivation and burning to destroy suitable refuges and habitat. Rolling immediately after sowing consolidates the seedbed which will restrict slug movement within the seedbed. This also increases soil to seed contact which will enhance crop establishment. Baiting is the only effective chemical control option. Research and development has established that the timing of bait applications is absolutely critical and the types of bait and application rates are also important. Currently there is not a suitable tool that can be used to monitor slug activity and enable an estimate of relative slug numbers. A reactive baiting strategy cannot be relied upon and instead growers must adopt a proactive and integrated approach to managing slug numbers to prevent damage to establishing crops. It is also important to recognise that currently available management strategies for no-till systems with heavy stubble loads cannot reliably achieve adequate levels of slug control to successfully establish canola crops sown during the late April to June period.
RCSN prioritising this issue	High-rainfall zone

RD&E actions to address this issue	Ideas for RD&E include:
	• Quantification and validation of the relationship between slug activity and soil moisture for a range of soil types;
	• Using the existing network of soil moisture probes and available tools to quantify the relationship between soil moisture and slug activity to provide an early warning system to enable growers and advisers to enact strategies to proactively manage slug populations;
	• Building sources of locally relevant data to validate research findings;
	• Collecting data that will be used to calculate a cost-benefit analysis of a range of approaches and management strategies;
	• Developing a decision-support tree and specific integrated slug management guidelines for growers and advisers to:
	  • Assess the level of risk for crop damage at a paddock level based upon a range of parameters, e.g. paddock history, soil moisture, stubble load, paddock preparation, sowing intention;
	  • Determine slug activity and breeding;
	  • Identify cultural and chemical management strategies that will be required to avoid damage to crops caused by slugs; and
	  • Access best management practice guidelines to implement an effective integrated package of cultural and chemical strategies.
	• Undertaking local extension activities using a range of communication and extension tools and via a range of networks; and
	• Identifying and developing enduring mechanisms e.g. GRDC Push Notifications to enable an early warning system for slug activity to be communicated to grower and adviser networks.

GRDC projects addressing this issue	*Improved management of snails and slugs* (DAS00134) *BA Biology and management of snails and slugs in grain crops* (DAS00160-BA) *Maintaining profitable farming systems with retained stubble – component 3 (insects)* (CSP00186)

TABLE 36 2015 Issue 6: Evaluating the effectiveness of fungicide strategies to manage Septoria tritici blotch and leaf rust.	
The issue	Septoria tritici blotch (STB) is now considered the primary disease threat for wheat in the HRZ. It is a disease of increasing importance given earlier sowing times, increased disease pressure and the predominance of the variety Revenue, which has a STB rating of moderately susceptible (MS). Complicating the issue is a new leaf rust pathotype which threatens a resurgence of leaf rust (LR). There have been recent STB mutations identified which will have implications for management. Currently, the frequency of these mutations within the variable populations across the Southern Region is unclear.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	Ideas for RD&E include: • Development and release of STB resistant varieties; • Assessment of rate response of active ingredients for the control of STB and leaf rust in a range of varieties with differing genetic resistance; • Examining the effectiveness of fungicides for the control of STB and LR; • Economic analysis of fungicide efficacy trial results; • Benchmark current fungicide efficacy to measure changes in efficacy as a measure of fungicide insensitivity; • Evaluating field performance of triazole mixes, strobilurins and SDHIs to assess role as an anti-resistance management strategy; • Greater awareness of the issues of fungicide resistance; • Extension of strategies to delay and manage fungicide resistance; • Developing integrated disease management guidelines to manage STB and LR; and • Extension of fungicide strategies for the control of STB and LR.
GRDC projects addressing this issue	*Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in southern NSW* (DAN00177) *Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in Victoria* (DAV00129) *Benchmarking resistance and managing STB and leaf rust* (FAR00004A)

TABLE 37 2015 Issue 7: Genetic advancements, soil amelioration and drainage strategies to reduce the impact of waterlogging.	
The issue	The need to manage drainage and waterlogging is placing restrictions on crop options on sodic clay subsoils, especially in the high-rainfall zones of Tasmania. However the issue also occurs in other high-rainfall areas of the GRDC Southern Region. Seasonal waterlogging and the development of perched watertables occurs over extensive areas of south-eastern Australia including Tasmania, in areas with high-rainfall (>700 mm) and duplex or texture contrast soils. In Tasmania, texture contrast soils occupy approximately 16.5 per cent of the Tasmanian landmass, including much of the agricultural midlands. While extensively used for dryland cropping and grazing, these soils are under increasing demand for conversion to irrigated cropping, perennial horticulture and irrigated pasture (dairy). Duplex or texture contrast soils are associated with a range of management problems including waterlogging, poor crop establishment, crusting, poor root penetration, desiccation, wind erosion, water erosion, salinity, poor nutritional status, water repellence, poor water-holding capacity, low infiltration rates, and natural hard setting. During the early 2000s raised beds were commonly used throughout the Tasmanian midlands, especially for poppies. Raised beds are not common now and it is not understood why. Raised beds have been shown to work effectively in other high-rainfall crop areas on texture contrast soils.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	Research would evaluate the effectiveness and cost-benefit analysis of a range of sub-surface drainage options. Further work to identify genes which would lead to the development of crop varieties with improved waterlogging tolerance.
GRDC projects addressing this issue	*Optimising yield and economic potential of high-input cropping systems in the HRZ* (DAV00141) *Understanding how waterlogging affects water and nitrogen use by wheat* (DAV00151)

TABLE 38 2015 Issue 8: Millipedes, slaters and earwigs – understanding these pests and impacts of chemical control options on these pests, beneficial species and population dynamics.	
The issue	The extent, severity and frequency of damage in crops during early crop establishment is increasing due to a range of emerging invertebrate pests including earwigs, millipedes and slaters. While these invertebrates have been present in crop systems for some time, they have not traditionally been considered as pests. Broadleaf crops such as canola and pulses are especially prone to damage from these emerging pests. Impacts are primarily on crop establishment, however some issues have arisen with earwig contamination of canola at harvest. Earwigs, millipedes and slaters have emerged as significant invertebrate pests in minimum and no-till farming systems with high stubble loads. Stubble retention, reduced tillage and increased soil organic matter are thought to have provided a more favourable environment for these pests to survive and reproduce and therefore the size of these populations has continued to increase. There is a need to understand the interaction between stubble load and stubble management strategies on pest numbers. Currently there are no effective target-specific chemical control options to manage these pests. Current management generally relies upon the application or repeated applications of non-specific insecticides while these pests are thought to be feeding on crops. The effectiveness of this practice is highly variable and is not considered sustainable given the impact on beneficial species and the potential development of insecticide resistance.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The development of an integrated pest management strategy specifically designed for emerging pests is needed. The strategy should enable or include: • An understanding of the specific biology, life cycle and behaviour of each pest. Currently this is a key knowledge gap limiting the development of effective integrated pest management strategies; • Monitoring tools for growers and advisers to correctly identify the presence of pests in crops, quantify pest numbers and the level of crop damage; • Currently available monitoring tools include pitfall and refuges traps. Catches in these traps have not been correlated to pest densities feeding on crops and levels of crop damage. These pests regularly occur in combination and it is often difficult to identify and attribute crop damage to an individual pest or the combinations of these pests and other invertebrates such as slugs. Hence, the development of monitoring tools is required to enable an accurate identification of the damage caused by each of the individual pest species and an assessment of the relative levels of damage; • Development of economic thresholds for pest species to guide growers and advisers with decisions on pest control; • A suite of cultural control tactics to manage pest populations to limit crop damage and economic losses to growers. For example burning and tillage which reduce stubble loads and available refuges are considered to be effective strategies that can reduce the numbers of these pests. It is therefore important to better understand and evaluate how stubble retention and other cultural control strategies influence the population dynamics of these pests and the level of damage caused to establishing crops; and • A suite of chemical control tactics to manage pest populations to limit crop damage and economic losses to growers by identifying, evaluating and, if applicable, registering target-specific options for emerging pests.
GRDC projects addressing this issue	*Current invertebrate pest management options risk matrix* (ICN00020) *New knowledge to improve the timing of pest management decisions in grain crops* (CSE00059) *Stubble Initiative – maintaining profitable farming systems with retained stubble, comprising research support* (CSP00186), *coordination and communication support (DAS00145) and component farming systems projects with specific focus on pests* (EPF00001, CSP000174, LEA00002, MFM00006, MSF00003, RPI00009, UNF00002 and YCR00003)

TABLE 39 2015 Issue 9: Understanding the opportunities and impact of growing cover crops in rotations across the HRZ.

The issue	Growers in the high-rainfall zone see the potential for growing cover crops over summer as a strategy that could provide a range of benefits including assisting to increase the diversity of crop options, enabling the use of alternative weed management strategies, improving soil structure, increasing soil carbon levels, acting as a stable organic nitrogen store, increasing water use efficiency, reducing production and financial risk and ultimately increasing the profitability of the farming system and farm business. Grain and graze and/or fodder crops are considered to be viable options which enable the integration of livestock into the cropping rotation. This also enables growers to extract additional value from grazing with the potential to increase financial returns to the farm business. The lack of fundamental information and knowledge to quantify and validate the benefits and risks of the range of potential summer cover crop options and systems is constraining the drive and confidence of growers to include summer cover crops in their farming system. Decision support tools are needed to enable growers to predict achievable yields and margins for a range of suitable summer cover crops over a range of variable seasons. Information is needed to identify suitable cover crop options for a range of environments and situations. It is essential that this information addresses the variable impacts of the range of summer crops on soil water, soil nutrient status, weed seedbanks and disease levels that will have consequences for subsequent crops. Outcomes from a cost-benefit analysis will be the critical information that will provide the rationale and motivation for the growing of summer cover crops.
RCSN prioritising this issue	High-rainfall zone

RD&E actions to address this issue	The RCSN recommends collation and review of existing information from past and current research and development, including scientific and grey information. Issues include:
	• The range of suitably adapted cover crop options including grain, grain and graze and fodder given variable environments and seasons;
	• Available or adaptable models that could provide base information for a tool to predict achievable outcomes including yield, financial returns and agronomic parameters for a range of crop options and environments under variable conditions;
	• Comparative grazing value (biomass production and availability) of a selection of cover crop options;
	• Understanding or quantifying the impact of cover crops on subsequent crops and over rotations on the following parameters including:
	  • Soil water;
	  • Soil nutrient status and availability;
	  • Soil organic carbon levels;
	  • Weed seedbank/populations of those key herbicide resistant weed species disease levels; and
	  • Invertebrate pest species e.g. slugs, snails and populations.
	• Optimum seeding and terminating timing for specific cover crop options to optimise returns;
	• Cost-benefit analysis for a range of cover crops and management packages to determine dollar value over a rotation and farm business, including livestock enterprises; and
	• Identify further RD&E needs.

TABLE 40 2015 Issue 10: Plant growth regulators – understanding key interactions, compiling data and filling gaps in registrations.

The issue	Issues around plant growth regulators (PGRs) include gaps in the registration of PGR products and a lack of maximum residue limits (MRLs) and withholding periods (WHPs) for many PGR products which limits access to fodder, e.g. silage, hay and straw, and livestock, e.g. grazing of crops and stubbles. The effects and results of PGR application have been highly variable and not well understood, however, PGR products are becoming cheaper and so return on investment is increasing. There needs to be a cost-benefit analysis which includes benefits other than yields and looks at the economics of risk versus rewards. Potential benefits include improved harvest index of beans and canola, improved harvestability/harvesting costs and stubble management, disease control benefits with more open canopy or more dense crops with greater susceptibility to disease, weed management benefits in competitive crops, timing and sequence of varieties/crops during harvest, assisting in canopy management and improved green leaf area retention. Further information is also required on the effects of PGRs in a range of environments. Variety-specific agronomy packages (VSAPs) which include the use of PGRs supported by evidence are required. The current limited knowledge and unreliable results has meant that growers and advisers are not confident that the application of PGRs is a sound investment given additional input cost and risk.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	Ideas for RD&E include: • Research to establish maximum residue limits (MRLs) and withholding periods (WHPs); • Evaluation and quantification of the economic effects of PGRs, e.g. tiller numbers, harvestability, grain quality, stubble characteristics; • Evaluating the use of PGRs to manipulate phenological development e.g. manipulating flowering dates to reduce risk the risk of potential frost damage; • Identifying the key drivers to explain results; • Knowledge and data for non-cereal crops, specifically canola, faba and broad beans; • Understanding how the timing of applications impacts upon yield; • Exploring the use of PGRs as part of an integrated weed management strategy (shading); • Determining the compatibility of PGR products with other products for tank mixing; • Defining yield thresholds; • Understanding the interaction between plant physiology and environment; • Knowledge of the specific phenological development of the range of varieties; • Knowledge around growth promoting effects, not just growth suppression; • Experimental design of experiments and protocols are required to evaluate PGRs; • Knowledge on the use of PGRs to increase the opportunity for direct heading of crops given the reduced risk of lodging, head loss and more even maturity of crops; • Explore effects of PGRs on gibberellic acid (GA) response important for crops to overcome stress; • Understanding the effect of PGRs on water soluble carbohydrates and how this can be manipulated for improved grain filling; • Better understanding of the bounce-back response following the application of PGRs; and • Proof-of-concept to see if PGR products are a tool to extend the green leaf area retention of crops through grain filling and maturing development phases.
GRDC projects addressing this issue	**Current investments that provide partial coverage of this issue:** *Understanding the implications of new traits on adaptation, crop physiology and management of pulses in the Southern Region* (DAV00150) *Management of barley and barley cultivars for the Southern Region* (DAN00173)

TABLE 41 2015 Issue 11: Building the capacity of growers, grower groups, advisers/consultants and researchers.	
The issue	Specialist skills and knowledge are required to service and advance crop production and mixed farming systems in the HRZ. It is worthy to note that while there are a number of retail agronomists, there are a relatively small number of consultants/advisers with specialist knowledge and skills for cropping compared to other zones. Improved connections and collaboration between the RD&E sectors and grower networks would enhance two-way communication and build a pipeline from research to adoption to better extract value from investment. Issues specific to the various sectors are outlined below. **Growers:** The role of growers is shifting from production based management towards farm business management and more needs to be done to better target and influence growers beyond the innovators and early adopters to achieve wider and broader adoption of improved farming practices. **Agronomists and advisers:** They are increasingly providing the technical expertise for tactical agronomic management and decision-making for clients/farm businesses. The distinctive role and relationships the re-seller agronomists have with growers needs to be recognised, along with the roles this sector can play in practice change. **Grower/farming systems groups:** Grower groups provide an effective platform to validate, communicate and extend information, although are not the sole provider of local RD&E; and there are a range of factors that challenge the long term viability, functioning and effectiveness of these groups. **Researchers:** There are only a small number of researchers working in specific disciplines and even fewer working in the HRZ; and researchers are often working in isolation and are not adequately connected to other researchers, extension providers and growers.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	Identified strategies to build capacity within the industry include: • Incorporating capacity building as a specific and required outcome in all GRDC investments; • Exploring farm business management for complex and whole farm decision-making; • Continuing to provide grower specific training opportunities on agronomy and logistics; • Offering a diversity of communication and extension activities for different segments, demographics and learning styles within this target audience; • Utilising extension specialists and specific extension activities to extract value from RD&E activities; • Engaging and utilising agribusiness/re-seller training programs to improve engagement and broaden networks to influence on-farm practice change; • Developing a mentoring program for graduates and advisers in the early stages of their careers; • Building overseas linkages and relationships to improve the understanding and knowledge which could be adapted to local conditions and farming systems; • Offering governance training and increase the awareness of models and strategies to improve the succession, recruitment and development of leaders with grower/farming systems groups; • Increasing GRDC project terms to a minimum of five years to reduce the fluctuations in income to improve the ability of the RD&E sector to attract and retain staff; • Auditing researchers working in the HRZ and facilitate the connection of researchers, extension providers and growers working within disciplines for the HRZ; and • Building awareness and target students at all levels of education, from primary school to secondary school through to tertiary stage.
GRDC projects addressing this issue	*Improving practices & adoption through strengthening D & E capability & delivery in the Southern Region – Regional Research Agronomists* (DAV00143) *GRDC Research Updates – Southern Region* (ORM00005) *GRDC Farm Business Updates – Southern Region* (ORM00015) GRDC Capacity Building for Growers and Advisors: Conference attendance awards, Training Awards, Domestic study Tours, International Study Tours. *Practical financial figures for farm business management – AgProfit* (APR00001) *National paddock survey initiative* (BWD000025) *Grain and Graze III – Extension and delivery of mixed farming benefits in the Southern Region* (SFS00028)

TABLE 42 2015 Issue 12: Fungicide resistance – awareness and growers/advisers understanding risks.	
The issue	Crop diseases are major constraints to production and profitability of farming systems in the medium and high-rainfall zones in the Southern Region and fungicides are an effective tool for controlling fungal crop diseases. The use of fungicides has dramatically increased over the past 15 years. The incidence and risk of further fungicide resistance is a major concern for the grains industry. The reliance and repeated use of a limited number of fungicide groups has increased the risk and rate of development of fungicide resistance. Growing susceptible varieties has exacerbated this risk. It is critical there is industry stewardship to ensure a consistent coordinated approach to managing fungicide resistance and prolonging the efficacy of new and existing chemical compounds. The mechanism and development of fungicide resistance is predictable and it is expected that fungicide resistance in Australia will continue to replicate the experiences from the United States and Europe. Fungal pathogens and mutations have the propensity to rapidly disperse across large geographical areas. Hence, the principles, strategies and key messages for communication will be generally applicable across the entire Southern Region. Identified knowledge gaps for growers and advisers and the industry more generally include the lack of awareness about the current extent and identified threats of fungicide resistance and the lack of knowledge and tools to implement integrated disease management.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	A coordinated approach that includes the Centre for Crop and Disease Management (CCDM), key pathology groups, RD&E providers and a network of growers and advisers would improve the capacity of the industry to predict, identify and monitor the development and extent of fungicide resistance at the regional and local level. This would include preparing a situation analysis detailing the current status and extent of fungicide resistance for the important diseases of the major crops and undertaking a risk assessment to identify the threats, risks and impact/cost of predicted fungicide resistance. Integrated disease management guidelines which detail the principles and strategies to manage key diseases and fungicide resistance for growers and advisers would be developed. These guidelines will include customised messages and guidelines specific to the agro-ecological zones. These guidelines will include a range of key diseases (not individual diseases in isolation) given local environments, farming systems, genetics and the risk or level of insensitivity and resistance. Communication and extension is required to raise the awareness among growers and advisers of the risks and cost of fungicide resistance and then deliver a range of activities and products to ensure growers use integrated disease management strategies to manage key diseases.
GRDC projects addressing this issue	GRDC – Curtin University Bilateral Agreement – Centre for Crop and Disease Management (CCDM) *Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in southern NSW* (DAN00177) *Improving grower surveillance, management, epidemiology, knowledge and tools to manage crop diseases in Victoria* (DAV00129)

TABLE 43 2015 Issue 13: International knowledge – facilitating the transfer of knowledge of agronomic research and systems from overseas that can be adapted to local high-rainfall environments and farming systems.

The issue	The skills and capacity within the high-rainfall zone have been identified by the RCSN as a high priority issue that limits crop production, profitability and the ability to capture opportunities. Specialist skills and knowledge are required to service and advance crop production and mixed farming systems in the HRZ. It is worthy to note that while there is a network of retail agronomists, there are only a relatively small number of consultants/advisers with specialist knowledge, skills and experience in crop production compared to other production zones. Improved connections and collaboration between the RD&E sectors and grower and adviser networks would enhance the two-way communication and build a pipeline from research to adoption to better extract value from investments. The unique conditions of the Australian high-rainfall zone mean that research, knowledge, tools and practices from traditional cropping zones are often not applicable or transferrable. An effective means of increasing the skills and capacity of researchers, agronomists and growers could be accomplished by capturing knowledge and skills about new technologies and farming practices specific to HRZ environments from overseas organisations and experts and making it relevant to local HRZ environments in the Southern Region.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	An identified strategy to effectively increase the skills and capacity of researchers, agronomists/advisers and growers is to capture and adapt knowledge, skills, technologies and practices for the HRZ from international experts. Growers and advisers in the HRZ are increasingly growing varieties and using farming practices and technologies that have been developed in European countries. The use of these European genetics, along with a range of management practices and tools have delivered tangible benefits and productivity gains for the grains industry in the HRZ. Further ideas for strategy and investment include: • Identifying, developing and fostering relationships between the local HRZ community and relevant international organisations and individuals; • Identifying opportunities to include overseas experts in the RD&E projects being undertaken by a range of organisations in Australia, or include knowledge and experience from overseas; • Participating in and delivering presentations at a series of workshops to more widely extend this information from overseas to researchers, agronomists and growers working in the HRZ; • Identifying the potential for the transfer or further development and adaptation of knowledge, skills, technologies and practices for use in the south eastern Australian HRZ environments; and • Distributing extension products to agronomists/consultants and growers to communicate key findings and messages from these visiting experts and most importantly its relevance and application to local HRZ environment and farming systems.
GRDC projects addressing this issue	GRDC Capacity Building for Growers and Advisors: Conference attendance awards, Training Awards, Domestic study Tours, International Study Tours.

The identified priority issues and RD&E needs to address the priorities identified by the high-rainfall zone RCSN in 2016, and current and recent GRDC investments which are addressing these issues are described below.

TABLE 44 2016 Issue 1: Growing the 6t/ha canola crop – variety specific agronomy packages to maximise yield potential, reducing harvest losses and extension, including case studies.

The issue	There is potential for canola crops with a yield of 6 tonnes per hectare to be achieved in the high-rainfall zone. In research trials, these yields have been achieved, however, yield advances are attributed to better-suited and newer varieties from overseas. International research has investigated plant physiology requirements to produce high grain yields. The HRZ RCSN has identified that agronomy and management are essential for maximising the potential of new varieties. It is critical to recognise the difference between maximum yield potential and optimum yields, with profit providing the ultimate measure not yield. Increasing or achieving increased or potential yield requires additional inputs and management, which increases economic risk. Hence it is critical to develop best management guidelines for optimum yields. Modelling has identified that nutrient deficiencies including nitrogen, phosphorus, potassium and sulfur, limit the capacity to meet potential yield. High input and management systems are not limited to macro-nutrients and must also include soil amendments, weed, canopy management including plant growth regulators, disease and pest management and irrigation scheduling and harvest management.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The desired outcome is to provide variety-specific agronomy packages (VSAPs) for growing canola in the HRZ which outline best management practices. Information would include the optimum production and management to grow profitable canola crops in high yielding environments (including irrigation) Further research is required to evaluate, quantify and identify: • Suitable new or alternative varieties; • Time of sowing, late spring versus autumn plus specific varieties; • Nutrient requirements and strategies, including soil amendments such as lime and gypsum; • Weed management systems; • Nutrient requirements and management; • Canopy management and plant growth regulators; • Disease management; • Pest management; • Irrigation scheduling; and • Harvesting, including reducing losses, e.g. windrowing or direct heading. Communication and extension activities would include: • Best management guidelines; • Demonstrations e.g. split paddock trials; and • Case studies including economic analysis.
GRDC projects addressing this issue	*Optimising the yield and economic potential of high-input cropping systems in the high-rainfall zone* (DAV00141) *Optimised canola profitability – Understanding the relationship between physiology and tactical agronomy management* (CSP00187) *Stepping up grain production in the high-rainfall zone of southern Australia* (DAV00016)

TABLE 45 2016 Issue 2: Managing sub-surface and subsoil acidity.

The issue	Sub-surface and subsoil acidity limit production and crop options, including limiting the inclusion or profitability of pulses into the rotation. This has been identified as a major issue as growers increase the area of pulses without increasing liming at the same rate. Liming is relatively affordable and easy, however, not applying adequate lime to match the rate of acidity or not liming regularly mean acidity increases through the soil profile. Capital applications and applying lime at depth is expensive. Lime is relatively insoluble and does not readily move through the profile, therefore, it needs to be incorporated which presents a conflict for no-till farmers. The low pH of the soil may not necessarily be the problem, but the associated effects such as aluminium toxicity, high levels of manganese, low availability of molybdenum and poor survival and nodulation of rhizobia can limit crop production. Current soil sampling procedures do not detect variations in soil PH or acid layers where samples are collected at 0-5cm or 0-10cm and 5-10cm or 10-20cm.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The RCSN recommends collating existing knowledge and investment, including that of: • Chris Gazey – trials that compared the effectiveness of different management strategies e.g. soil inversion and capital rates of lime for a trickle-down effect. WA Department of Agriculture; • Roger Armstrong – GRDC project Understanding the amelioration processes of the subsoil application of amendments in the Southern Region (DAV00149); • Catchment Management Authorities (CMAs) in Victoria; • South East Natural Resources Management – demonstrations including ripping and spading, extension – soil sampling and testing pH, targeted pilot of incentive funding; and • CSIRO and State government agencies – mapping, monitoring and extension. Further validation, communication and extension needs to: • Quantify lime rates based on sales compared to the rate of acidification to calculate the impact of the issue; • Address barriers to change; • Demonstrate cost-benefit of addressing acidity to drive adoption; • Include proactive and collaborative marketing campaign from lime producers and suppliers; • Build awareness about the issue – variability of pH within soil layers 0-10cm, 10-20cm and deeper and the impact to motivate change; • Build understanding of how current practices are exacerbating rates of acidification and the stratification of acidity within soil layers and at depth; and • Build knowledge about the specific factors limiting crop production e.g. aluminium toxicity, low molybdenum, high manganese and rhizobia survival and nodulation and variations with soil types. Research questions identified by the RCSN include: • How do you cost-effectively correct low pH at depth? • How can you cost-effectively get lime at depth? • If you correct pH in the upper part of the profile (0-5, 5-10 and 10-20cm) are you just pushing the problem or acid layer further down in the soil profile? • Can we select and then breed pulse varieties that are more tolerant of low pH soil conditions? • Can we develop strains of rhizobia for low pH soil conditions? • Can we develop a tool that will measure and pH at depth?
GRDC projects addressing this issue	*Soil acidity is limiting grain yield – South Australia (RSS00010) and Southern Victoria* (SFS00026) *Nitrogen-fixing break crops and pastures for high-rainfall zone acid soils* (DAN00191)

TABLE 46 2016 Issue 3: Variety specific agronomy packages for growing barley in irrigated and high yielding environments.

The issue	Local demand for feed or malt barley will determine the relative profitability of malt versus feed quality in specific regions. Generally, the protein levels of barley in the HRZ are too high to achieve malt quality. Additionally, the profit margins for barley are comparatively lower than wheat in high yielding environments. This disparity in profitability is largely due to the higher cost of production for barley. The introduction of European varieties has seen significant advances in yield and profitability of barley in the HRZ and there is now potential to further increase yield and profitability through introducing superior varieties which are currently available in Europe and could provide further genetic gains for the HRZ, and the development and adoption of specific management strategies to maximise the potential of European varieties. Research needs to measure yield and grain quality and include evaluation of long season, dual purpose and winter and spring varieties and/or six-row varieties.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The desired outcome is to ensure barley is a profitable crop option for irrigation and in high-rainfall environments with a cost of production comparable to wheat and with specific management guidelines for suitable varieties that enable growers to optimise production and profitability in these environments. Communication and extension is required to achieve on-farm adoption and practice change. Further research is required to: • Quantify profit drivers; • Develop omission trials – highest package of inputs and management and then omit inputs one at a time. Omission trials are useful research tools but also an effective demonstration and extension tool; • Develop combination sites using both small and large scale plots for research and demonstration purposes respectively; and • Run trials on irrigated and dryland sites in Tasmania and/or south east SA. Treatments would include: • Time of sowing; • Sowing rates – 120 plants/m² equates to 60-80kg/ha; • Seed dressings, e.g. nutrients, insecticides, fungicides; • Nutrition including nitrogen rates and timings of applications and phosphorus, copper, manganese and zinc; • Disease management; and • Canopy management including interactions between time of sowing, seeding rates, nitrogen rates and times and include use of plant growth regulators. Measurements would include: • Yield, quality and profit; • Herbicide tolerance; • Competitiveness and architecture for weed management; • Lodging and head retention; and • Disease rating, e.g. disease resistance, to net form net blotch and scald, leaf rust, powdery mildew and spot form of net blotch.
GRDC projects addressing this issue	**Current investment that provides partial coverage of this issue:** *Management of barley and barley cultivars for the Southern Region* (DAN00173)

TABLE 47 2016 Issue 4: Understanding nutrition (nitrogen, phosphorus, potassium, sulphur and trace elements) limitation for high yielding cereals in the HRZ.	
The issue	Research modelling has identified that nutrient levels are limiting the yield potential of crops in the HRZ. Crop nutrition trials for canola and wheat in high yielding HRZ environments are being undertaken as part of an existing GRDC investment (DAV00141), however, this project does not include barley. Objective data is needed to identify nutrient responses, economic/risk analysis and modelling to identify probabilities and return on investment.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The HRZ RCSN recommends extending the existing nutrient omission trials to include barley and adding treatments such as nitrogen rates and timing of applications of phosphorus, potassium, sulphur and trace elements copper, zinc and manganese. This would also include adding additional sites to include a wider range of environments and soils types and irrigated situations, including Tasmania and Gippsland. The research needs to quantify yield response to key nutrients, including macro and trace elements and provide an economic analysis of results to quantify return on investment in fertiliser inputs. A risk analysis to quantify the production and financial analysis to understand probabilities of outcomes is also required.
GRDC projects addressing this issue	*Optimising the yield and economic potential of high-input cropping systems in the high-rainfall zone* (DAV00141) GRDC More Profit from Crop Nutrition Initiative II *Optimised canola profitability – Understanding the relationship between physiology and tactical agronomy management* (CSP00187)

TABLE 48 2016 Issue 5: Optimum (early) sowing time and management of early sown crops to optimise yield and maximise profitability.	
The issue	Early sowing in dryland systems is opportunistic and therefore it is important to maintain flexibility if there is a late break to the season. Strategies to conserve soil moisture are critical to capitalise on the opportunities to sow early. The majority of growers are sowing crops earlier based upon research and experience. However, this has raised a number of issues and questions for growers and their advisers including: • How early can we sow? • Can you sow too early? • What planning and preparation is required to shift to earlier sowing? • What additional inputs and management are required to capture the benefits and manage the risks of early sowing? • What are the economic impacts of early sowing and additional inputs?
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The RCSN recommends utilising existing research information and knowledge from James Hunt, Nick Poole, collaborators and grower groups. Economic analysis is required to identify optimum time of sowing and inputs to maximise profitability not yields. Further, best management guidelines for early sown crops need to be developed and include: • Variety options for sowing windows; • Sowing rates; • Disease management – barley yellow dwarf virus, septoria, leaf rust; • Nutrient management – requirements and timing of fertiliser applications; • Weed management – strategies to achieve season long control of weeds and reduce weed seed set; • Canopy management, including plant growth regulators; and • Irrigation scheduling. Extension of best management packages using a number of networks and tools would include demonstrations with paired paddock comparisons, crop walks, field days and grower case studies.
GRDC projects addressing this issue	*Optimising the yield and economic potential of high-input cropping systems in the high-rainfall zone* (DAV00141) *Increasing yield and reducing risk through early sowing in the Southern Grains Region – Part 2: National Expansion* (CSP00178)

TABLE 49 2016 Issue 6: Millipedes, slaters and earwigs – understanding impacts of chemical control options on these pests, beneficial species and population dynamics.	
The issue	The extent, level, frequency and cost of damage caused by millipedes, slaters and earwigs in crops continues to increase. The increased abundance of these pests is generally attributed to the adoption of stubble retention and reduced tillage farming systems which has increased the organic matter food resource and provides a suitable habitat for these species. It is also important to recognise that there are several species within each of these emerging pests and that a number of these pests often occur in combination within an individual paddock and therefore it may not be clear which pest or pests are causing damage to the crop. This confusion is often exacerbated by the presence of additional established invertebrate pests including snails and/or slugs within a paddock. There exist significant deficiencies in our knowledge and understanding of millipedes, slaters and earwigs. An improved understanding of the biology, life cycle, ecology and behaviour of each of the key species of these important emerging pests and beneficial species is required to identify and develop new management tactics and effective integrated pest management strategies. Current deficiencies in the knowledge, the increasing frequency and cost and the lack of effective management strategies for these emerging pests has resulted in growers and agronomists/consultants applying a whole range and combinations of non-targeted chemical applications in a bid to protect or salvage crops. Research will directly impact on-farm practices and will reduce the use of ineffective or not registered chemicals.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The RD&E required to address this specific knowledge gap will not be addressed through current GRDC investments. This includes the lack of available information on the effectiveness of existing chemical control options and the effect of chemical application timings on pest populations as well as the numbers of these emerging pests and beneficial species. Further screening of common chemical control options is required to provide growers and advisers with information to understand effectiveness and impacts of chemical control options on beneficials and, if possible, effects on soil biota.
GRDC projects addressing this issue	*New knowledge to improve the timing of pest management decisions in grain crops* (CSE00059) *Maintaining profitable farming systems with retained stubble – component 3 (insects)* (CSP00186)

TABLE 50 2016 Issue 7: New or alternative nitrogen fixing (pulse and/or legume) crops and management packages for low pH soils which are prone to waterlogging.

The issue	Growing pulses in the HRZ environments is generally not profitable. While the benefits and value of pulses and legumes in the rotation are recognised, there are significant areas where there are no adapted or profitable pulse crops. Pulses not adapted or profitable to acidic soils with pH less than six or alkaline soils with pH more than eight that are prone to waterlogging. There are limited alternative pulse options for the HRZ so growers need to consider soil amelioration, growing pulses on raised bed or legume options not pulses. There is demand for suitably adapted and profitable legume options for these environments with establishing and growing local markets in the HRZ for fodder. There is a wide range of pasture legumes that may be suitable and the production and financial risks of growing pasture legumes is significantly less than that for pulses. There is also potential to use pulses and/or legumes as a manure crop to gain rotational benefits but limiting production and financial risk. The current GRDC investment in nitrogen fixing crops and pastures for the high-rainfall zone acid soils (DAN00191) being delivered by NSW Department of Primary Industries' Mark Norton and Helen Burns focuses on identifying factors limiting faba bean production on acid soils, including potential strategies to address limitations, stratification of acidity within the profile, effects of Group B herbicides on nodulation and covers two sites that compare production and gross margins of faba beans and clover mixes. The RCSN has identified gaps and issues including screening and testing of a wide range of pasture/forage legume options, identifying potential roles, uses and fit within the rotation, and economic analysis to determine profitable options.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The desired outcome is to identify profitable pulse and/or legume options for each of the environmental sub-regions e.g. SA's South East, Victoria's Western Districts (basalt soil), Gippsland (red gum soil type) and Tasmania, including dryland and irrigated systems. Options to be included are pulses, pasture fodder and manure crops, annual, perennial and biannual species and narrow options based on suitability for key sowing times, e.g. early autumn or season break, winter July/August, and spring/summer. Research would identify and build upon existing information. Existing information sources include: • SARDI balansa, lucerne and medic breeding programs; • Victorian Department of Economic Development, Jobs, Transport and Resources white and sub clover breeding programs, Hamilton; • Future Farm Industries – EverCrop; • GRDC Crop Sequencing project; and • Legume Species for Profit – Tasmanian publication. Research would include: • Initial screening of a wide range of potential options in small plots; • Larger demonstrations of best bet options in subsequent years; • Quantification of rotational benefits such as nitrogen fixation and effects on weed seedbanks; • Determining where options have a best fit in rotations; • Identifying purposes e.g. grain, forage, fodder and manure; • Developing and extending variety specific agronomy packages (VSAPs); • Developing skills of growers to successfully grow and manage these pulses and legumes; Collaborative delivery via grower groups and other relevant RD&E organisations e.g. Southern Farming Systems, Tasmania Institute of Agriculture, Mackillop Farm Management Group, South Australian Research and Development Institute, Riverine Plains, Victorian Department of Economic Development, Jobs, Transport and Resources; and • A steering committee of local growers and advisers to assist in planning trials and extension activities/products.
GRDC projects addressing this issue	*Nitrogen fixing break crops and pastures for HRZ acid soils* (DAN00191)

TABLE 51 2016 Issue 8: Quantifying the potential use of cover and/or summer crops to minimise winter waterlogging.	
The issue	There is potential for growers to use cover and/or summer crops to minimise winter waterlogging. The HRZ RCSN has identified a range of issues relating to the potential benefits and impacts of cover crops, including understanding: • The predicted achievable yields and margins for a range of suitable summer cover crops for a range of environments; • The impacts of a range of summer crops on subsequent crops given effects on soil water, soil nutrient status, weed seedbanks and disease levels; • The impact of cover crops on drying the soil profile which could have positive consequences for following crops including reduced risk or duration and losses caused by waterlogging and improved water use efficiency; and • The potential negative consequences of growing summer and cover crops including reduced soil moisture which limits potential yield and income, particularly in dry seasons following the cover crop. A cost-benefit analysis will be the critical information that will provide the rationale and motivation for the growing of summer cover crops. An identified knowledge gap is the limited data quantifying the impact of cover crops on soil moisture and the waterlogging in the subsequent year. The network of soil moisture probes and improved modelling capability provide the opportunity and tools to measure the impact of cover crops on soil moisture.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	RD&E will include: • Analysing soil moisture data to quantify the effects of summer cover crops; • Using soil moisture probes as a tool to measure the impact of cover crops on soil moisture; • An opportunity to install or use existing network of soil moisture tools and cover crop demonstration sites and commercial crops to collect locally specific data; and • Collation and communication of information to growers and advisers.

TABLE 52 2016 Issue 9: Better use of data that growers collect.	
The issue	Growers are collecting large amounts of data while in the paddock, however, many are not utilising this data to full effect. There is potential to aggregate, build and utilise soil information to manage the variation in soil characteristics across the HRZ. Combining GPS referenced point data would enable growers to make better decisions and use variable rate technology to deliver increased margins. There is demand for systems which provide the capability to use and point data from within paddocks from a range of sources and collected over a number of years. Foundation information to enter into a database includes soil characteristics which can then have data such as yield maps, soil moisture probe information, normalised difference vegetation index (NDVI) and deep soil nitrogen data overlayed. The current limitation is that data sources are generally not compatible and this limits the power. Another barrier to adoption is the skills and confidence of advisers and growers or the service industry.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	The HRZ RCSN believes RD&E should include a scoping study to identify the best current database options both in Australia and overseas. Following this, four sites will be established in SA's South East, western Victoria, Gippsland and Tasmania to quantify and demonstrate the application and value of building a database for paddocks to assist in decision-making. This research would include undertaking variable rate applications based on the database; measuring yield and quality from across the paddocks when using variable rate applications compared to the use of a standard rate across the whole paddock; measuring economic returns from variable rate applications; and extending results to growers, incorporating grower case studies to extend messages and learnings to growers and advisers.
GRDC projects addressing this issue	GRDC is part of the Federal Government's Rural RD&E for Profit project *Accelerating precision agriculture to decision agriculture* along with Meat and Livestock Australia, Dairy Australia Limited, Sugar Research Australia, Rural Industries Research & Development Corporation, Australian Wool Innovation, Horticulture Innovation Australia, Australian Pork Limited, Wine Australia, Forest & Wood Products Australia, Fisheries Research and Development Corporation, Australian Farm Institute, Data to Decisions CRC, University of New England, Griffith University, University of the Sunshine Coast, and CSIRO. *Future Farm Investment – Theme 1: Intelligent sensing* (CSP00201) *Future Farm Investment – Theme 2: Intelligent decisions* (US000709) *Future Farm Investment – Theme 3: Intelligent infrastructure* (USQ00022) *National Paddock Survey* (BWD00025)

TABLE 53 2016 Issue 10: Soil health – increasing organic matter to address declining levels and consequences.	
The issue	We are experiencing declining organic carbon levels in soils and research is required to understand whether we can expect this trend to continue or plateau. Recent research has shown that the rate of change in organic carbon levels is very slow. Stubble retention did not increase levels but incorporating nutrient enriched stubble is not an economically viable option. Further research would provide an understanding of the consequences of declining levels on productivity and profitability, the cost and value of building organic carbon or using cover crops as a tool to build organic carbon.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	Research and modelling is required to understand if the trend of declining organic carbon will continue or plateau. This would include: • Quantifying the consequences and economic impact of declining levels on productivity and profitability; • Quantifying the cost and value of building organic carbon through economic analysis; • Long-term research to quantify the impact of cover crops on soil health or organic carbon; • Collating and communicating findings from long-term rotation and tillage trials; and • Understanding and extending RD&E findings on this issue that have been delivered through the Federal Government's Filling the Research Gap, which is part of the Carbon Farming Futures program.
GRDC projects addressing this issue	*Maintaining profitable farming systems with retained stubble – component 1 (stubbles)* (CSP00186) *Coordination and extension of 'Improved management of soil organic matter for profitable and sustainable cropping'* (CRF00002) *Building resilient and profitable grain cropping systems through improved knowledge of soil organic carbon fractions and their functionality* (DAN00169)

TABLE 54 2016 Issue 11: Controlled traffic farming (CTF) in the HRZ – an economic study.	
The issue	There are a range of potential benefits in controlled traffic farming (CTF) but it appears the key benefit is reduced compaction. CTF in the HRZ has generally been limited to raised bed farming systems with almost no broader adoption of CTF in the zone. Issues for research include: • Determining whether it is possible to obtain the benefits of reduced compaction using other strategies or components of CTF without moving to a full CTF system; • Understanding whether the scale of cropping or paddock size in the HRZ limits the economies of scale, logistics and economic benefits of CTF; and • Understanding if running livestock on cropping paddocks limits the application and benefits of CTF. There is currently no evidence or economic analysis of CTF available or relevant to the HRZ, including alternative strategies to reduce soil compaction.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	Research would measure and quantify the impact of CTF across a number of environments across the HRZ along with economic evaluation of CTF in the HRZ. This needs to use a consistent approach and methodology as CTF economic studies being undertaken in the GRDC in the western region and low-rainfall zone of the Southern Region, including using paired paddock comparisons and case studies for extension.
GRDC projects addressing this issue	**Current investment (not directly related to HRZ):** *Application of controlled traffic farming in the low-rainfall zone* (ACT00004)

TABLE 55 2016 Issue 12: New crops in the rotation, including linseed, buckwheat, fodder beet, poppies and a range of summer crops.	
The issue	There is an assumption that a greater diversity of crops and/or pastures in the rotation will improve the robustness and sustainability of systems and therefore increase the long term profitability of farm businesses. The HRZ RCSN has identified a range of crops and pastures that could be included within the rotation including linseed, buckwheat, fodder beet, poppies and a range of summer crops. These are a potential fit for alternative crops in the rotations for opportunistic cropping and spring or summer crops.
RCSN prioritising this issue	High-rainfall zone
RD&E actions to address this issue	Research would initially collate existing scientific and grey information and then determine if and where, according to climate and soil types, these crops could fit within the HRZ farming systems. Further analysis or modelling would compare the long-term profitability of a range of rotations.
GRDC projects addressing this issue	No investment as identified crops are not presently levied by the GRDC

8. Appendices

Identifying critical industry issues to determine RD&E

A key role of each RCSN is to identify the critical issues affecting growers in their rainfall zone and to ensure these are captured, described and, where feasible, appropriately addressed by the GRDC. Ultimately, the RCSNs are working to ensure the future profitability and growth of the grains industry in each rainfall zone. Issues are typically identified by members' networks, feedback, observation and/or experience, and are reported back to the RCSN at the scheduled meetings or via out-of-session correspondence.

GUIDED CONSIDERATION

With hundreds of issues presented and discussed annually, the RCSN members work to clearly understand and define constraints or opportunities to grains profitability, and identify perceived gaps in knowledge, skills, tools or technology in regards to the issue. The analysis of each issue is structured and the RCSNs assess each issue by considering the following points.

1 Understand the issue. What is the constraint or opportunity and how does it fit within the context of the farm system? How is it limiting production, or, more importantly, profit? Is it common to most growers in the district or limited to local areas? What contribution will finding a solution make to individual farm profit and risk management and to the district? How likely is it that the solution will be adopted?

2 What is already known? Have we explored the literature to see if there is already a solution? Are there growers in the district or in similar environments elsewhere who have developed a solution, or at least tried things? Do we need to do further work or would it be better to share the current know-how with other scientists and growers?

3 Review what type of work is needed. Do we need to generate a solution through research and do we have the resources and scientific capability? Or should we engage someone else with greater experience and skills? Will the research just provide technical information or can we add a profitability dimension? Or, if there is already a body of knowledge (see step 2), should we concentrate on validating that information in our district, either by a simple plot set-up or larger demonstration strips in grower paddocks? Or should we just move straight to extending the known information?

4 What is the value/return of any proposed solution? Having generated a possible technical solution what difference will it make to farm profit. Does it increase farm risk and how can that be managed? Are there any side benefits or downsides? These considerations need to cover the range of farms in the district. What is the district impact? Can it be applied to farms elsewhere in similar environments?

5 Review how growers might adopt the solution. What is the current level of understanding of growers and how does the solution fit their system? What do they need to know? How do we deliver the information so that growers are confident to build it into their decision-making? Do we use demonstrations, field days, farmer discussion groups or something else? What is the role of the commercial sector in extension (for example private consultants)? How are we going to measure the level of adoption and understand the reasons why some growers do not adopt, as will inevitably be the case? How can growers and advisers in areas with similar environments be informed of the results?

6 Understand the timeframe. Recognising what has been done elsewhere/learning from this. What will be delivered and in what timeframe, and will it require an extension response?

After all issues are considered, the highest ranking issues undergo another process of structured analysis to identify and define what RD&E is required to address the issue – the process is called program logic.

USING PROGRAM LOGIC

The program logic approach identifies practice changes that would address the issue. A practice change is described as how things can be done differently once an issue is addressed.

Using this approach, members can visualise what practices they believe can realistically be adopted by various stakeholders (growers, consultants, industry, government) in an ideal commercial environment.

Once the practice change has been identified then what is stopping growers from adopting the practice change is determined. Is it motivation, ability, knowledge, ability or tools? This process is called the MAKAT process and it provides a structured way to identify the biggest hurdles to overcoming an issue. That is, is it:

- Motivation?
- Attitude?
- Knowledge?
- Ability?
- Tools?

The MAKAT approach is primarily used to expand participants' thinking on an issue, rather than going straight to a solution (eg. more trial sites!), to help drill down to define the activities/actions required to achieve the desired practice change. The MAKAT process also considers where the audience is now and where it needs to be:

- Issue justification – what is the evidence that this issue is a problem?
- Defining the outcome(s) – how do growers want the issue to look after the activity?
- Defining the practice changes that are needed to get to the outcome.

The GRDC has adapted the program logic concept, which demonstrates the logic pathway to achieving the desired outcome, from Cameron Nicholson (Figure A1). While this process challenged many RCSN members' natural thinking styles, it proved very successful because it stopped them diving straight into solution mode without having first considered the desired outcome. It has also been successful in providing GRDC program managers with a comprehensive insight into each issue and helps develop a sound project proposal.

To date, the program logic process has enabled each RCSN to generate:

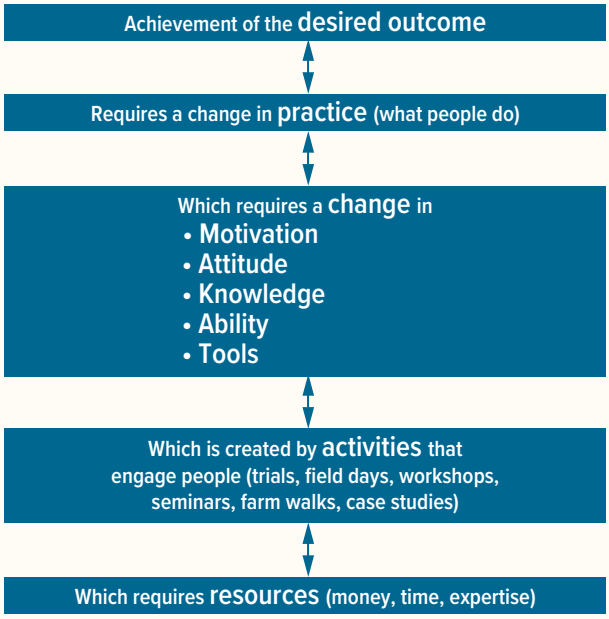
- A list of key issues;
- Prioritised practice changes required to address each key issue; and
- A MAKAT for the top priority practice changes, as well as key activities (RD&E) identified to create change.

Once a MAKAT has been completed for a specific issue, it is fed back to the GRDC and then used to guide GRDC's investment decisions on an ongoing basis.

The information from the MAKATs that have been completed for specific issues is collated by the RCSN facilitators and supplied to the GRDC for consideration by staff and the Regional Panel. This information is invaluable in prioritising investments at a regional level based on broader consideration and knowledge relating to existing investments; technical feasibility and risk, financial investment required, potential return on investment spend, potential for co-investment, time to solution delivery and regional investment strategy.

The information generated as part of this process also provides solid points of reference about the issue, including required practice change and desired outcomes which can be used to monitor the performance of any investment made in regards to the issue.

FIGURE 3 The program logic process used by the RCSNs identifies the practice changes, resources and actions that are required to address priority issues.



THE 2015–2017 GRDC SOUTHERN REGIONAL PANEL

DECEMBER 2016

CHAIR KEITH PENGILLEY

Keith was previously the general manager of a dryland and irrigated family farming operation at Conara in the northern midlands of Tasmania, operating a 7000-hectare mixed-farming operation over three properties. He is a director of Tasmanian Agricultural Producers, a grain accumulation, storage, marketing and export business. Keith is the chair of the GRDC Southern Regional Panel, which identifies and directs the GRDC's RD&E investments in the southern grains region.

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DEPUTY CHAIR MIKE MCLAUGHLIN

Based in Adelaide, Mike is a researcher with the University of Adelaide and CSIRO. He specialises in soil fertility and crop nutrition, contaminants in fertilisers, wastes, soils and crops. Mike manages the Fertiliser Technology Research Centre at the University of Adelaide and has a wide network of contacts and collaborators nationally and internationally in the fertiliser industry and in soil fertility research.

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JOHN BENNETT

Based at Lawloit, between Nhill and Kaniva in Victoria's west Wimmera, John and his wife, Allison, run a mixed-farming operation across diverse soil types. The farming system is 70 to 80 per cent cropping, with cereals, oilseeds, legumes and hay grown. John serves on the Regional Cropping Solutions Network and the BCG Wimmera Advisory Committee. John wants the agricultural sector promoted as an exciting career path for young people and to see R&D investments promote resilient and sustainable farming systems that deliver more profit to the grower.

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PETER KUHLMANN

Peter is a grower at Mudamuckla near Ceduna on SA's western Eyre Peninsula. He uses liquid fertiliser, no-till and variable-rate technology to assist with low rainfall and subsoil constraints. He has been involved with the Eyre Peninsula Agricultural Research Foundation and the South Australian Grain Industry Trust. In 2012 Peter won the ABC Rural and Kondinin Group Australian Farmer of the Year award.

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BILL LONG

Bill is an agricultural consultant and grower on SA's Yorke Peninsula. He has led and been involved in many RD&E programs and was one of the founding members of the Yorke Peninsula Alkaline Soils Group and is a former chair of Ag Excellence Alliance. He has a strong interest and involvement in farm business management and communication programs within the GRDC. He is a Churchill Fellow.

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JON MIDWOOD

Jon has worked in agriculture for the past 28 years, both in the UK and Australia. In 2004 he moved to Geelong, Victoria, and managed Grainsearch, a grower-funded company evaluating European wheat and barley varieties for the high-rainfall zone. In 2007, his consultancy managed the commercial contract trials for Southern Farming Systems (SFS). In 2010 he became chief executive of SFS, which has five branches covering southern Victoria (Gippsland and the western district) and Tasmania. In 2012, Jon became a member of the GRDC's HRZ Regional Cropping Solutions Network.

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ROHAN MOTT

A fourth-generation grain grower at Turriff in the Victorian Mallee, Rohan has been farming for 24 years and is a director of Mott Ag. With significant on-farm storage investment, Mott Ag produces wheat, barley, lupins, field peas, lentils and vetch, including vetch hay. Rohan continually strives to broaden his understanding and knowledge of agriculture, is passionate about the sustainability of Australian agriculture, and has a keen interest in new technology and value-adding.

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ROB SONOGAN

From Swan Hill in north-west Victoria, Rob is an extension agronomist who has specialised within government agencies in of soil conservation, resource conservation and dryland farming systems. He has been privileged to have had access to many growers, businesses, consultants, rural industry and agribusiness advisers. Rob also has been closely involved in rural recovery and emergency response into issues as diverse as locusts, fire, mice, flood and drought. Rob is employed part-time within the Mallee consultancy group AGRIvision Consultants.

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MARK STANLEY

Mark comes from a mixed-farming background and has had extensive experience in field crops development and extension and in natural resources management. He operates his own project-management business, Regional Connections, on SA's Eyre Peninsula. Mark leads a large carbon farming outreach and extension project with the Australian Department of Agriculture, and provides executive leadership to Ag Excellence Alliance. He is on the board of the Eyre Peninsula Agricultural Research Foundation and is a committee member of the Lower Eyre Agricultural Development Association.

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KATE WILSON

Kate is a partner in a large grain operation in Victoria's southern Mallee region. Kate's husband, Grant, is a third-generation grower in the area and, with their two children, they grow wheat, canola, lentils, lupins and field peas. Kate has been an agronomic consultant in the Mallee and northern Wimmera for more than 20 years. Kate is passionate about growing high-quality grain, while enhancing the natural ability of the soil to do so. She is also passionate about research and the extension of that research to bring about positive practice change to growers.

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PANEL SUPPORT REBECCA JEISMAN

SOUTHERN

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

GRDC SOUTHERN REGION STAFF

JANUARY 2017

DR STEPHEN LOSS

GENERAL MANAGER OF FARMING SYSTEMS, SOILS AND AGRONOMY

Stephen is responsible for developing an investment strategy for management of the portfolio of research projects in the areas of agronomy, farming systems, nutrition and soils for the southern grains region. He leads GRDC engagement with research partners in this area in collaboration with the GRDC Southern Regional Panel. Stephen has previously worked in cereal and pulse agronomy for the Department of Agriculture and Food, Western Australia; in soil science and plant nutrition research and development with fertiliser company CSBP; and in conservation agriculture in the Middle East.

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ANDREW ETHERTON

MANAGER OF FARMING SYSTEMS, SOILS AND AGRONOMY

Andrew works closely with the GRDC's research partners to maximise investment returns and quality outcomes. He is responsible for the development of research projects to address challenges and opportunities in the areas of agronomy, farming systems, nutrition and soils and the ongoing oversight and review of those projects to ensure desired outcomes for the benefit of growers. Andrew was previously employed with Pacific Seeds where he was involved in wheat, canola and summer crops, and has held agronomy positions with Landmark and Murray Goulburn. He has also undertaken an exchange program to Scandinavia.

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DENNI GREENSLADE

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CRAIG RUCHS

REGIONAL MANAGER GROWER SERVICES

Craig is responsible for the regional adaptation of GRDC-funded R&D activities, ensuring the rapid delivery of applied research outcomes to growers. He also assists in the identification of regional RD&E needs and manages the regional delivery of information through targeted communication and extension activities. Craig is manager of the Southern Regional Cropping Solutions Network (RCSN) and acts as an interface between the Southern Regional Panel, the RCSN, farming systems groups, agribusiness, researchers, advisers and growers. Craig's career began as a research agronomist with IAMA and then joined Syngenta Crop Protection in 2004. He has worked in regional and national product development and extension roles. Prior to joining GRDC in early 2016, Craig was based in Singapore with Syngenta in the roles of Herbicide Technical Lead, Asia Pacific, and Head of Herbicides, South-East Asia.

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FIGURE 1 Map depicting GRDC Southern Region.

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SOUTHERN

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2017–2019 SOUTHERN REGIONAL CROPPING SOLUTIONS NETWORK (RCSN)

JANUARY 2017

The RCSN initiative was established to identify priority grains industry issues and desired outcomes and assist the GRDC in the development, delivery and review of targeted RD&E activities, creating enduring profitability for Australian grain growers. The composition and leadership of the RCSNs ensures constraints and opportunities are promptly identified, captured and effectively addressed. The initiative provides a transparent process that will guide the development of targeted investments aimed at delivering the knowledge, tools or technology required by growers now and in the future. Membership of the RCSN network comprises growers, researchers, advisers and agribusiness professionals. The three networks are focused on farming systems within a particular zone – low rainfall, medium rainfall and high rainfall – and comprise 38 RCSN members in total across these zones.

REGIONAL CROPPING SOLUTIONS NETWORK SUPPORT TEAM

SOUTHERN RCSN CO-ORDINATOR: JEN LILLECRAPP

Jen is an experienced extension consultant and partner in a diversified farm business, which includes sheep, cattle, cropping and viticultural enterprises. Based at Struan in South Australia, Jen has a comprehensive knowledge of farming systems and issues affecting the profitability of grains production, especially in the high rainfall zone. In her previous roles as a district agronomist and operations manager, she provided extension services and delivered a range of training programs for local growers. Jen was instrumental in establishing and building the MacKillop Farm Management Group and through validation trials and demonstrations extended the findings to support growers and advisers in adopting best management practices. She has provided facilitation and coordination services for the high and medium rainfall zone RCSNs since the initiative's inception.

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LOW RAINFALL ZONE LEAD: BARRY MUDGE

Barry has been involved in the agricultural sector for more than 30 years. For 12 years he was a rural officer/regional manager in the Commonwealth Development Bank. He then managed a family farming property in the Upper North of SA for 15 years before becoming a consultant with Rural Solutions SA in 2007. He is now a private consultant and continues to run his family property at Port Germein. Barry has expert and applied knowledge and experience in agricultural economics. He believes variability in agriculture provides opportunities as well as challenges and should be harnessed as a driver of profitability within farming systems. Barry was a previous member of the Low Rainfall RCSN and is current chair of the Upper North Farming Systems group.

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LOW RAINFALL ZONE LEAD: JOHN STUCHBERY

John is a highly experienced, business-minded consultant with a track record of converting evidence-based research into practical, profitable solutions for grain growers. Based at Donald in Victoria, John is well regarded as an applied researcher, project reviewer, strategic thinker and experienced facilitator. He is the founder and former owner of JSA Independent (formerly John Stuchbery and Associates) and is a member of the SA and Victorian Independent Consultants group, a former FM500 facilitator, a GRDC Weeds Investment Review Committee member, and technical consultant to BCG-GRDC funded 'Flexible Farming Systems and Water Use Efficiency' projects. He is currently a senior consultant with AGRIvision Consultants.

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HIGH RAINFALL ZONE LEAD: CAM NICHOLSON

Cam is an agricultural consultant and livestock producer on Victoria's Bellarine Peninsula. A consultant for more than 30 years, he has managed several research, development and extension programs for organisations including the GRDC (leading the Grain and Graze Programs), Meat and Livestock Australia and Dairy Australia. Cam specialises in whole-farm analysis and risk management. He is passionate about up-skilling growers and advisers to develop strategies and make better-informed decisions to manage risk – critical to the success of a farm business. Cam is the program manager of the Woady Yaloak Catchment Group and was highly commended in the 2015 Bob Hawke Landcare Awards.

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MEDIUM RAINFALL ZONE LEAD: KATE BURKE

An experienced trainer and facilitator, Kate is highly regarded across the southern region as a consultant, research project manager, public speaker and facilitator. Based at Echuca in Victoria, she is a skilled strategist with natural empathy for rural communities. Having held various roles from research to commercial management during 25 years in the grains sector, Kate is now the managing director of Think Agri Pty Ltd, which combines her expertise in corporate agriculture and family farming. Previously Kate spent 12 years as a cropping consultant with JSA Independent in the Victorian Mallee and Wimmera and three years as a commercial manager at Warakirri Cropping Trust.

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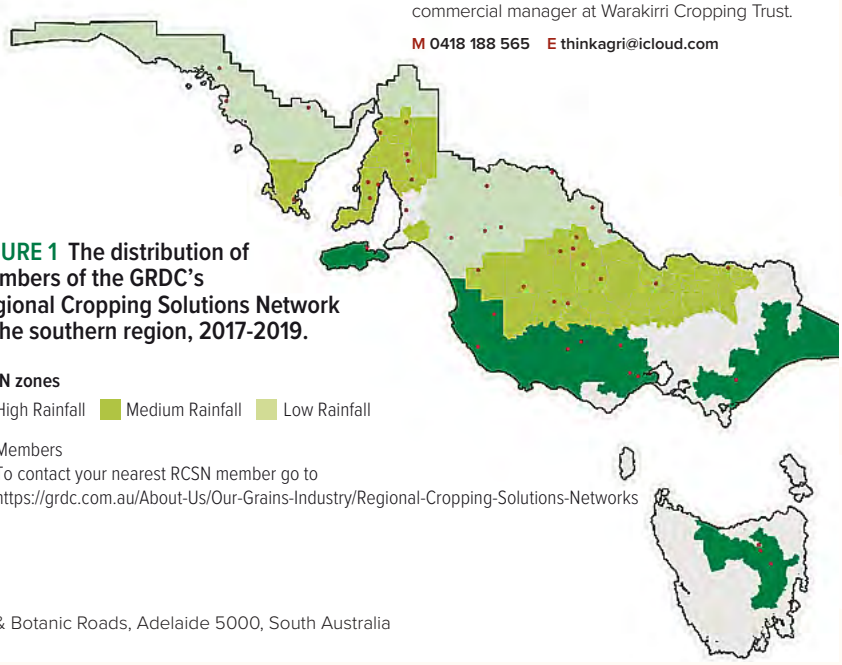

FIGURE 1 The distribution of members of the GRDC's Regional Cropping Solutions Network in the southern region, 2017-2019.

To contact your nearest RCSN member go to https://grdc.com.au/About-Us/Our-Grains-Industry/Regional-Cropping-Solutions-Networks

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Notes

Notes

Southern Regional Cropping Solutions Network

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GRDC REGIONAL MANAGER, GROWERS SERVICES SOUTH AND MANAGER SOUTHERN RCSN

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2015-16 SOUTHERN RCSN FACILITATORS:

HIGH RAINFALL AND MEDIUM RAINFALL ZONES

Jen Lillecrapp

MEDIUM RAINFALL ZONE

Tony Craddock

HIGH RAINFALL ZONE

Trent Potter

LOW RAINFALL ZONE

Nigel Wilhelm and Naomi Scholz

FORMER IRRIGATION ZONE

Rob Fisher and Bree Laughliny

Map depicting GRDC Southern Region

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