FINAL REPORT 2014

PROJECT CODE	:	S1201

PROJECT TITLE
Demonstrating best management for Rhizoctonia on upper EP and the Mallee

PROJECT DURATION

Project Start date	1 July 2012
Project End date	30 June 2014

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Office Use Only

Project Code	
Project Type	

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PROJECT REPORT

Executive Summary

Farmer demonstrations of canola, Juncea canola, medic and vetch break crops performed well lowering Rhizoctonia inoculum levels, allowing other weed control options, earlier sowing opportunities and higher yield for the following cereal. Oilseeds proved to be a financial risk compared to medic, with economic modelling indicating canola needs to yield at least 0.45t/ha to provide an equivalent gross margin with higher risk compared to a ‘medic pasture (sheep)/wheat’ rotation in this environment. Low input vetch performed well compared to medic pasture, with a higher yield and a gross margin improvement of $100/ha being achieved (M Krause Appendix 1).

Fungicide products used in paddock demonstrations, in second year cereals with high Rhizoctonia disease inoculum levels, have shown variable responses depending on products and application. In farm demonstrations the lower cost products provided a better economic benefit. The fungicide products showed responses in field trials at Minnipa in 2013 similar to other regions with in-furrow fungicides being more effective than seed treatments, despite all treatments still having visual Rhizoctonia patches present in wheat and barley. Economically the yield responses were positive on wheat but not on barley and the lower cost options performed well economically despite not achieving the highest yields.

The key findings from the Eyre Peninsula (EP) and Mallee Rhizoctonia grower survey were; that break crops are used as a Rhizoctonia management option, with canola rotation being higher in the Mallee and medics higher on EP; fungicide application has been the highest practice change in the last 2 years and the most frequent change farmers would implement if possible; controlling summer weeds and the green bridge have increased in the last two years; growers know nutrition (P, N and trace elements) are important for Rhizoctonia management, and nitrogen and TE applications have increased in the last 2 years.

Project Objectives

Key Aim: To show the combined value of management practices which reduce the impact of Rhizoctonia on farm in typical upper EP and Mallee environments.

After a resurgence in Rhizoctonia research over the last decade, our understanding of this difficult to manage disease has increased substantially. The aim of this project was to use the latest findings from Rhizoctonia research to demonstrate the collective value of 'best bet' strategies in broad acre environments of the upper EP and Mallee in comparison to current farming practices. This project looked at the impact of break crops on Rhizoctonia inoculum and of crop management on disease expression in the following cereal crop.

Reducing inoculum level is an important tool in minimising disease impact in crop. The 'best bets' used in the farmer demonstrations for minimising Rhizoctonia inoculum levels were; including canola, fallow, vetch and medic as break crops within the rotation with adequate grass control, controlling summer weeds and controlling the green bridge before seeding.

The 'best bets' used to reduce the impact of Rhizoctonia infection in the crop included adequate nutrition, particularly zinc and other trace elements, fluid phosphorus fertilizer delivery in calcareous grey soils, sowing depth, timeliness of sowing (earlier into warmer soil temperatures) and use and placement of fungicides (ongoing research).

Factors which can also reduce the inoculum and impact of Rhizoctonia not included by farmers in the demonstrations were 'directed or targeted' disturbance (tillage) and reducing herbicide residues which impact on plant root growth (sulfonylureas). This project evaluated farmer demonstrations of 'best bet' packages of Rhizoctonia management with farm machinery on a paddock scale.

Rhizoctonia risk level for farmers, based on the latest Rhizoctonia research and previous research has been developed as a single page hardcopy publication (Appendix 2) and an interactive computer based decision tool is currently being developed with WOOF Design, Port Lincoln.

This will help farmers decide on where to concentrate efforts to get the most likely chance of reward, where to take a short cut if appropriate and will focus attention on treating paddocks with different risks with different management strategies. The impacts of changing practices on whole farm profitability and risk will continue to be discussed in the extension of results of the project.

Overall Performance

Project objectives were achieved with three farmer co-operators, two on Eyre Peninsula (Streaky Bay and Warramboo) and one in the SA Mallee (Wynarka) undertaking broad acre demonstrations to reduce the impact of Rhizoctonia within their farming system.

Reducing inoculum level is an important tool in minimising disease impact in crop. The 'best bets' used in the farmer demonstrations for minimising Rhizoctonia inoculum levels were; including canola, fallow, vetch and medic as break crops within the rotation with adequate grass control; controlling summer weeds and controlling the green bridge before seeding.

The 'best bets' used to reduce the impact of Rhizoctonia infection in the crop included adequate nutrition especially zinc and other trace elements, phosphorus fluid fertilizer delivery in calcareous grey soils, sowing depth, timeliness of sowing (earlier into warmer soil temperatures) and use and placement of fungicides (ongoing research).

The rotational best bet options demonstrated canola and Juncea canola compared to medic and medic/fallow at Piednippie, and medic and vetch at Warramboo. All grass free break crop options lowered the Rhizoctonia inoculum levels validating previous research, and a vetch crop had not been monitored previously on EP. The break crops also allowed other chemical weed control options and earlier crop establishment in the following cereal crop.

The economic evaluation of the break crops showed oilseeds are a higher financial risk in low rainfall regions than medic pasture in rotation. Economic modelling for average seasons indicated that canola needed to yield at least 0.36 t/ha to provide an equivalent gross margin with 'medic pasture (sheep)/wheat' rotation. However to allow for the risk of growing canola, it was suggested that a yield of 0.45 t/ha in an average season should be the break-even yield (M Krause). The rotation of vetch/wheat compared to medic pasture/wheat gave the best financial result in the farmer demonstrations ($100/ha higher).

The farmer paddock demonstrations showed variable responses to the fungicides depending on the product and application method in second year cereal paddocks with high Rhizoctonia inoculum. The lower cost products provided an economic benefit in some situations.

In field trials at Minnipa in 2013 the fungicide products showed responses similar to other regions with in-furrow fungicides being more effective than seed treatments. There were yield responses to fungicide treatments in both wheat and barley however there were still visual Rhizoctonia patches present in the treatments. Economically these yield responses to fungicide application were positive on wheat but not on barley. Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments. A three week delay in seeding reduced yield by nearly one third and had the lowest gross margins of $201/ha in wheat ($137/ha less than control) and $217/ha in barley ($128/ha less).

KASAP Rhizoctonia Survey of Eyre Peninsula and Mallee Farmers (Appendix 3)
Key Findings

- 97% of growers in both EP and Mallee consider Rhizoctonia as an issue when making decisions about their farming program.
- Growers in both regions have good knowledge of Rhizoctonia as a cereal root disease, disease management and environmental factors which impact on

disease severity.

- Only 26% of growers knew crown root damage can be an indicator of the level of Rhizoctonia inoculum for the next season. This message could be extended more to the industry.
- 71% of growers examine plant roots but there is a low use of PreDicta B testing.
- Break crops are used as a Rhizoctonia management option, with canola being more common in the Mallee and medics higher on EP.
- Growers sow early with some cultivation, especially with points working below the seed, as a management tool.
- Fungicide application has been the highest practice change in the last 2 years and the most frequent change farmers would implement if possible.
- Controlling summer weeds and the green bridge have increased in the last two years.
- Growers know nutrition, P, N and trace elements are important and nitrogen and TE applications have increased in the last 2 years.
- Changes which growers would implement given no constraints to their systems would be the adoption of fluid delivery systems for fungicide application (19 growers total with 14 wanting split application), apply fungicides, not necessarily as fluids (10 growers), fluid delivery system for trace elements (13), bigger machinery to implement tillage below seed, better seed placement or deep rip (14), change rotation to increase break crop in rotation (legume) and longer breaks with two year grass free (15 with 11 of these growers in Mallee).

Growers source information from local researchers and research institutions, GRDC publications and updates, local consultants (greater in Mallee), internet, Stock Journal and newspapers and interaction/discussions with local growers/neighbours.

Personnel:
Amanda Cook – Principal Researcher (Yr 1 0.30, Yr 2 0.35 FTE, PS02)
Ian Richter – Technical Officer (Yr 1 0.25 , Yr 2 0.37 FTE, OPS03*)*
Co-operators - Dion, Neville and Karen Trezona – Piednippie, Kane and Veronica Sampson – Warramboo, Stuart and Amanda Pope – Wynarka.
In kind support - EPARF Committee, MAC/EPARF Research and Review Committee, Wade Shepperd (in-kind technical support sampling and root washing), Nigel Wilhelm, Naomi Scholz, Tanya Morgan (organising Mallee farmer contact), Peter Treloar (monitoring Mallee site), Rebecca Tonkin (Mallee harvest travelling cost in 2012), Linden Masters - EP Farmer meetings and Sticky Beak Days extension, GRDC National Rhizoctonia Project – Vadakattu Gupta, Alan McKay, Kathy Ophel-Keller, Nigel Wilhelm, Amanda Cook, Paul Bogacki, Bill MacLeod, Daniel Huberli and Sjaan Davey.
Paid contractors - Dodgshun and Medlin – Mallee extension, Struan NVT – harvesting 2013, Mike Krause – Economic analysis.

The main difficulty encountered was the distance from Minnipa to the Mallee farmer site to maintain and monitor the farmer demonstration, this was resolved by working with other SARDI personnel with research in the area and contracting some of the harvest and extension activities.

Key Performance Indicators (KPI)		
KPI	***Achieved (Y/N)***	***If not achieved, please state reason.***
Identify three desirable paddocks and willing farmer co-operators on EP (2 sites) and in the Mallee (1 site).	Yes - April 2012, 3 farmer co-operators with suitable paddocks identified: Trezona – Piednippie (EP) Sampson – Warramboo (EP) Pope – Wynarka (Mallee)	
Devise and implement program to establish Best Bet control options for Rhizoctonia in their farming system	Yes - July 2012, 2013 - Some Best Bet control options already established in 3 paddocks Trezona: canola break crop in previous year (greater weed control options), summer weed control, earlier seeding. Sampson: fungicides in fluid fertiliser system and vetch and medic break crops, summer weed control, adequate nutrition especially trace elements in fluid fertilizer system, earlier seeding. Pope: fungicides in fluid fertiliser, summer weed control, adequate nutrition with trace elements delivered in fluid system. Sites visited, information presented and discussed at annual farmer meetings and farmer sticky beak days. GRDC Southern Panel Tour visited K. Sampson's site and SAGIT/MAC/EPARF Best bets trial. Results published in Eyre Peninsula Farming Systems Summary.	Other –A replicated trial funded by EPARF established at MAC in 2013 to implement all Best Bet options and new fungicide products, rates and delivery methods. Site was focus for SAGIT Best Bets project at MAC field day and GRDC Southern Panel Tour. Four farmer paddock fungicide demonstrations were also monitored in 2013: Peter Kuhlmann, Mudamuckla, Graeme and Heather Baldock, Buckleboo, Andrew and Jenny Polkinghorne, Lock, and Minnipa Ag Centre, Paddock South 3 North.

Monitoring paddocks and results collated, analysed, published and presented to EP farmers annually	Yes - December 2012, 2013. Paddocks sampled and results collated, articles published in EPFS Summary 2012, 2013 and March 2014 and MSF Compendium (online). Attended Mallee Tristate Forum and GRDC National Rhizoctonia Meeting, Adelaide.	
Rhizoctonia management decision tree tool developed. KASAP survey completed. Economic analysis completed.	Yes – August 2014. See Appendices.	

Technical Information

The current management impacts on Rhizoctonia disease have largely been evaluated individually in plot based research, but this project evaluated these 'best bet' options of Rhizoctonia management with farm machinery on a paddock scale. A report on the economics of the break crops and fungicides using gross margins has been prepared by Mike Krause, Applied Economic Solutions (Appendix 1).

Break crops to lower Rhizoctonia inoculum levels and reduce disease impact

The break crop options evaluated at Warramboo in 2012 included Blanchefleur vetch (no fertiliser) and self-regenerating medic (mixture of Harbinger and Parabinger). The paddock was grass free sprayed twice, and spray topped ensuring adequate grass control and no seed set was achieved during the break phase. The PreDicta B disease *Rhizoctonia solani AG8* risk was low for both vetch and medic. The paddock was sown early on 12 May 2013 with Mace wheat using a fluid fertiliser delivery system. Wheat after vetch yielded greater than after medic.

The break crop option used in 2012 at Dion, Nev and Karen Trezona's at Piednippie was CL Oasis mustard in a paddock with a medic/fallow strip (one seeder run). The previous paddock history was; 2011 barley (with high Rhizoctonia damage); 2010: wheat (mouse plague resulted in large bare patch causing the pimpernel weed problem and grass issues in this paddock). The PreDicta B *Rhizoctonia solani AG8* risk was medium with 62 pg DNA/g soil after canola and low (22) after the medic/fallow. The paddock was sown with CL Kord wheat on 27 April 2013 with 55 kg/ha of DAP (18:20:0:0) with a post sowing application of 2 L/ha Zn.

The Rhizoctonia patch score showed greater damage in the canola than the fallow area, and the canola had higher total soil nitrogen levels at the start of the season. The early and late dry matters were greater in the canola than the fallow. Grain yield and grain protein were also higher in the canola than the fallow area. There were no other differences in grain quality between the canola or medic/fallow treatments.

Cereal crops following canola break crops at Piednippie in 2012 and 2013 performed well (validating previous trial research in this region), have addressed other issues (weed control), have been sown earlier, have achieved closer to potential yield in both seasons, and increased interest in alternative break crops with local growers.

The low input vetch break crop at Warramboo was the first monitored on EP as a Rhizoctonia break crop and it performed well compared to the medic, with both break crops having low Rhizoctonia inoculum levels and higher yield being achieved with the vetch rotation. Grass free break crops are currently the best recommended option to lower Rhizoctonia inoculum levels, allowing the following cereal crop to have lower initial disease pressure. The break crop options also allow grass weed control options and earlier sowing options for the cereal crop in the following season. However the Rhizoctonia inoculum level will increase during the wheat season and be back to a higher level following one cereal crop.

Fungicide evaluation for Rhizoctonia management
Fungicides gave variable responses in broad acre farmer demonstrations depending on the product, application method and paddock location. The fungicide products were used in paddocks with second year cereals with high Rhizoctonia disease inoculum levels.

The farmers selected for the Best Bet demonstrations of Rhizoctonia management were using summer weed control, green bridge control, early time of sowing, adequate fertiliser levels, starter nitrogen with in-season applications if required, fluid delivery of trace elements (Zn, Cu and Mn) and the fungicide products.

The EPARF Committee supported this project by funding a trial located on the Minnipa Agricultural Centre in 2013 to be a local demonstration of this research for farmers, be a focal point at the Minnipa Agricultural Centre Field Day and obtain further information on 'best bet' management options and the potential of future fungicide products and rates. The Field Day was attended by 150 farmers, industry and staff and the GRDC Southern Panel visited this trial in September 2013.

The replicated trial followed a wheat crop and the PreDicta B *Rhizoctonia solani AG8* risk was high with 205 pg DNA/g soil. In the trial there were yield responses to fungicide treatments in both wheat (up to 14 % of control) and barley (up to 12 % of control), however there were still visual Rhizoctonia patches present in the treatments. There were reductions in Rhizoctonia seminal root scores with fungicides in wheat but not in barley. The in-furrow fungicides were more effective than seed treatments. A three week delay in seeding reduced yield by nearly one third. Fungicide treatments did not prevent a buildup in Rhizoctonia inoculum levels during the growth of the cereal crop. Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments. [EPARF Rhizoctonia Fungicide Trial, Eyre Peninsula Farming Systems Summary 2013, Appendix 4]

Economic evaluation of rotations and fungicides (Appendix 1) Demonstrating Best Management for Rhizoctonia in Low Rainfall Zones of SA (EP and Mallee 2012 to 2013) Economic Comment, August 2014, Mike Krause, Principal, Applied Economic Solutions.

Key Points:

- A rotation of vetch/wheat compared to medic pasture/wheat gave the best financial result in the farmer demonstrations assessed. Vetch sown with minimal input provided an improved financial performance when compared to medic pasture so perhaps should be considered as a better break for upper EP systems.
- The use of fungicides provided an economic benefit for most farm demonstrations. However, label recommendations for applying fungicides should always be followed. The lower cost products provided the better economic benefits.
- Canola and mustard (Juncea canola), in the seasons tested in the farmer trials, proved to be a significant financial risk. Economic modelling using these results, and for average seasons, indicated that canola needed to yield at least 0.36 t/ha to provide an equivalent gross margin with 'medic pasture (sheep)/wheat' rotation. When allowing for the risk of growing canola, it was suggested that a yield of 0.45 t/ha in an average season should be the break even yield.
- The EPARF fungicide trials of 2013 indicated that there were positive economic responses to using the various fungicides on wheat, but not for barley.

<u>Piednippie: Canola and Juncea Canola (mustard) as break crops compared to medic</u>
The cereal crops following the canola and medic break crops at Piednippie in 2012 and 2013 performed well and had a lower Rhizoctonia inoculum level following both the canola and medic/fallow rotations, validating previous trial research.

2011 was a poor year and the medic being in the same paddock as the canola was not grazed, so no income was generated from the medic in the medic/wheat rotation. While the wheat yields were the same following both rotation options in 2011, the rotation gross margin results were very different. The rotation gross margin was significantly in favour of the medic/wheat rotation ($104/ha) as the variable costs were greater in the canola ($22/ha GM) in the poor year of 2011 (Appendix 1, Table 1). This result highlights the risk associated with canola compared to a volunteer medic pasture in this environment.

In 2012 the rotational choices of Juncea Canola (mustard) and medic/fallow in the demonstration resulted in different wheat yields in the second year of 2t/ha and 1.7 t/ha respectively. However, the rotation gross margins of the break crops showed little difference in financial performance with only $4/ha difference in gross margin (Appendix 1, Table 2).

The wheat/wheat rotation provided the lowest rotation gross margin ($228/ha) when compared to the rotations with a break year ($284 and $288/ha) indicating the overall production and financial benefits of a rotation with a break when compared to a wheat/wheat rotation.

Rotation selection can make an economic difference, however this season again showed how risky oil seed is to grow profitably in this area. Modelling was undertaken to determine the break-even yield for canola in this environment, and it would need to yield 0.36t/ha for it to be financially equivalent with a medic/wheat rotation, given average conditions. However, as has been discussed, canola is a riskier crop to grow. Mike Krause reports a long term yield of 0.45 t/ha is needed to provide a profitable risk reward and should be considered as the necessary canola breakeven yield in this environment. This may impact on the area sown to canola on Western and Eastern Eyre Peninsula which has increased by 9,100 ha in the past 5 years (PIRSA Crop Production Estimates 2013 & 2009).

Warramboo: vetch and medic as break crops

The wheat gross margin after low input vetch was $100/ha higher than after a medic pasture due to a 0.4 t/ha increase in yield. As the medic pasture was not grazed in this trial, there was no allowance for sheep gross margin. However sheep would have had to achieve a gross margin of $100/ha for both treatments to have the same economic outcome.

Fungicides: Warramboo, Wynarka and Minnipa

The new fungicide products available in 2013 for Rhizoctonia suppression varied in performance in paddock demonstrations with some products only performing marginally better than the controls in grain yield. There were differences detected in the demonstrations in the level of Rhizoctonia infection of seminal roots and but these were not significant in 2013.

At Warramboo average yield obtained from two areas within the demonstration were used for the economic analysis (Appendix 1, Table 5). Both fungicides had lower Rhizoctonia patch score (significant) but not lower Rhizoctonia root infection. The economic evaluation in this demonstration showed the selection of fungicide was important as the EverGol Prime gave an improved gross margin ($251/ha) due to an increase in yield and lower input costs. The use of Uniform ($183/ha) gave minimal improvement in gross margin over the control treatment ($180/ha) despite an increase in yield, due to the higher input cost ($17/ha).

At Wynarka there were no differences in plant growth, Rhizoctonia seminal or crown root scores, grain yield or grain quality between the control and the fungicide treatment at this site in 2013. While there was some gross margin improvement when using fungicides (EverGol Prime and Flutriafol), this financial improvement was minimal when comparing the three year rotational gross margin (Appendix 1, Table 8).

Results from the Best Bets for Rhizoctonia trial showed banded in-furrow fungicides were more effective than seed treatments, and new products at higher rates were also effective. There were yield responses to fungicide treatments in both wheat and barley however there were still visual Rhizoctonia patches present in the treatments. Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments. A three week delay in seeding reduced yield by nearly one third. The fungicide treatments did not prevent an increase in Rhizoctonia inoculum levels during the cereal phase.

Sowing 3 weeks later than the control produced the poorest gross margin of $200/ha (Appendix 1, Figure 1). Eight treatments provided noticeably improved gross margins (over $350/ha) when compared to the 'control treatment' ($338). The use of fungicides Uniform (SYN SIF1), EverGol Prime and Vibrance seed dressing provided improvements in gross margins when compared to the control. The use of fluid fertiliser did not improve gross margin over the control in this soil type.

In the barley trial, sowing 3 weeks later than the control produced the poorest gross margin ($217) (Appendix 1, Figure 2). Most treatments in the barley trial gave no significant gross margin improvement when compared to the control. Only one fungicide treatment, Vibrance seed dressing 360 ml/t & Uniform (SYN SIF1) in-furrow medium rate ($372/ha), produced an improved gross margin above the control treatment ($345/ha).

Conclusions Reached &/or Discoveries

Grass free break crops are currently the best recommended option to lower the Rhizoctonia inoculum level, allowing the following cereal crop to have lower initial disease pressure. The break crop options included in the farmer demonstrations of canola, Juncea canola, vetch and medic lowered Rhizoctonia inoculum levels, allowed other grass weed control options and earlier sowing for the cereal crop in the following season. Growers are currently using rotation as a Rhizoctonia management option with higher levels of canola being used in the Mallee, and medic pasture on EP.

However on upper EP in the seasons tested, canola and Juncea canola proved to be a significant financial risk compared to medic. Economic modelling for average seasons, indicated that canola needed to yield at least 0.36t/ha to provide an equivalent gross margin with 'medic pasture (sheep)/wheat' rotation in this environment. When allowing for the risk of growing canola, a yield of 0.45t/ha in an average season should be the break-even yield (Appendix 1).

The low input vetch break crop performed well as a break crop compared to medic. The rotation of vetch/wheat compared to medic pasture/wheat gave the best financial result with a higher yield being achieved and an increase of $100/ha with the vetch rotation.

The new fungicide products for Rhizoctonia suppression have varied in performance in paddock demonstrations with some products only performing marginally better than the controls in grain yield. The lower cost products provided better economic benefits in these demonstrations.

In 2013 a trial at Minnipa showed banded in-furrow fungicides yielded higher than seed treatments, and new products at higher rates were effective, similar to results from other research trials. There were yield responses to fungicide treatments in both wheat and barley however there were still visual Rhizoctonia patches present. The economic evaluation of the fungicide trial indicated that there were positive economic responses to using the various fungicides on wheat, but not for barley. Economically in wheat, some of the lower cost products and lower rates were as effective. Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments. A three week delay in seeding reduced yield by nearly one third and $137/ha in wheat and $217/ha less in barley. The fungicide treatments did not prevent an increase in Rhizoctonia inoculum levels during the cereal phase.

The knowledge, attitudes, skills, aspirations and practice change (KASAP) Rhizoctonia Survey showed Rhizoctonia is still an important issue in both EP and Mallee farming systems as 97% of growers considered Rhizoctonia when making decisions about their farming program. Growers have a good knowledge of Rhizoctonia disease management and environmental factors which impact on disease severity, through extension messages provided by local researchers/publications, GRDC updates/publications, and local consultant/agronomists. Rhizoctonia management options being used by growers are break crops (canola higher in the Mallee and medics higher on EP), sowing early, some cultivation especially with points working below the seed, controlling summer weeds and the green bridge, and adequate nutrition (P, N and trace elements). Fungicide application has been the biggest practice change in the last 2 years and the most frequent change farmers would implement if possible.

Intellectual Property

Protocol for Measuring Broad Acre Farmer Demonstrations of Fungicides for Rhizoctonia Management, Appendix 5.

Rhizoctonia risk level identification has been developed as a single page hardcopy publication, Appendix 2.

An interactive computer based decision tool is still being developed with WOOF Design, Port Lincoln.

Application / Communication of Results

Main outcomes
The canola area sown on Eyre Peninsula has increased in the last 5 years with Western EP increasing by 3600 ha, Eastern EP by 5,500 ha and 10,000 ha on Lower EP. The area of peas has increased slightly but all other break crops have remained at similar areas sown (PIRSA Crop Production Estimates 2013 & 2009).

Canola and Juncea canola (mustard) lowered Rhizoctonia disease inoculum levels(validating previous trial research in this region), have addressed other issues (weed control), allowed the following cereal to be sown earlier achieving closer to potential yield in both seasons, and increased interest in alternative break crops with local growers. However canola and mustard (Juncea canola) in the seasons tested proved to be a significant financial risk. Economic modelling using these results, and for average seasons, indicated that canola needed to yield at least 0.36 t/ha to provide an equivalent gross margin with 'medic pasture (sheep)/wheat' rotation. When allowing for the risk of growing canola, it was suggested that a yield of 0.45 t/ha in an average season should be the break-even yield (M Krause).

The low input vetch break crop performed well as a break crop compared to medic, with both break crops having low Rhizoctonia inoculum levels and higher yield being achieved with the vetch rotation. The rotation of vetch/wheat compared to medic pasture/wheat gave the best financial result in the farmer demonstrations assessed so perhaps should be considered as a better break for upper EP systems.

Grass free break crops are currently the best recommended option to lower the Rhizoctonia inoculum level, allowing the following cereal crop to have lower initial disease pressure. The break crop options also allow other grass weed control options, earlier sowing for the cereal crop in the following season, achieving closer to potential yields, and increased interest in alternative break crops with local growers. However the Rhizoctonia inoculum level will increase during the season and be back to a higher level following one cereal crop.

The new fungicide products for Rhizoctonia suppression have varied in performance in paddock demonstrations with some products only performing marginally better than the controls in grain yield. There were no significant differences detected in the demonstrations in Rhizoctonia infection of seminal or crown roots in 2013. The lower cost products provided better economic benefits.

The Best Bets for Rhizoctonia trial showed banded in-furrow fungicides are more effective than seed treatments, and new products at higher rates were effective. There were yield responses to fungicide treatments in both wheat and barley however there were still visual Rhizoctonia patches present in the treatments. Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments. A three week delay in seeding reduced yield by nearly one third. The fungicide treatments did not prevent an increase in Rhizoctonia inoculum levels during the cereal phase.

The economic evaluation of the EPARF fungicide trial indicated that there were positive economic responses to using the various fungicides on wheat, but not for barley.

The key outcomes of the Best Bets for Rhizoctonia Management and the financial implications of rotation and fungicide application and the Rhizoctonia Survey of Eyre Peninsula and Mallee growers has been presented as a potential topic for a concurrent session at the GRDC Advisor Update in Adelaide in February 2015.

Potential Industry Impact

- The economics and cost of some fungicide products may limit their adoption in low rainfall, low cost farming systems.

Extension activities undertaken during project

Over the two year period of the project the latest Rhizoctonia research and 'best bet' options were delivered in 2012 to 485 growers and 20 agribusiness staff, and at the EP/MAC Student Field Day to 48 students and 10 agriculture teachers, and in 2013 to 441 growers and 15 agribusiness staff, plus 4 Mallee farmer group meetings.

2012

- The Wynarka Field Day was attended by 11 growers and 6 agronomists. Chris McDonough, Tanja Morgan and Stuart Pope talked about this project and gave the growers handouts about the project and site.
- Streaky Bay Sticky Beak Day attended by 32 farmers and industry representatives visited the Summer weed control and Rhizoctonia site.
- The latest Rhizoctonia research results and management strategies were presented to 14 Eyre Peninsula farmer groups at the EPFS farmer meetings in March 2012

reaching 202 growers and 13 industry reps.

- 180 farmers attended the annual MAC Field Day in September.
- MAC Women's Field Day held 4 September with PinG with 60 women attending and Amanda Cook presented and ran interactive session on Identifying Cereal Root Diseases.
- Student Information Day held on 9 October with 48 EP school students attending and 10 teachers and Amanda Cook presented Cereal Root Diseases session.

2013

- Amanda Cook presented the latest Rhizoctonia research at the Minnipa Ag Centre annual field day (150 attended) at a Best Bet Rhizoctonia trial located on the Minnipa Agricultural Centre which was funded by EPARF. Amanda was part of a panel session discussing N deficiency, disease, frost and rust issues of the 2013 season with Andy Bates, Craig James and Andrew Polkinghorne.
- GRDC Southern Panel tour visited Eyre Peninsula in September 2013. They visited the SAGIT Best Bets demonstration at Kane Sampson's, where Amanda Cook and Kane spoke to the group. They also visited the EPARF funded trial at MAC with where Amanda presented results on Rhizoctonia management options and the potential of future products and rates. Gupta also presented National GRDC Rhizoctonia project outcomes.
- Two Youtube videos produced. *Managing Rhizoctonia root disease* and *Testing for disease suppressive soils*.
- Streaky Bay Sticky Beak Day attended by 35 farmers and industry representatives. Amanda Cook was invited to give a lunch time presentation in the Piednippie Hall on the latest Rhizoctonia research results. Central Eyre Sticky Beak day was attended by 42 farmers and industry reps who visited the Warramboo Best bets demonstration at Sampson's where Amanda Cook presented the results.
- The results from this project and the latest Rhizoctonia research results and management strategies presented to 14 Eyre Peninsula farmer groups at the EPFS farmer meetings in March 2014 reaching 214 growers and 14 industry reps. Dodgshun and Medlin presented the results from this project and the latest Rhizoctonia research results and management strategies to 4 Mallee farmer groups in March 2013.
- The results will be published in the EPFS Summary 2014 and results are accessible for farmers on the EPARF website. Rhizoctonia research results and management strategies presented to Eyre Peninsula farmer meetings in March 2014.

2012, 2013 & 2014

- The results were published in the EPFS Summary which is distributed to farmers and agribusiness on Eyre Peninsula, farmers in other low rainfall regions and the wider scientific community, and is accessible for farmers on the EPARF website. The results were also published in the MSF Results Compendium.
- The project was discussed with the National Rhizoctonia team on an ongoing basis and contributed to discussion of results and key outcomes whenever possible.

Publications

Cook, A., et al. (2014). Farmer best bet demonstrations for Rhizoctonia management. Eyre Peninsula Farming Systems Summary 2013. R. Latta. Port Lincoln, The Printing Press: 88-92.

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Online publications

2012 Mallee Sustainable Farming Research Compendium. Cook, A., et al. (2013). Farmer best bet demos for Rhizoctonia management. http://msfp.org.au/wp-content/uploads/2013/06/2012-Farmer-best-bet-demos-for-Rhizoctonia-management-Root-Disease.pdf

2013 Mallee Sustainable Farming Research Compendium. Cook, A., et al. (2014). EPARF Rhizoctonia fungicide trial.
http://msfp.org.au/wp-content/uploads/2014/02/MSF1315.pdf

Conference Paper

The impact of crop rotation and nutrition on Rhizoctonia disease incidence in cereals on grey calcareous soils of upper Eyre Peninsula. Amanda Cook[1], Nigel Wilhelm[1], Gupta VVSR[2] and Alison Frischke[3]. [1]SARDI, Minnipa Agricultural Centre_[2] CSIRO Ecosystem Sciences,[3] BCG, Birchip. 16th Australian Agronomy Conference, Armidale, New Zealand, 14-18 October 2012.

YouTube videos

Two Youtube videos produced.
Managing Rhizoctonia root disease http://youtu.be/4EehbdkdrEo
Testing for disease suppressive soils http://youtu.be/yDl6sYMCCVM

POSSIBLE FUTURE WORK

Further evaluation of yield responses of the new fungicide products, the best fit in farming systems and economic returns. The seed dressings (especially Verdict, and EverGol Prime) need to evaluated as stand-alone products in low rainfall environments as the economics and cost of other fungicide products may limit their adoption in low rainfall, low cost farming systems.

Understanding the nutritional benefits to cereal after canola break crops in low rainfall farming systems.

AUTHORISATION	
Name:	Professor Alan Tilbrook
Position:	Research Chief, Livestock & Farming Systems
Signature:	
Date:	

APPENDIX 1

Demonstrating Best Management for Rhizoctonia in Low Rainfall Zones of SA

(EP and Mallee 2012 to 2013)

Economic Comment

August 2014

By Mike Krause

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Key Points:

- Farmer demonstrations and trials assessed from both a biological and economic perspective are valuable, as the biological results may not always justify the change in returns and costs.
- This economic assessment highlights some significant profits from the use of fungicides in wheat, when it follows a cereal.
- Rotation selection can have a significant impact on economic returns.
- The economic risk of some crops is highlighted in poorer seasons.

Introduction

Research is still one of the keys for unlocking economic potential in farming today. While there is a keen interest in physical trial results, these results also need to be assessed economically, to determine what drives increases in profits and efficiencies. This report assesses the economic outcomes of the following trials that the Minnipa Agricultural Centre was involved with during 2012 and 2013. These trials were managed by Amanda Cook, Wade Shepperd and Ian Richter (SARDI), with input from Dr. Nigel Wilhelm (SARDI).

The specific trials assessed in this analysis are:

1. Piednippie, Western Eyre Peninsula - Rhizoctonia management through break crop rotations
2. Warramboo, Upper Eyre Peninsula – Rhizoctonia management through rotations and use of fungicides
3. Wynarka, Southern Murray Mallee – Rhizoctonia management through fungicides
4. Minnipa Agricultural Centre - EPARF Fungicide Trials

The first three set of results mentioned above are farmer based demonstrations, where the impact of farmer decision making and operations have been monitored at a broad acre scale. These demonstrations were not replicated, but numerous sampling occurred within the zone. Any observations would need to be tested in other environments before there can be greater confidence in the results. However, the results do provide some insight into the issues being studied, which varied between farms and the two years of trials, 2012 and 2013. The fourth listed trial is a replicated plot trial where performance of treatments can be compared more rigorously.
While yields and Rhizoctonia infection levels were recorded, the costs and prices used in this report were guided by the farmers experience and memory of the costs at the time. Costs have been cross checked with other data sources in lower rainfall areas.

1. Piednippie, Western Eyre Peninsula - Rhizoctonia management through break crop rotations

This demonstration was established by the farmer to determine effect of rotation has on the management of Rhizoctonia. A number of break crops were tested with the effects measured on the following wheat crop.

The 2012 results focused on a wheat paddock, where the previous year had been a failed canola crop severely affected by mice. When the paddock was seeded to canola in 2011, a strip was left to volunteer medic, which was not grazed prior to the following wheat crop. Thus the demonstration compared the impact of a grass-free medic with canola on following wheat performance. The gross margin results for both years are shown in Table 1.

Table 1: Rotation gross margin comparing canola and a medic pasture

Rotation 1				Rotation Gross Margin
Canola paddock 2011		Wheat paddock 2012		
Yield	0 t/ha	Yield	0.96 t/ha	
Price	$450/t	Price	$252/t	
Gross income	$0/ha	Gross income	$241/ha	
Variable cost	$100/ha	Variable cost	$120/ha	
Gross margin	-$100/ha	Gross margin	$122/ha	$22/ha
Rotation 2				
Medic paddock 2011		Wheat paddock 2012		
Yield	0 t/ha	Yield	0.97 t/ha	
Price	$0/t	Price	$252/t	
Gross income	$0/ha	Gross income	$244/ha	
Variable cost	$20/ha	Variable cost	$120/ha	
Gross margin	-$20/ha	Gross margin	$124/ha	$104/ha

Comments:

- 2011 was a poor year and the medic being in the same paddock as the canola was not grazed, so no income was generated from the medic in the medic/wheat rotation.
- While the wheat yields were the same following both rotation options in 2011, the rotation gross margin results were very different.
- The rotation gross margin is significantly in favour of the medic/wheat rotation as more variable costs were lost by the canola in the poor year of 2011.
- This result highlights the risk associated with canola compared to a volunteer medic pasture in this environment.

The next year, a similar comparison was made, except mustard (Juncea Canola) was used instead of canola, due to the mustard (Juncea Canola) 'package' being offered by local retailers. Table 2 shows the rotation gross margin results and this time the financial results were very similar. It should be noted that the mustard (Juncea Canola) suffered financially when compared to canola, as it obtained a lower $100/t price in 2012. The lower yield meant only 13t was produced, causing a significantly higher freight cost per tonne.

Table 2: Rotation gross margins comparing mustard (Juncea Canola)/wheat, volunteer medic pasture/wheat and wheat/wheat

Rotation 1				Rotation Gross Margin
Mustard paddock 2012		Wheat paddock 2013		
Yield	0.17 t/ha	Yield	2.0 t/ha	
Price	$350/t	Price	$252/t	
Gross income	$60/ha	Gross income	$504/ha	
Variable cost	$160/ha	Variable cost	$120/ha	
Gross margin	-$100/ha	Gross margin	$384/ha	$284/ha
Rotation 2				
Medic paddock 2012		Wheat paddock 2013		
Yield	0 t/ha	Yield	1.7 t/ha	
Price	$0/t	Price	$252/t	
Gross income	$0/ha	Gross income	$428/ha	
Variable cost	$20/ha	Variable cost	$120/ha	
Gross margin	-$20/ha	Gross margin	$308/ha	$288/ha
Rotation 3				
Wheat paddock 2012		Wheat paddock 2013		
Yield	0.3 t/ha	Yield	1.5 t/ha	
Price	$300/t	Price	$252/t	
Gross income	$90/ha	Gross income	$378/ha	
Variable cost	$120/ha	Variable cost	$120/ha	
Gross margin	-$30/ha	Gross margin	$258/ha	$228/ha

Comments:

- Given this set of seasons, the results did provide different wheat yields in the second year. However, the rotation gross margins of rotations with break crops showed little difference in financial performance.
- The wheat/wheat rotation provided the lowest rotation gross margin when compared to the rotations with a break year. This is an example of the economic differences rotation selection can make.
- This result also showed how risky oilseeds are to grow profitably in this area.
- These results indicate the overall production and financial benefits of a rotation with a break when compared to a wheat/wheat rotation.

The question of what yield canola has to achieve in a canola/wheat rotation for it to be financially comparable to medic pasture/wheat rotation still remains. Using the costs and yields from the experience of the demonstration results, the rotations were modelled, with the result shown in Table 3. The figures used in Table 3 assume two average years and the medic pasture carries 3DSE/ha. Also, the self-replacing merino flock has a $30/DSE gross margin. The wheat yield reflects a 0.2 t/ha improvement in wheat after canola, compared with a medic pasture.

Table 3: Modelled finances comparing canola to medic pasture given average conditions

Rotation 1				Rotation Gross Margin
Canola paddock (Av.)		Wheat paddock (Av.)		
Yield	0.36 t/ha	Yield	1.7 t/ha	
Price	$450/t	Price	$250/t	
Gross income	$160/ha	Gross income	$425 /ha	
Variable cost	$120/ha	Variable cost	$120/ha	
Gross margin	$40/ha	Gross margin	$305/ha	$345/ha
Rotation 2				
Medic paddock (Av.)		Wheat paddock (Av.)		
Grazing 3 dse/ha		Yield	1.5 t/ha	
Merino gross margin $30/dse		Price	$250/t	
Gross margin	$90/ha	Gross income	$375 /ha	
		Variable cost	$120/ha	
		Gross margin	$255/ha	$345/ha

Comments:

- This modelling indicated that canola would need to yield 0.36 t/ha for it to financially breakeven with a medic/wheat rotation, given average conditions.
- However, as has been discussed, canola is a riskier crop to grow. So perhaps a long term yield of 0.45 t/ha is needed to provide a profitable risk reward. This should be considered as the necessary canola breakeven yield.

2. Warramboo, Upper Eyre Peninsula – Rhizoctonia management through rotations and use of fungicides

The demonstration was established by the farmer to determine whether using fungicides to manage Rhizoctonia and other leaf disease was profitable in a wheat/wheat rotation.

Table 4 shows the gross margin results of the second wheat after wheat.

Table 4: Trial assessing fungicide on the second wheat crop of a wheat/wheat rotation 2012

Wheat with no fungicide		**Wheat with fungicide**	
Yield	1.57 t/ha	Yield	1.54 t/ha
Price	$250/t	Price	$250/t
Gross income	$393/ha	Gross income	$385 /ha
		Flutriafol	$5/ha
		Triad	$4/ha
		Other costs	$160/ha
Variable cost	$160/ha	Variable cost	$169/ha
Gross margin	$233/ha	Gross margin	$216/ha

Comments:

- In this instance, the fungicide increased the variable costs and the yield was poorer. So, the resulting gross margin was poorer, which meant this fungicide did not provide a positive economic return.

In 2013, this farm experienced a better season. The farm demonstration again assessed the wheat gross margin of the second wheat crop of a wheat/wheat rotation. In this year two different types of fungicides were tested. Table 5 shows the gross margin results of the second wheat crop using the average yield obtained from two areas within the demonstration areas of either EverGol Prime or Uniform fungicides. The EverGol Prime treatment yielded better on the flatter area (2.2 t/ha) than the control (1.8 t/ha) and Uniform (1.7 t/ha on sandy rise) where the farmer demonstration was located, and grain protein reflected differences in possible nitrogen levels; Control 11.8%, EverGol Prime (in flat) 12.2%, Uniform (sandy rise) 11.4%. Both fungicides had lower Rhizoctonia patch score (significant) and lower Rhizoctonia root infection (not significant). However on a more even soil type (heavier flat), Uniform performed better (1.2 t/ha), EverGol Prime (0.96 t/ha) and Control (0.95 t/ha).

Table 5: Trial assessing fungicides on the second wheat crop of a wheat/wheat rotation in 2013

Wheat with no fungicide		**Wheat with fungicide** (EverGol Prime)		**Wheat with fungicide** (Uniform)	
Wheat paddock		Wheat paddock		Wheat paddock	
Yield	1.36 t/ha	Yield	1.68 t/ha	Yield	1.44t/ha
Price	$250/t	Price	$250/t	Price	$250/t
Gross income	$340/ha	Gross income	$420 /ha	Gross income	$360/ha
		EverGol Prime	$9/ha	Uniform	$17/ha
		Other costs	$160/ha	Other costs	$160/ha
Variable cost	$160/ha	Variable cost	$169/ha	Variable cost	$177/ha
Gross margin	$180/ha	Gross margin	$251/ha	Gross margin	$183/ha

Comments:

- In this demonstration, the selection of fungicide was important as the EverGol Prime treatment gave an improved gross margin due to the increase in yield and lower input costs.
- The use of Uniform gave minimal improvement in gross margin over the control treatment of 'no fungicide' despite an increase in yield.

There was also farmer interest in assessing the benefit of two different break crops in the demonstration strips: (1) medic pasture and (2) vetch. Table 6 shows the gross margin differences of the wheat crop following these two types of break crops.

Table 6: Trial assessing wheat gross margins after a break crop in 2013

Wheat after medic		**Wheat after vetch**	
Yield	1.2 t/ha	Yield	1.6 t/ha
Price	$250/t	Price	$250/t
Gross income	$300/ha	Gross income	$400 /ha
EverGol Prime	$9/ha	EverGol Prime	$9/ha
Other costs	$160/ha	Other costs	$160/ha
Variable cost	$169/ha	Variable cost	$169/ha
Gross margin	$131/ha	Gross margin	$231/ha

Comments:

- The wheat on vetch had lower Rhizoctonia root infection in crown roots, had greater early and late dry matter during the season and yielded greater than after medic. However the vetch systems also had greater Take-all damage in the wheat following vetch in spring than following medic. There were no differences in grain quality between the medic or vetch treatments.
- The wheat gross margin after vetch was $100/ha higher than after a medic pasture.
- As the medic pasture was not grazed in this trial, there has been no allowance for sheep gross margin. However, this analysis shows that sheep would have had to achieve a gross margin of $100/ha for both treatments to have the same economic outcome.

3. Wynarka, Southern Murray Mallee – Rhizoctonia management through fungicides

The question being tested was whether the use of fungicides on the second cereal crop of a cereal/cereal rotation resulted in improved yields and profits.

Table 7 shows the gross margin results of fungicide used on a barley crop in 2012, which followed a 2011 wheat crop.

Table 7: Trial assessing fungicide for cereal leaf disease on barley in 2012 after wheat

Barley with no fungicide		Barley with fungicide	
Barley paddock		Barley paddock	
Yield	3.7 t/ha	Yield	3.92 t/ha
Price	$200/t	Price	$200/t
Gross income	$740/ha	Gross income	$784/ha
		Flutriafol	$5/ha
		Other costs	$140/ha
Variable cost	$140/ha	Variable cost	$145/ha
Gross margin	$600/ha	Gross margin	$639/ha

Comments:

- These results indicated that there was an improved gross margin when using an additional fungicide (Flutriafol) on the barley crop in 2012.

Table 8 shows the rotation gross margin results of a canola/wheat/wheat rotation, where a fungicide was used in the second wheat crop (2013).

Table 8: Trial assessing fungicide on the second wheat crop of a canola/wheat/wheat rotation in 2013

Canola 2011		Wheat 2012		Demonstration 2013		Rotation Gross Margin
				Wheat with no fungicide		
Yield	0.9 t/ha	Yield	2.2 t/ha	Yield	2.37 t/ha	
Price	$450/t	Price	$300/t	Price	$250/t	
Gross income	$405/ha	Gross income	$660/ha	Gross income	$593 /ha	
				Flutriafol	$12/ha	
Variable cost	$160/ha	Variable cost	$140/ha	Variable cost	$152/ha	
Gross margin	$245/ha	Gross margin	$520/ha	Gross margin	$440/ha	$1,206/ha
				Wheat with two fungicides		
As above		*As above*		Yield	2.5 t/ha	
				Price	$250/t	
				Gross income	$625 /ha	
				EverGol Prime	$9/ha	
				Flutriafol	$12/ha	
				Other costs	$145/ha	
				Variable cost	$161/ha	
				Gross margin	$464/ha	$1,229/ha

Comments:

- There were no differences in plant growth, Rhizoctonia seminal or crown root scores, grain yield or grain quality between the control and the fungicide treatment at the Mallee site in this season.
- While there was some gross margin improvement when using a fungicide (mix of EverGol Prime and Flutriafol), this financial improvement was minimal when comparing the three years results.
- Looking at the rotational gross margin, there is minimal financial difference between these treatments.

4. Minnipa Agricultural Centre - EPARF Fungicide Trials

The EPARF fungicide trials at Minnipa Agricultural Centre were established in 2013, which was a top 20% rainfall season.

A research summary of this trial is:

- At Minnipa in 2013 there were cereal yield responses to fungicide treatments in both wheat (up to 14% better than no fungicide) and barley (up to 12 % better than no fungicide but not all strategies were effective). However there were still visual Rhizoctonia patches present.
- In-furrow fungicide applications were more effective than seed treatments.
- Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments.
- A three week delay in seeding reduced yield by nearly one third.
- Fungicide treatments did not prevent an increase in Rhizoctonia inoculum levels during a cereal phase.
- There were differences in Rhizoctonia seminal root scores in wheat but not in barley, however scoring at six weeks after sowing in this season (with early and warm

conditions at seeding) may not have allowed the greatest differences in seminal root infection to be detected. The extra 20 kg/ha N applied as urea at seeding resulted in higher Rhizoctonia root damage in the seminal root scores in wheat.

- The placement of the fungicides banded below the seed has resulted in only seminal roots being protected not the crown roots, as the Rhizoctonia % crown root infection and numbers of crown roots were not different between treatments.

The treatments were economically assessed using the following assumptions:

- The fuel, repairs and maintenance variable costs for putting in the trial are the same costs as those experienced by the closest 'farmer demonstration' sites.
- DAP was costed at $450/t.
- Fluid fertiliser was costed at $1,100/t or $46/ha, double the DAP cost.
- The starter N (Urea) was costed at $9/ha.
- The wheat price was $250/t and barley $200/t, which is seen as average.
- Vibrance seed dressing at 360 ml/t was costed at $6/ha, 180 ml/t at $3/ha.
- The fungicide EverGol Prime was costed at $8.75/ha.
- The fungicide of Uniform (SYN SIF1) at the higher rate was costed at $17.00/ha and medium rate at $11.22/ha.

Applying the respective treatment variable costs and yields, the gross margin results for the wheat component of the trial is shown in Figure 1 and for barley in Figure 2.

Comments on the **wheat** trial gross margins:

- The treatment of sowing 3 weeks later than the control produced the poorest gross margin.
- Eight treatments provided noticeably improved gross margins when compared to the 'control treatment'.
- The use of fungicides Uniform (SYN S1F1), EverGol Prime and Vibrance seed dressing provided improvements in gross margins when compared to the control.
- The use of fluid fertiliser did not provide any gross margin improvement over the control in this soil type.

Comments on the **barley** trial gross margins:

- Similar to the wheat trial, the treatment of sowing 3 weeks later than the control produced the poorest gross margin.
- Most treatments in the barley trial gave no significant gross margin improvement when compared to the control.
- Only one treatment, Vibrance seed dressing 360 ml/t & Uniform (SYN S1F1) in-furrow medium rate, produced an improved gross margin above the control treatment.

Figure 1:Gross Margins ($/ha) for Fungicides in Wheat

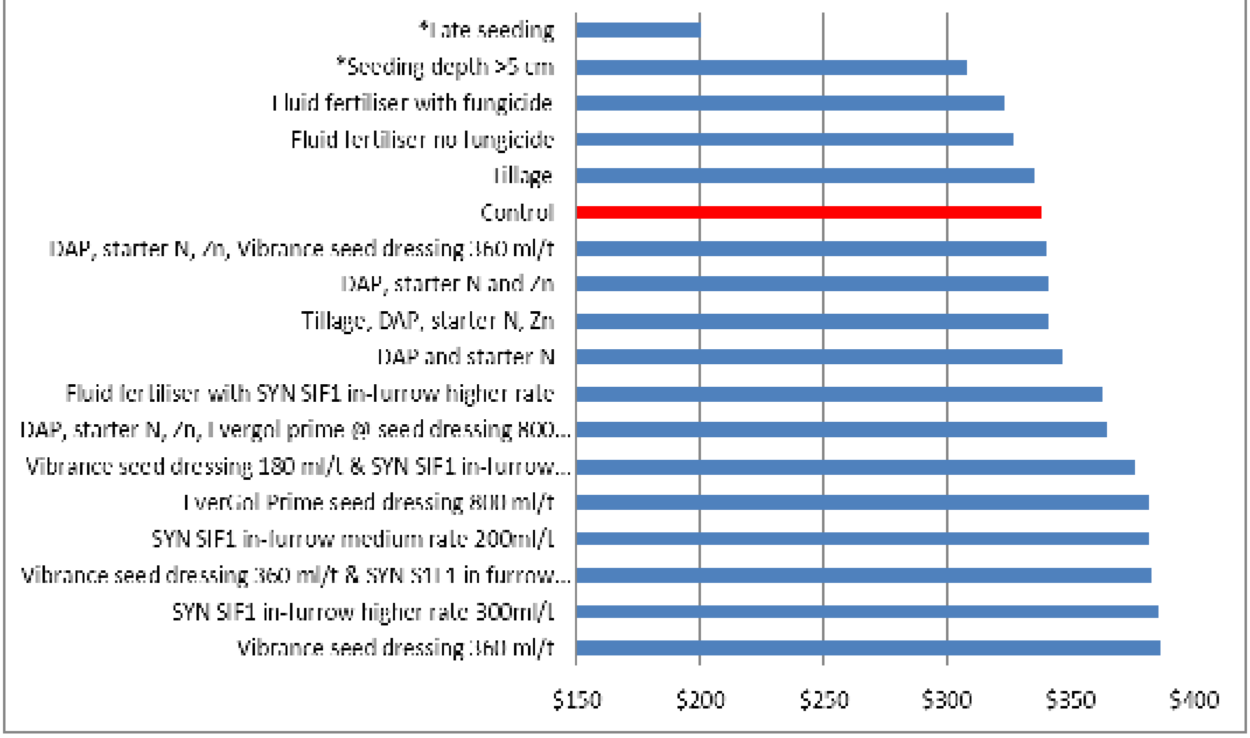
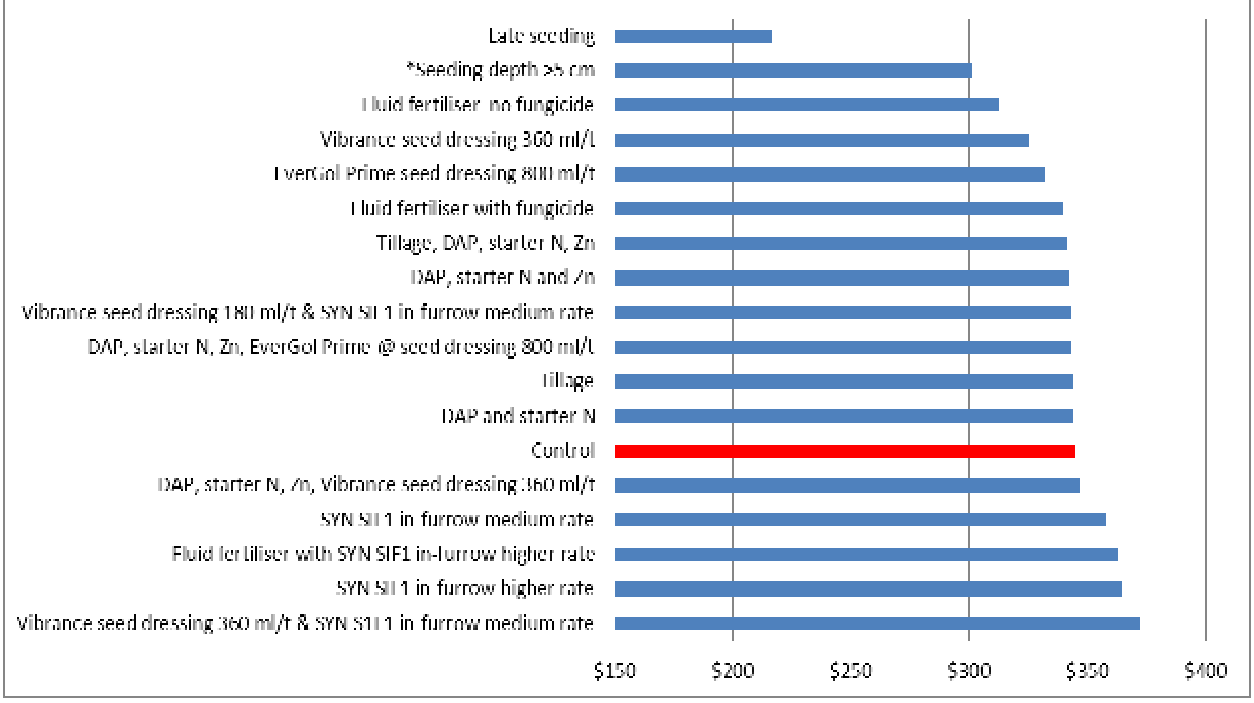


Figure 2: Gross Margins ($/ha) for Fungicides in Barley



Conclusion

It is useful to assess both biological and economic results of farmer demonstrations and trials to help farmers determine which treatments potentially provide financial improvements in their business. While farmer based demonstrations are generally less scientifically rigorous when compared to professional research trials, they do provide valuable insight into how the new technology performs in a commercial environment. Economically assessing farm demonstrations provide greater rigor for the farmer, as they will also be subjectively assessing the economic outcome of different research results and the implications for adoption of these in their business.

The outcomes from the demonstrations were:

- The rotation of vetch/wheat compared to medic pasture/wheat gave the best financial result in the farmer demonstrations assessed. Sown vetch may provide an improved financial performance when compared to medic pasture so perhaps should be considered as a better break for upper EP systems. However, this was a minimal input vetch crop.

- The use of fungicides provided an economic benefit for most farm demonstrations. However, label recommendations for applying fungicides should always be followed. The lower cost products provided the better economic benefits.

- Canola and mustard (Juncea Canola), in the seasons tested in the farmer trials, proved to be a significant financial risk. Economic modelling using these results, and for average seasons, indicated that canola needed to yield at least 0.36 t/ha to provide a breakeven with 'medic pasture (sheep)/wheat' rotation. When allowing for the risk of growing canola, it was suggested that a yield of 0.45 t/ha in an average season should be the break-even yield.

- The EPARF fungicide trials of 2013 indicated that there were positive economic responses to using the various fungicides on wheat, but not for barley.

Acknowledgements

EverGol Prime® – registered trademark of Bayer CropScience.

Uniform® (SYNSIF1) and Vibrance® – registered trademark of Syngenta.

APPENDIX 2

RHIZOCTONIA RISK LEVELS

The RHIZOCTONIA decision tool has been developed to enable farmers to evaluate their Rhizoctonia cereal root disease risk level depending on previous crop rotation, management decisions, timing in the cropping season and the environmental conditions.

For further information contact Amanda Cook, SARDI, Minnipa Agricultural Centre, (08) 8680 5104, amanda.cook@sa.gov.au

PREVIOUS CROP TYPE

GRASS FREE CANOLA AND BREAKCROPS LOWER RISK	GRASSY PASTURES OR BREAKCROPS Grass controlled early June in pasture MEDIUM RISK	CEREAL HIGHER RISK

HARVEST

CHECK CEREAL CROWN ROOT DAMAGE IN CROP

DROUGHT IN PREVIOUS SEASON — HIGHER RISK

SUMMER AUTUMN RAINFALL — LOWER RISK

Control weeds within 3 weeks, as host Rhizoctonia and inoculum will increase

Soils wet for 3 days to increase microbial activity and reduce Rhizoctonia inoculum

PREDICTA B TEST

IF UNSURE

PRE SOWING

SOWING

LOWER RISK FACTORS

MANAGEMENT

Adequate nutrition and trace elements (P N Zn)
Pre tillage or working with points below the seed
Sowing 3cm
Control green bridge within 3 weeks of season break
Consider fungicide options
In crop - Additonal N and trace elements as required

ENVIRONMENTAL

Early season break with warm soils

HIGHER RISK FACTORS

MANAGEMENT

Low nutrition and deficiencies (P N Zn)
Low disturbance seeding systems
Deeper sowing
No green bridge control
Soil compaction layers
SU chemical use

ENVIRONMENTAL

Late season break and cold soils - N tie up
Early moisture stress
Lighter soils / non wetting soils

HARVEST

CHECK CEREAL CROWN ROOT DAMAGE IN CROP

APPENDIX 3

KASAP Rhizoctonia Survey of Eyre Peninsula and Mallee Farmers 2014

Amanda Cook and Naomi Scholz
SARDI, Minnipa Agricultural Centre

78 growers responded to the survey in total
66% Eyre Peninsula growers (50 total growers)
29% Mallee growers (24)
5% Other (4)

97% consider Rhizoctonia as an issue when making decisions about their farming program on EP and in the VIC/NSW/SA Mallee (this figure is the same in both regions).

When farmers were asked what they do to manage Rhizoctonia, their responses as a % were;

What do you do to manage Rhizoctonia?	Yes, I have been doing this for more than 2 years (%)	Yes, but I have only begun using this practice in the past 2 years (%)	No, I don't do this at all (%)
Dig up and examine plant roots during season for Rhizoctonia damage	Total (EP & Mallee combined): 71 EP only: 71	6 4	23 25
Use Predicta B test to determine diseases present	16 13	8 6	76 81
Examine cereal crown roots for Rhizoctonia damage near grain fill	19 15	11 6	70 79
Grow break crops (canola, peas, vetch, beans)	66 56	9 8	25 36
Grass free pastures	79 90	7 4	14 6
Sow as early as possible	87 90	2 2	11 8
Control summer weeds within 3 weeks of germination	79 75	10 10	11 15
Control green bridge 6-8 weeks before seeding	80 75	10 15	10 10
Cultivate/work up paddocks for disease break	34 38	9 10	57 52
Use tynes/points which work below seeding depth	76 75	7 10	17 15

What do you do to manage Rhizoctonia?	Yes, I have been doing this for more than 2 years (%)	Yes, but I have only begun using this practice in the past 2 years (%)	No, I don't do this at all (%)
Ensure adequate P fertilizer	90 94	3 2	7 4
Ensure adequate N fertilizer	84 84	7 8	9 8
Ensure adequate trace elements	83 88	8 6	9 6
Use fungicides for Rhizoctonia	26 21	20 21	54 58
Avoid sulphonylurea (SU) chemical use	59 71	10 10	31 19
Deep rip/work compacted soils	20 23	6 4	74 73

If you had no barriers such as cost, time, labour or machinery, what would you change in your system to manage Rhizoctonia? These were written responses (69 growers), with no options or limits provided, so the sum is greater than the number of growers responding. The answers have been grouped into similar responses.

Responses	Number of EP Growers	Number of Mallee Growers	Total
Fluid delivery system for fungicide application	10 split application of fungicide - 7	9 split application of fungicide - 7	19
Fluid delivery system for TE application	9	4	13
Bigger machinery to implement tillage below seed, better seed placement or deep rip	9	5	14
Apply fungicides (not necessarily fluid system)	8	2	10
Increase break crop in rotation (legume), longer breaks, two year grass free	4	11	15
Summer weed control improved and green bridge control in autumn	6	1	7
Canola in rotation or increase amount canola	5	2	7
Increase urea at seeding/split application urea	4		4
Earlier seeding	4	1	5

Fluid delivery system for liquid P application	3		3
Increase P application		4	4
Increase Predicta B root disease testing	2		2
No change/Rhizoctonia not an issue	2	1	3
Increase applied TE (Zn, Cu, Mn)	1 Soil applied and foliar to crop least 2 times	3	4
Develop resistant cereals		1	1
Remove medic from rotation		1	1
Increase organic matter by spading to improve microbial activity		1	1
Fumigate the soil		1	1
Infrared spot spray in summer (Weedseeker)	1		1
No sheep in system (better grass control)	1		1
Remove barley from rotation	1		1
Two year chemical fallow in rotation	1		1
More holidays in July (so don't see Rhizoctonia)	1		1

When asked where do you access information on Rhizoctonia from farmers responses were;
These were written responses (68 growers), with no options or limits provided, so the sum is greater than the number of growers responding. The answers have been grouped into similar responses.

Information source	EP Growers	Mallee Growers	Total
Minnipa Agricultural Centre, Amanda Cook, EPFS Summary, EP Farmer Ag Bureau meetings/sticky beak days and Minnipa field days	24	4	28
MFS, Alan McKay, Jack Desbiolles, SARDI, CSIRO, BCG, Farmer Ag Bureau meetings/groups/sticky beak days		10	10
GRDC publications and GRDC updates/agronomy sessions	11	14	25
Consultants and agronomists	6	16	22
Internet	6	7	13
Other farmers/neighbours (pub/football)	5	2	7
Stock Journal/ Newspapers/Other	5	5	10

When asked if they feel they have up to date information to deal with Rhizoctonia farmers answered;

	Up to date information to deal with Rhizoctonia	Not enough information	Unsure
EP	55%	21%	21%
Total	57%	20%	23%

For EP and Mallee farmers 19% are using fluid delivery systems for fertilisers and trace elements, and 81% are not using these systems.

SUMMARY

- 97% of growers in both EP and Mallee consider Rhizoctonia as an issue when making decisions about their farming program.
- Growers in both regions have good knowledge of Rhizoctonia as a cereal root disease, disease management and environmental factors which impact on disease severity.
- Only 26% of growers knew crown root damage can be an indicator of the level of Rhizoctonia inoculum for the next season. This message could be extended more to the industry.
- 71% of growers examine plant roots but there is a low use of Predicta B testing.
- Break crops are used as a Rhizoctonia management option, with canola being higher in the Mallee and medics higher on EP.
- Growers sow early with some cultivation, especially with points working below the seed, as a management tool.
- Fungicide application has been the highest practice change in the last 2 years and the most frequent change farmers would implement if possible.
- Controlling summer weeds and the green bridge have increased in the last two years.
- Growers know nutrition, P, N and trace elements are important and nitrogen and TE applications have increased in the last 2 years.
- Changes which growers would implement given no constraints to their systems would be the adoption of fluid delivery systems for fungicide application (19 growers total with 14 wanting split application), apply fungicides, not necessarily as fluids (10 growers), fluid delivery system for trace elements (13), bigger machinery to implement tillage below seed, better seed placement or deep rip (14), change rotation to increase break crop in rotation (legume) and longer breaks with two year grass free (15 with 11 of these growers in Mallee).
- Growers sources of information are from local researchers and research institutions, GRDC publications and updates, local consultants (greater in Mallee), internet, Stock Journal and Newspapers and interaction/discussions with local growers/neighbors.

APPEXDIX 4

EPARF Rhizoctonia fungicide trial

Amanda Cook, Nigel Wilhelm, Wade Shepperd and Ian Richter
SARDI, Minnipa Agricultural Centre

RESEARCH

Searching for answers

Location:
Minnipa Ag Centre South 3 North
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
2013 Total: 334 mm
2013 GSR: 237 mm
Yield
Potential: 3 t/ha (Yield prophet MAC S2/8 Mace)
Actual: Wheat 1.3 - 2.1 t/ha, Barley 1.7 - 2.6 t/ha
Paddock History
2013: Hindmarsh barley
2012: Wheat
2011: Canola
Soil Type
Red sandy loam
Plot Size
20 m x 2 m 3 reps

Key messages

- **At Minnipa in 2013 there were cereal yield responses to fungicide treatments in both wheat (up to 14% better than no fungicide) and barley (up to 12 % better than no fungicide, but not all strategies were effective). However there were still visual Rhizoctonia patches present.**
- **In-furrow fungicide applications were more effective than seed treatments.**
- **Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments.**
- **A three week delay in seeding reduced yield by nearly one third.**
- **Fungicide treatments did not prevent an increase in Rhizoctonia inoculum levels during a cereal phase.**

Why do the trial?

Several new fungicide products for Rhizoctonia suppression have been recently released onto the market. This trial was undertaken to assess the benefits of these products, and various application strategies, on wheat and barley performance in a typical upper Eyre Peninsula environment. Historically, fungicidal control of rhizoctonia which infects the major crops grown in southern Australia has generally been poor. However, these new products have shown greater promise in the development trials undertaken so far (McKay *et al,* 2013 GRDC Update) but our experience with them under commercial conditions is still limited. With the relatively recent development of processes to evenly coat fertiliser granules with fungicides and to deliver liquid products around the seed row during the seeding pass, there is now a range of application strategies available to growers to make use of these new products.

This trial assessed the new products with a range of application strategies and compared them to other management options (tillage, zinc, starter nitrogen, deep sowing, fluid fertiliser and late sowing) which can change the impact of rhizoctonia on crop production.

How was it done?

Two identical replicated trials were established in MAC paddock S3N which had a high level of Rhizoctonia inoculum. One trial was sown to CL Kord wheat, the other to CL Scope barley; Clearfield varieties were used due to the potential for grassy weeds to be a problem in the paddock in 2013. Paddock history, PreDictaB disease inoculum levels (RDTS), plant establishment, Rhizoctonia seminal root score, Rhizoctonia crown root score, green leaf area index, Rhizoctonia patch score, grain yield and quality were measured during the season.

The trial was sown with current best management options for Rhizoctonia control on the western end and fungicide products and rates on the eastern end. The control treatment was 60 kg/ha of wheat or barley with 50 kg/ha of 18:20:0:0. For treatments which required tillage prior to seeding plots were worked once on 11 April. Cultivation prior to seeding and seeding itself were conducted with a 6 row seeder at 27 cm spacing and with knife points. Starter N was an extra 20 kg/ha N applied as urea at seeding. A fluid fertiliser delivery system placed fluid fertiliser and banded fungicides approximately 3 cm below the seed at an output rate of 85 L/ha. Fungicides were applied as seed treatments according to label recommendations. The fluid fertiliser treatments were equivalent to 50 kg/ha of 18:20:0:0 as phosphoric acid and zinc sulphate but with N applied as granular urea below the seed.

Chemical control of weeds (eliminating a green bridge) occurred on 4 April with 0.8 L Roundup Attack, 350 ml Ester 680 LVE and 175 ml/ha LI 700. Trials were sown on 13 May @ 60 kg/ha of wheat or barley with 50 kg/ha of 18:20:0:0 (other than fluid fertiliser treatments) after receiving 1.5 L Spray.Seed. The late seeding treatment was sown three weeks later on 4 June. Further weed control was achieved with 700 ml Intervix and 500 ml/ha Supercharge on 27 June after early root sampling (25 June).

Rhizoctonia infection on seminal roots was assessed using the root scoring method described by McDonald and Rovira (1983) six weeks from seeding.

Paddock patch score for Rhizoctonia is a visual score of the number plants of 5 plants affected by Rhizoctonia (400 plants scored per treatment) across 4 transects. Crown roots were sampled on the 17 and 18 September after a rainfall event. Crown roots per plant were counted with the number of roots infected with Rhizoctonia used to calculate % crown root infection. Barley plots were harvested on 25 October and wheat on 30 October. Selected treatments were sampled for rhizoctonia inoculum levels in crop rows after harvest.

Data were analysed using Analysis of Variance in GENSTAT version 16, the late seeding and seeding depth >5 cm data was excluded from the analysis because of obviously poor yield performance, thereby improving the basis for the overall comparison among the remaining treatments.

What happened?

The initial Predicta B inoculum level predicted a high risk of severe Rhizoctonia disease (205 pgDNA/g soil). There were only low levels of inoculum for other soil borne diseases.

Plant establishment was the same for all treatments (an average of 112 plants/m^2 for barley and 128 plants/m^2 for wheat) except with deeper seeding of barley (only 87 plants/m^2). Late sown wheat and barley (sown 3 weeks later) had less dry matter at the same number of weeks after sowing than all other treatments.

Rhizoctonia infection on seminal roots was scored six weeks after seeding. Rhizoctonia infection of wheat was higher on treatments with extra N (Table 1). In barley rhizoctonia infection (Table 2) was higher with high nitrogen and lower rate in-furrow fungicide treatments. Rhizoctonia patch scores both early and at anthesis showed some level of Rhizoctonia patches regardless of treatments (data not shown). Infection of crown roots was the same for all treatments (Table 2).

Disease

Table 1 Disease scores and growth measurements, yield and grain quality for CL Kord wheat in EPARF fungicide trial in MAC S3N, 2013

Treatment	Rhizoctonia seminal root score (0-5)	Crown root infection (%)	Late dry matter (g/plant)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hL)
Vibrance seed dressing 360 ml/t & SYN SIF1 in-furrow medium rate	1.0	75.6	5.0	2.13	11.7	2.8	82.8
Fluid fertiliser with SYN SIF1 in-furrow higher rate	1.5	82.0	4.6	2.12	11.5	2.2	82.5
SYN SIF1 in-furrow higher rate	1.1	88.6	4.3	2.12	12.0	2.5	82.1
SYN SIF1 in-furrow medium rate	1.3	77.1	4.4	2.08	11.6	2.2	82.5
Vibrance seed dressing 360 ml/t	1.3	71.6	4.3	2.08	11.7	2.5	83.5
Vibrance seed dressing 180 ml/t & SYN SIF1 in-furrow medium rate	1.3	80.1	4.6	2.07	12.2	2.5	81.7
EverGol Prime seed dressing 800 ml/t	1.0	76.6	4.3	2.07	11.9	2.6	82.0
DAP, starter N, Zn, Evergol Prime @ seed dressing 800 ml/t	1.3	73.3	4.2	2.04	12.1	2.6	82.1
DAP and starter N	1.8	77.0	4.2	1.93	11.9	3.2	81.8
Fluid fertiliser with fungicide	1.6	73.9	5.3	1.93	12.0	3.5	82.1
Tillage, DAP, starter N, Zn	1.3	80.4	3.9	1.91	11.7	2.6	82.6
DAP, starter N, Zn, Vibrance seed dressing 360 ml/t	1.7	67.6	4.0	1.93	11.5	2.8	82.4
Fluid fertiliser no fungicide	1.3	81.3	3.9	1.91	11.6	3.0	82.7
DAP, starter N and Zn	2.0	85.8	3.8	1.91	11.8	2.6	82.2
Tillage	1.3	88.4	3.5	1.87	11.9	2.6	82.1
Control	1.5	82.8	4.1	1.86	11.5	2.8	82.3
*Seeding depth >5 cm	1.0	71.8	5.5	1.74	11.9	3.2	81.5
*Late seeding	1.5	85.1	2.7	1.31	13.3	4.3	79.1
LSD (P=0.05)	*0.4*	*ns*	*ns*	*0.15*	*ns*	*0.52*	*ns*

**Data removed from Analysis of Variance using GENSTAT16 because of obviously poor yield performance, thereby improving the basis for the overall comparison among the remaining treatments.*

Table 2 Yield and grain quality for CL Scope barley in EPARF fungicide trial in MAC S3N, 2013

Treatment	Rhizoctonia seminal root score (0-5)	Crown root infection (%)	Late dry matter (g/plant)	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hL)
Fluid fertiliser with SYN S1F1 in-furrow higher rate	1.22	75	5.55	2.63	12.1	11.7	70.7
Vibrance seed dressing 360 ml/t & SYN S1F1 in-furrow medium rate	1.48	78	6.36	2.56	12.4	18.2	69.6
SYN S1F1 in-furrow higher rate	1.31	85.6	4.69	2.52	12.3	15.0	70.1
Fluid fertiliser with fungicide	1.25	67.2	5.62	2.47	11.8	18.5	70.0
SYN S1F1 in-furrow medium rate	1.75	81.7	5.08	2.46	12.0	14.4	69.8
DAP, starter N, Zn, EverGol Prime seed dressing 800 ml/t	1.34	77.5	4.71	2.42	12.9	24.2	69.0
DAP, starter N, Zn, Vibrance seed dressing 360 ml/t	1.27	61.7	6.17	2.42	12.8	26.5	68.6
Vibrance seed dressing 180 ml/t & SYN S1F1 in-furrow medium rate	1.38	76.7	4.79	2.40	12.8	18.9	69.4
Tillage, DAP, starter N, Zn	1.22	74.6	5.22	2.39	13.0	27.1	68.8
DAP and starter N	1.65	77.9	5.80	2.38	11.7	20.7	69.6
DAP, starter N and Zn	1.57	85.9	5.16	2.37	12.6	23.4	69.2
Tillage	1.14	76.3	5.27	2.36	11.9	22.3	69.6
Control	1.49	74.9	5.65	2.34	12.0	23.5	68.8
EverGol Prime seed dressing 800 ml/t	1.23	79.8	5.57	2.32	12.2	22.8	68.5
Fluid fertiliser no fungicide	1.29	75.6	5.34	2.29	12.6	22.6	68.8
Vibrance seed dressing 360 ml/t	1.43	88.5	4.95	2.27	12.6	22.0	68.7
*Seeding depth >5 cm	1.35	75.6	4.58	2.12	12.8	20.5	68.8
*Late seeding	1.10	88.8	3.40	1.70	13.7	28.1	66.9
LSD (P=0.05)	*ns*	*ns*	*ns*	*0.15*	*ns*	*ns*	*ns*

**Data removed from Analysis of Variance using GENSTAT16 because of obviously poor yield performance, thereby improving the basis for the overall comparison among the remaining treatments.*

Fungicide treatments increased yield of wheat by between 0.07 and 0.27 t/ha (Table 1), and of barley by up to 0.28 t/ha compared to district practice (Table 2) with in-furrow and higher rates having the greater effect. In-furrow fungicides at higher rates increased yield but tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments. Delayed sowing for 3 weeks depressed yield in both wheat and barley, as did sowing barley at greater than 5 cm, (a strategy to place the root system below the bulk of Rhizoctonia inoculum).

The yield loss in barley may have been partly due to reduced plant numbers (data not shown).

Grain protein contents and screenings were high in these trials due to lack of rain in September and October (Tables 1 and 2).

Rhizoctonia inoculum post harvest was in the high disease risk level after both wheat and barley regardless of treatments (data not shown). This suggests that fungicide treatments will not decrease Rhizoctonia inoculum levels for the next season.

What does this mean?

There were differences in Rhizoctonia seminal root scores in wheat but not in barley, however scoring at six weeks after sowing in this season (with early and warm conditions at seeding) may not have allowed the greatest differences in seminal root infection to be detected. The extra 20 kg/ha N applied as urea at seeding resulted in higher Rhizoctonia root damage in the seminal root scores in wheat.

At Minnipa in 2013 there were yield increases to fungicide treatments in both wheat (up to 14 % of control) and barley (up to 12 % of control), however there were still visual Rhizoctonia patches present in the treatments. The results indicate in-furrow fungicides and higher rates are more effective than seed treatments. In-furrow fungicides at higher rates increased yield but tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments.

The placement of the fungicides banded below the seed has resulted in only seminal roots being protected not the crown roots, as the Rhizoctonia % crown root infection and numbers of crown roots were not different between treatments.

A three week delay in seeding resulted in significant loss of yield compared to the control, 29% in wheat and 28% in barley, and grain quality was also reduced in this season. High grain protein and high screenings were present in both wheat and barley due to the dry finish to season, with little spring rainfall. PredictaB soil samples were taken at harvest in selected treatments for Rhizoctonia inoculum levels, and all levels were in the high disease risk level after both wheat and barley indicating the fungicide treatments did not decrease Rhizoctonia inoculum levels.

Acknowledgements

Thank you to Syngenta and Bayer for supplying the products used in the trial.

EverGol Prime – registered trademark of Bayer CropScience. Vibrance – registered trademark of Syngenta.

Disease

APPENDIX 5

Measuring Broad Acre Farmer Demonstrations of Fungicides for Rhizoctonia Management

- Farmers implemented broad acre demonstrations of fungicide products within cereal paddocks. Demonstrations sown on even soil type and ideally control/nil fungicide strip between each fungicide treatment.

- Predicta B soil samples should be taken according to most recent methodology;

    - Collect 3 cores (1 cm diameter X 10 cm deep) from each of 15 different locations within the target paddock or sampling zone.
    - Take cores from along the rows of previous cereal crop if visible and retain any stubble collected by the core.
    - Add one piece of cereal stubble (if present) to the sample bag at each of the 15 sampling locations. Each piece should include the segment from the crown to the first node (discard material from above the first node).
    - Note the maximum sample weight should not exceed 500g.

    Soil samples sent to SARDI Soil Diagnostics.
    Postal Address for PreDicta B samples
    C/- SARDI RDTS
    Locked Bag 100
    Glen Osmond SA 5064
    (*www.**sardi**.sa.gov.au/diagnostic_services/**predicta_b**)*

- Within the areas of the paddock, treated and untreated (nil) demonstration strips, four replicated sampling lines approximately 20 metres apart across the seeder row are established to measure and collect data.

- Plant establishment, dry matter, Rhizoctonia patch, seminal and crown root scores, grain yield and quality are measured during the season in the treated and nil strips.

- Plant establishment measurements taken by counting two rows using a 50cm ruler at 4 locations across each of the four transects, totalling 16m of crop row being counted and this needs to be averaged. The row spacing needs to be measured to calculate the number of rows within 1m. Convert data from plants per row to plants per square metre and record as plants per square metre for each treatment.

- Paddock patch score for Rhizoctonia is a visual score (0-5) of number plants out of 5 plants affected by Rhizoctonia (400 plants scored per treatment) across 4 transects. Starting in the first treatment the first 5 plants across the seeder rows in a direct line are visually scored (0/5=5 strong healthy plant, 1/5 = 1 plant in 5 has growth restricted due to Rhizoctonia, 5/5= all 5 plants severely affect by Rhizoctonia). Move to the next 5 rows and repeat the score until 20 scores are recorded within the treated or nil area. This is repeated 4 times across the sampling lines.

- 6 -10 weeks after sowing depending on seasonal conditions and symptoms of Rhizoctonia (plant root infection and patches) appearing in the paddock, 20 whole plants per treatment across 4 transects in each strip were carefully dug up with a shovel or trowel collecting the whole root system. The tops of plants were cut off dried at 50^{o}C for 48 hrs and weighed for dry matter. The roots were gently washed and Rhizoctonia seminal root scores were measured using 0-5 root scoring rating (McDonald and Rovira, 1983). Assessing seminal roots takes approximately 10-15 minutes per 20 plants for an experienced person. Washed plant root samples may be frozen in plastic bags directly after collecting and scored immediately when defrosted.

- A second plant sampling was undertaken after the development of crown roots, approximately 16-18 weeks after seeding (and after a rainfall event to successfully dig them up). 20 whole plants were collected per treatment across the 4 transects. The total numbers of crown roots were counted and the number of crown roots infected with Rhizoctonia (spear tips). This was used to calculate % crown root infection and tops of plants were removed, dried and weighed for late dry matter. Assessing crown roots takes approximately 10-15 minutes per 20 plants for an experienced person.

- Harvest strips of 20m were taken next to the sampling lines (8 *20m) across the treatments. Grain yield was recorded and calculated from the given area. A grain sample was retained and grain quality parameters of screenings (%), grain protein (%), test weight (kg/hL) were measured in the lab.

- For further information contact Amanda Cook, SARDI, Minnipa Agricultural Centre. amanda.cook@sa.gov.au

SAGIT

SARDI
R&D
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

APPENDIX 1

Demonstrating Best Management for Rhizoctonia in Low Rainfall Zones of SA

(EP and Mallee 2012 to 2013)

Economic Comment

August 2014

By Mike Krause

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Key Points:

- Farmer demonstrations and trials assessed from both a biological and economic perspective are valuable, as the biological results may not always justify the change in returns and costs.
- This economic assessment highlights some significant profits from the use of fungicides in wheat, when it follows a cereal.
- Rotation selection can have a significant impact on economic returns.
- The economic risk of some crops is highlighted in poorer seasons.

Introduction

Research is still one of the keys for unlocking economic potential in farming today. While there is a keen interest in physical trial results, these results also need to be assessed economically, to determine what drives increases in profits and efficiencies. This report assesses the economic outcomes of the following trials that the Minnipa Agricultural Centre was involved with during 2012 and 2013. These trials were managed by Amanda Cook, Wade Shepperd and Ian Richter (SARDI), with input from Dr. Nigel Wilhelm (SARDI).

The specific trials assessed in this analysis are:

1. Piednippie, Western Eyre Peninsula - Rhizoctonia management through break crop rotations
2. Warramboo, Upper Eyre Peninsula – Rhizoctonia management through rotations and use of fungicides
3. Wynarka, Southern Murray Mallee – Rhizoctonia management through fungicides
4. Minnipa Agricultural Centre - EPARF Fungicide Trials

The first three set of results mentioned above are farmer based demonstrations, where the impact of farmer decision making and operations have been monitored at a broad acre scale. These demonstrations were not replicated, but numerous sampling occurred within the zone. Any observations would need to be tested in other environments before there can be greater confidence in the results. However, the results do provide some insight into the issues being studied, which varied between farms and the two years of trials, 2012 and 2013. The fourth listed trial is a replicated plot trial where performance of treatments can be compared more rigorously.
While yields and Rhizoctonia infection levels were recorded, the costs and prices used in this report were guided by the farmers experience and memory of the costs at the time. Costs have been cross checked with other data sources in lower rainfall areas.

1. Piednippie, Western Eyre Peninsula - Rhizoctonia management through break crop rotations

This demonstration was established by the farmer to determine effect of rotation has on the management of Rhizoctonia. A number of break crops were tested with the effects measured on the following wheat crop.

The 2012 results focused on a wheat paddock, where the previous year had been a failed canola crop severely affected by mice. When the paddock was seeded to canola in 2011, a strip was left to volunteer medic, which was not grazed prior to the following wheat crop. Thus the demonstration compared the impact of a grass-free medic with canola on following wheat performance. The gross margin results for both years are shown in Table 1.

Table 1: Rotation gross margin comparing canola and a medic pasture

<table>
<tr><td>Rotation 1</td><td></td><td>Rotation Gross Margin</td></tr>
<tr><td>Canola paddock 2011
Yield 0 t/ha
Price $450/t
Gross income $0/ha
Variable cost $100/ha
Gross margin -$100/ha</td><td>Wheat paddock 2012
Yield 0.96 t/ha
Price $252/t
Gross income $241/ha
Variable cost $120/ha
Gross margin $122/ha</td><td>$22/ha</td></tr>
<tr><td>Rotation 2</td><td></td><td></td></tr>
<tr><td>Medic paddock 2011
Yield 0 t/ha
Price $0/t
Gross income $0/ha
Variable cost $20/ha
Gross margin -$20/ha</td><td>Wheat paddock 2012
Yield 0.97 t/ha
Price $252/t
Gross income $244/ha
Variable cost $120/ha
Gross margin $124/ha</td><td>$104/ha</td></tr>
</table>

Comments:

- 2011 was a poor year and the medic being in the same paddock as the canola was not grazed, so no income was generated from the medic in the medic/wheat rotation.
- While the wheat yields were the same following both rotation options in 2011, the rotation gross margin results were very different.
- The rotation gross margin is significantly in favour of the medic/wheat rotation as more variable costs were lost by the canola in the poor year of 2011.
- This result highlights the risk associated with canola compared to a volunteer medic pasture in this environment.

The next year, a similar comparison was made, except mustard (Juncea Canola) was used instead of canola, due to the mustard (Juncea Canola) ‘package’ being offered by local retailers. Table 2 shows the rotation gross margin results and this time the financial results were very similar. It should be noted that the mustard (Juncea Canola) suffered financially when compared to canola, as it obtained a lower $100/t price in 2012. The lower yield meant only 13t was produced, causing a significantly higher freight cost per tonne.

Table 2: Rotation gross margins comparing mustard (Juncea Canola)/wheat, volunteer medic pasture/wheat and wheat/wheat

Rotation 1				Rotation Gross Margin
Mustard paddock 2012		Wheat paddock 2013		
Yield	0.17 t/ha	Yield	2.0 t/ha	
Price	$350/t	Price	$252/t	
Gross income	$60/ha	Gross income	$504/ha	
Variable cost	$160/ha	Variable cost	$120/ha	
Gross margin	-$100/ha	Gross margin	$384/ha	$284/ha
Rotation 2				
Medic paddock 2012		Wheat paddock 2013		
Yield	0 t/ha	Yield	1.7 t/ha	
Price	$0/t	Price	$252/t	
Gross income	$0/ha	Gross income	$428/ha	
Variable cost	$20/ha	Variable cost	$120/ha	
Gross margin	-$20/ha	Gross margin	$308/ha	$288/ha
Rotation 3				
Wheat paddock 2012		Wheat paddock 2013		
Yield	0.3 t/ha	Yield	1.5 t/ha	
Price	$300/t	Price	$252/t	
Gross income	$90/ha	Gross income	$378/ha	
Variable cost	$120/ha	Variable cost	$120/ha	
Gross margin	-$30/ha	Gross margin	$258/ha	$228/ha

Comments:

- Given this set of seasons, the results did provide different wheat yields in the second year. However, the rotation gross margins of rotations with break crops showed little difference in financial performance.
- The wheat/wheat rotation provided the lowest rotation gross margin when compared to the rotations with a break year. This is an example of the economic differences rotation selection can make.
- This result also showed how risky oilseeds are to grow profitably in this area.
- These results indicate the overall production and financial benefits of a rotation with a break when compared to a wheat/wheat rotation.

The question of what yield canola has to achieve in a canola/wheat rotation for it to be financially comparable to medic pasture/wheat rotation still remains. Using the costs and yields from the experience of the demonstration results, the rotations were modelled, with the result shown in Table 3. The figures used in Table 3 assume two average years and the medic pasture carries 3DSE/ha. Also, the self-replacing merino flock has a $30/DSE gross margin. The wheat yield reflects a 0.2 t/ha improvement in wheat after canola, compared with a medic pasture.

Table 3: Modelled finances comparing canola to medic pasture given average conditions

Rotation 1				Rotation Gross Margin
Canola paddock (Av.)		Wheat paddock (Av.)		
Yield	0.36 t/ha	Yield	1.7 t/ha	
Price	$450/t	Price	$250/t	
Gross income	$160/ha	Gross income	$425 /ha	
Variable cost	$120/ha	Variable cost	$120/ha	
Gross margin	$40/ha	Gross margin	$305/ha	$345/ha
Rotation 2				
Medic paddock (Av.)		Wheat paddock (Av.)		
Grazing 3 dse/ha		Yield	1.5 t/ha	
Merino gross margin $30/dse		Price	$250/t	
Gross margin	$90/ha	Gross income	$375 /ha	
		Variable cost	$120/ha	
		Gross margin	$255/ha	$345/ha

Comments:

- This modelling indicated that canola would need to yield 0.36 t/ha for it to financially breakeven with a medic/wheat rotation, given average conditions.
- However, as has been discussed, canola is a riskier crop to grow. So perhaps a long term yield of 0.45 t/ha is needed to provide a profitable risk reward. This should be considered as the necessary canola breakeven yield.

2. Warramboo, Upper Eyre Peninsula – Rhizoctonia management through rotations and use of fungicides

The demonstration was established by the farmer to determine whether using fungicides to manage Rhizoctonia and other leaf disease was profitable in a wheat/wheat rotation.

Table 4 shows the gross margin results of the second wheat after wheat.

Table 4: Trial assessing fungicide on the second wheat crop of a wheat/wheat rotation 2012

Wheat with no fungicide		**Wheat with fungicide**	
Yield	1.57 t/ha	Yield	1.54 t/ha
Price	$250/t	Price	$250/t
Gross income	$393/ha	Gross income	$385 /ha
		Flutriafol	$5/ha
		Triad	$4/ha
		Other costs	$160/ha
Variable cost	$160/ha	Variable cost	$169/ha
Gross margin	$233/ha	Gross margin	$216/ha

Comments:

- In this instance, the fungicide increased the variable costs and the yield was poorer. So, the resulting gross margin was poorer, which meant this fungicide did not provide a positive economic return.

In 2013, this farm experienced a better season. The farm demonstration again assessed the wheat gross margin of the second wheat crop of a wheat/wheat rotation. In this year two different types of fungicides were tested. Table 5 shows the gross margin results of the second wheat crop using the average yield obtained from two areas within the demonstration areas of either EverGol Prime or Uniform fungicides. The EverGol Prime treatment yielded better on the flatter area (2.2 t/ha) than the control (1.8 t/ha) and Uniform (1.7 t/ha on sandy rise) where the farmer demonstration was located, and grain protein reflected differences in possible nitrogen levels; Control 11.8%, EverGol Prime (in flat) 12.2%, Uniform (sandy rise) 11.4%. Both fungicides had lower Rhizoctonia patch score (significant) and lower Rhizoctonia root infection (not significant). However on a more even soil type (heavier flat), Uniform performed better (1.2 t/ha), EverGol Prime (0.96 t/ha) and Control (0.95 t/ha).

Table 5: Trial assessing fungicides on the second wheat crop of a wheat/wheat rotation in 2013

Wheat with no fungicide		**Wheat with fungicide** (EverGol Prime)		**Wheat with fungicide** (Uniform)	
Wheat paddock		Wheat paddock		Wheat paddock	
Yield	1.36 t/ha	Yield	1.68 t/ha	Yield	1.44t/ha
Price	$250/t	Price	$250/t	Price	$250/t
Gross income	$340/ha	Gross income	$420 /ha	Gross income	$360/ha
		EverGol Prime	$9/ha	Uniform	$17/ha
		Other costs	$160/ha	Other costs	$160/ha
Variable cost	$160/ha	Variable cost	$169/ha	Variable cost	$177/ha
Gross margin	$180/ha	Gross margin	$251/ha	Gross margin	$183/ha

Comments:

- In this demonstration, the selection of fungicide was important as the EverGol Prime treatment gave an improved gross margin due to the increase in yield and lower input costs.
- The use of Uniform gave minimal improvement in gross margin over the control treatment of 'no fungicide' despite an increase in yield.

There was also farmer interest in assessing the benefit of two different break crops in the demonstration strips: (1) medic pasture and (2) vetch. Table 6 shows the gross margin differences of the wheat crop following these two types of break crops.

Table 6: Trial assessing wheat gross margins after a break crop in 2013

Wheat after medic		**Wheat after vetch**	
Yield	1.2 t/ha	Yield	1.6 t/ha
Price	$250/t	Price	$250/t
Gross income	$300/ha	Gross income	$400 /ha
EverGol Prime	$9/ha	EverGol Prime	$9/ha
Other costs	$160/ha	Other costs	$160/ha
Variable cost	$169/ha	Variable cost	$169/ha
Gross margin	$131/ha	Gross margin	$231/ha

Comments:

- The wheat on vetch had lower Rhizoctonia root infection in crown roots, had greater early and late dry matter during the season and yielded greater than after medic. However the vetch systems also had greater Take-all damage in the wheat following vetch in spring than following medic. There were no differences in grain quality between the medic or vetch treatments.
- The wheat gross margin after vetch was $100/ha higher than after a medic pasture.
- As the medic pasture was not grazed in this trial, there has been no allowance for sheep gross margin. However, this analysis shows that sheep would have had to achieve a gross margin of $100/ha for both treatments to have the same economic outcome.

3. Wynarka, Southern Murray Mallee – Rhizoctonia management through fungicides

The question being tested was whether the use of fungicides on the second cereal crop of a cereal/cereal rotation resulted in improved yields and profits.

Table 7 shows the gross margin results of fungicide used on a barley crop in 2012, which followed a 2011 wheat crop.

Table 7: Trial assessing fungicide for cereal leaf disease on barley in 2012 after wheat

Barley with no fungicide		**Barley with fungicide**	
Barley paddock		Barley paddock	
Yield	3.7 t/ha	Yield	3.92 t/ha
Price	$200/t	Price	$200/t
Gross income	$740/ha	Gross income	$784/ha
		Flutriafol	$5/ha
		Other costs	$140/ha
Variable cost	$140/ha	Variable cost	$145/ha
Gross margin	$600/ha	Gross margin	$639/ha

Comments:

- These results indicated that there was an improved gross margin when using an additional fungicide (Flutriafol) on the barley crop in 2012.

Table 8 shows the rotation gross margin results of a canola/wheat/wheat rotation, where a fungicide was used in the second wheat crop (2013).

Table 8: Trial assessing fungicide on the second wheat crop of a canola/wheat/wheat rotation in 2013

Canola 2011		Wheat 2012		Demonstration 2013		Rotation Gross Margin
				Wheat with no fungicide		
Yield	0.9 t/ha	Yield	2.2 t/ha	Yield	2.37 t/ha	
Price	$450/t	Price	$300/t	Price	$250/t	
Gross income	$405/ha	Gross income	$660/ha	Gross income	$593 /ha	
				Flutriafol	$12/ha	
Variable cost	$160/ha	Variable cost	$140/ha	Variable cost	$152/ha	
Gross margin	$245/ha	Gross margin	$520/ha	Gross margin	$440/ha	$1,206/ha
				Wheat with two fungicides		
As above		*As above*		Yield	2.5 t/ha	
				Price	$250/t	
				Gross income	$625 /ha	
				EverGol Prime	$9/ha	
				Flutriafol	$12/ha	
				Other costs	$145/ha	
				Variable cost	$161/ha	
				Gross margin	$464/ha	$1,229/ha

Comments:

- There were no differences in plant growth, Rhizoctonia seminal or crown root scores, grain yield or grain quality between the control and the fungicide treatment at the Mallee site in this season.
- While there was some gross margin improvement when using a fungicide (mix of EverGol Prime and Flutriafol), this financial improvement was minimal when comparing the three years results.
- Looking at the rotational gross margin, there is minimal financial difference between these treatments.

4. Minnipa Agricultural Centre - EPARF Fungicide Trials

The EPARF fungicide trials at Minnipa Agricultural Centre were established in 2013, which was a top 20% rainfall season.

A research summary of this trial is:

- At Minnipa in 2013 there were cereal yield responses to fungicide treatments in both wheat (up to 14% better than no fungicide) and barley (up to 12 % better than no fungicide but not all strategies were effective). However there were still visual Rhizoctonia patches present.
- In-furrow fungicide applications were more effective than seed treatments.
- Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments.
- A three week delay in seeding reduced yield by nearly one third.
- Fungicide treatments did not prevent an increase in Rhizoctonia inoculum levels during a cereal phase.
- There were differences in Rhizoctonia seminal root scores in wheat but not in barley, however scoring at six weeks after sowing in this season (with early and warm

conditions at seeding) may not have allowed the greatest differences in seminal root infection to be detected. The extra 20 kg/ha N applied as urea at seeding resulted in higher Rhizoctonia root damage in the seminal root scores in wheat.

- The placement of the fungicides banded below the seed has resulted in only seminal roots being protected not the crown roots, as the Rhizoctonia % crown root infection and numbers of crown roots were not different between treatments.

The treatments were economically assessed using the following assumptions:

- The fuel, repairs and maintenance variable costs for putting in the trial are the same costs as those experienced by the closest 'farmer demonstration' sites.
- DAP was costed at $450/t.
- Fluid fertiliser was costed at $1,100/t or $46/ha, double the DAP cost.
- The starter N (Urea) was costed at $9/ha.
- The wheat price was $250/t and barley $200/t, which is seen as average.
- Vibrance seed dressing at 360 ml/t was costed at $6/ha, 180 ml/t at $3/ha.
- The fungicide EverGol Prime was costed at $8.75/ha.
- The fungicide of Uniform (SYN SIF1) at the higher rate was costed at $17.00/ha and medium rate at $11.22/ha.

Applying the respective treatment variable costs and yields, the gross margin results for the wheat component of the trial is shown in Figure 1 and for barley in Figure 2.

Comments on the **wheat** trial gross margins:

- The treatment of sowing 3 weeks later than the control produced the poorest gross margin.
- Eight treatments provided noticeably improved gross margins when compared to the 'control treatment'.
- The use of fungicides Uniform (SYN S1F1), EverGol Prime and Vibrance seed dressing provided improvements in gross margins when compared to the control.
- The use of fluid fertiliser did not provide any gross margin improvement over the control in this soil type.

Comments on the **barley** trial gross margins:

- Similar to the wheat trial, the treatment of sowing 3 weeks later than the control produced the poorest gross margin.
- Most treatments in the barley trial gave no significant gross margin improvement when compared to the control.
- Only one treatment, Vibrance seed dressing 360 ml/t & Uniform (SYN S1F1) in-furrow medium rate, produced an improved gross margin above the control treatment.

Figure 1:Gross Margins ($/ha) for Fungicides in Wheat

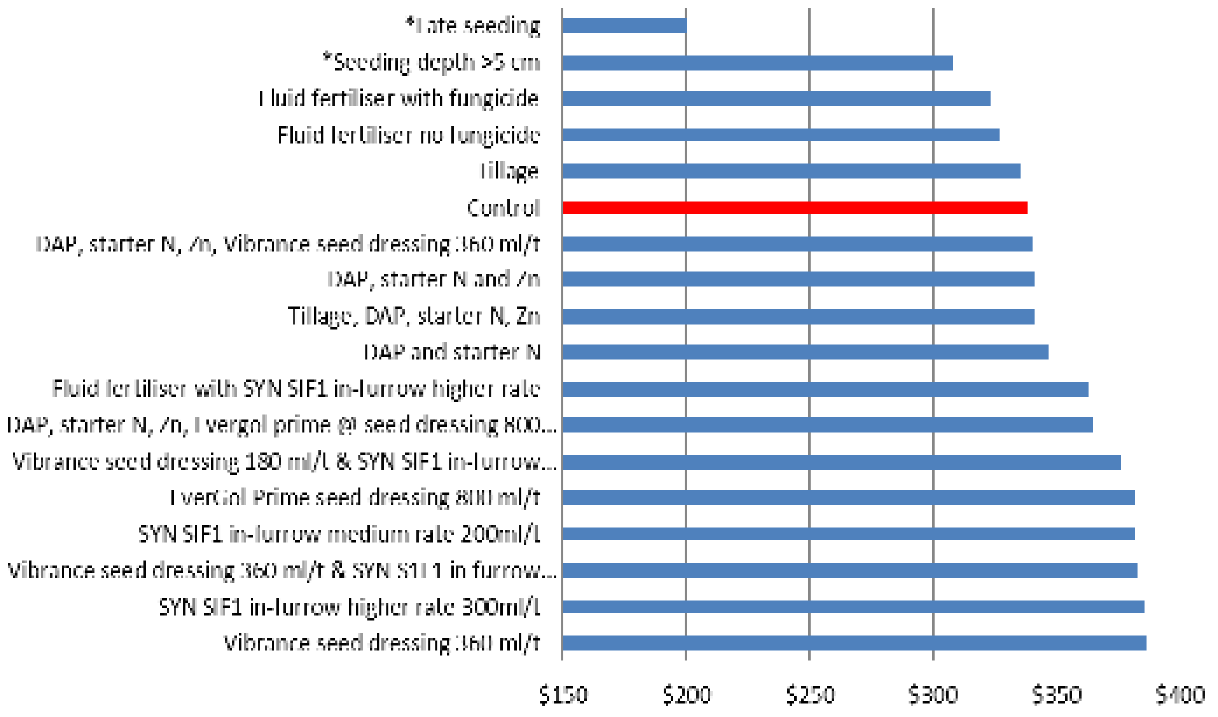
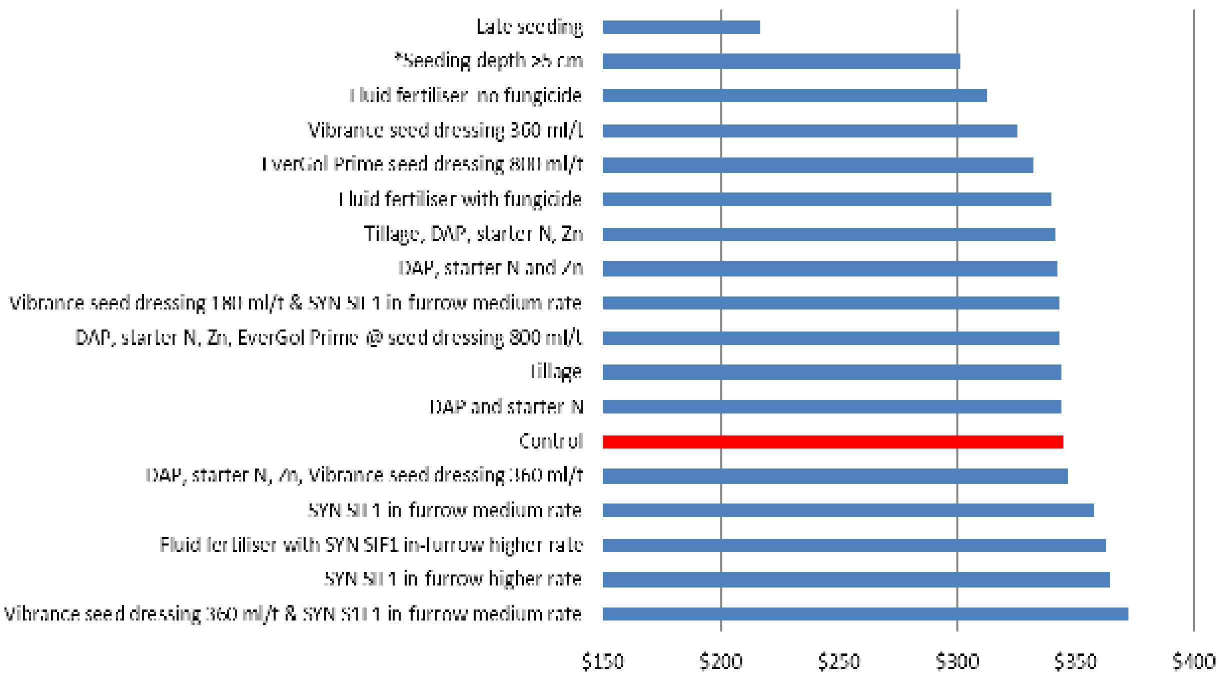


Figure 2: Gross Margins ($/ha) for Fungicides in Barley



Conclusion

It is useful to assess both biological and economic results of farmer demonstrations and trials to help farmers determine which treatments potentially provide financial improvements in their business. While farmer based demonstrations are generally less scientifically rigorous when compared to professional research trials, they do provide valuable insight into how the new technology performs in a commercial environment. Economically assessing farm demonstrations provide greater rigor for the farmer, as they will also be subjectively assessing the economic outcome of different research results and the implications for adoption of these in their business.

The outcomes from the demonstrations were:

- The rotation of vetch/wheat compared to medic pasture/wheat gave the best financial result in the farmer demonstrations assessed. Sown vetch may provide an improved financial performance when compared to medic pasture so perhaps should be considered as a better break for upper EP systems. However, this was a minimal input vetch crop.

- The use of fungicides provided an economic benefit for most farm demonstrations. However, label recommendations for applying fungicides should always be followed. The lower cost products provided the better economic benefits.

- Canola and mustard (Juncea Canola), in the seasons tested in the farmer trials, proved to be a significant financial risk. Economic modelling using these results, and for average seasons, indicated that canola needed to yield at least 0.36 t/ha to provide a breakeven with 'medic pasture (sheep)/wheat' rotation. When allowing for the risk of growing canola, it was suggested that a yield of 0.45 t/ha in an average season should be the break-even yield.

- The EPARF fungicide trials of 2013 indicated that there were positive economic responses to using the various fungicides on wheat, but not for barley.

Acknowledgements

EverGol Prime® – registered trademark of Bayer CropScience.

Uniform® (SYNSIF1) and Vibrance® – registered trademark of Syngenta.