SAGIT Research Snapshot

S1201: Demonstrating best management for rhizoctonia on Upper EP and Mallee

FAST FACTS

The details

Start: July 1, 2012 Finish: June 30, 2014

Project participants: SARDI – Amanda Cook, Ian Richter, with support from Vadakattu Gupta, Alan McKay, Kathy Ophel-Keller, Nigel Wilhelm, Paul Bogacki, Bill McLeod, Daniel Huberli and Sjaan Davey; Dodgshun Medlin and Mike Krause.

The problem

There are a number of different strategies for reducing rhizoctonia inoculum. However deciding on the most efficient and cost-effective strategy can be difficult.

The research

SARDI conducted trials looking at best bet strategies for rhizoctonia management.

RESEARCH AIMS

- Demonstrate the value of 'best bet' rhizoctonia management strategies in comparison to current farming practices.
- Examine the impact of break crops on rhizoctonia inoculum and of crop management on disease expression in the following cereal crop.

IN THE FIELD

Broadacre demonstrations on the Eyre Peninsula, at Piednippie (near Streaky Bay) and Warramboo, and in the Mallee, at Wynarka, researched methods to reduce the impact of rhizoctonia in farming systems.

Strategies used to minimise rhizoctonia inoculum levels included grass-free break crops in a rotation, such as canola, fallow, vetch and medic, while controlling the green bridge before seeding.

In a nutshell

SARDI demonstrated the combined value of management practices which reduce the impact of rhizoctonia in typical upper EP and Mallee environments.

Strategies used to reduce the impact of in-crop rhizoctonia infection included adequate nutrition, particularly zinc and other trace elements, fluid phosphorus fertiliser delivery in calcareous grey soils, sowing depth, sowing time (earlier into warmer soil temperatures) and fungicide use and placement.

Paddock fungicide demonstrations were monitored at Mudamuckla, Buckleboo, Lock and Minnipa Agricultural Centre in 2013.

RESULTS

In 2012 and 2013, rotation options using canola and medic/fallow reduced rhizoctonia inoculum in the following cereal crop, validating previous trial research. At Piednippie in 2011, wheat yields were the same under both rotations. However the gross margin result was higher for the medic/wheat rotation because the variable costs were greater in the canola (see table. For economic analysis, see appendix).

In 2012, rotations of juncea canola (mustard) and medic/fallow resulted in different wheat yields, however the break crop gross margins showed little difference in financial performance.

	Wheat yield (t/ha)	Break crop costs ($/ha)	Wheat gross margin ($/ha)	Rotation gross margin ($/ha)
2011-12				
Canola-wheat	0.96	100	122	22
Medic-wheat	0.97	20	124	104
2012-13				
Mustard-wheat	2.0	160	384	284
Medic-wheat	1.7	20	308	288
Wheat-wheat	1.5	120	258	228

The lowest rotation gross margin was wheat/wheat compared to the rotations with a break year (see table) indicating the overall production and financial benefits of a rotation with a break when compared to a wheat/wheat rotation.

Modelling was used to determine the break-even yield for canola in lower rainfall environments. A yield of 0.36t/ha is needed to be financially equivalent with a medic/wheat rotation, given average seasonal conditions. A long-term yield of 0.45t/ha is needed to provide a profitable risk-reward and should be considered as the necessary canola break-even yield.

Fungicides

Performance of new fungicide products released in 2013 for rhizoctonia suppression was variable. Some products performed only marginally better than the controls.

At Warramboo, the fungicides used produced significantly lower rhizoctonia patch score but not lower rhizoctonia root infection. The economic evaluation showed the selection of fungicide was important when evaluating yield and input costs. The cheaper EverGol Prime gave an improved gross margin due to an increase in yield and lower input costs, while the use of Uniform gave minimal improvement in gross margin over the control despite an increase in yield.

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 treated crops. While there was some gross margin improvement when using fungicides, this financial improvement was minimal when comparing the three year rotational gross margin.

Banded in-furrow fungicides were more effective than seed treatments, and new products at higher rates were also effective. Yield responses to fungicide treatments in both wheat and barley occurred however visual rhizoctonia patches were still present in treatments. Tillage, starter nitrogen and zinc produced similar yields to many of the fungicide treatments.

Most treatments in the barley trial gave no significant gross margin improvement when compared to the control. Only one fungicide treatment produced an improved gross margin above the control treatment ($345/ha).

Researcher Amanda Cook at the Minnipa Agricultural Centre site

A survey of EP and Mallee growers found they consider rhizoctonia when making planting decisions, and the use of break crops, fungicide and green bridge control, to manage rhizoctonia had increased.

VALUE FOR GROWERS

- Grass-free break crops such as canola, juncea canola, medic and vetch are the best options to lower rhizoctonia inoculum levels, allowing other weed control options, earlier sowing opportunities and higher yield for the following cereal.
- Vetch/wheat rotation (compared to medic pasture/wheat) gave the best financial result.
- Low input vetch lowered rhizoctonia inoculum levels similar to medic, and provided a gross margin improvement of $100/ha.
- Oilseeds proved to be a financial risk compared to medic in low rainfall regions, particularly in a poor season.
- Lower cost fungicide products provided a better economic benefit in farm demonstrations. 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.
- A rhizoctonia risk decision-making tool has been developed to help farmers evaluate cereal root disease risks based on previous crop rotation, management decisions, timing in the cropping season and environmental conditions and will be available on the EPARF website.

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APPENDIX 1

Demonstrating Best Management for Rhizoctonia in Low Rainfall Zones of SA

(EP and Mallee 2012 to 2013)

Economic Comment

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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

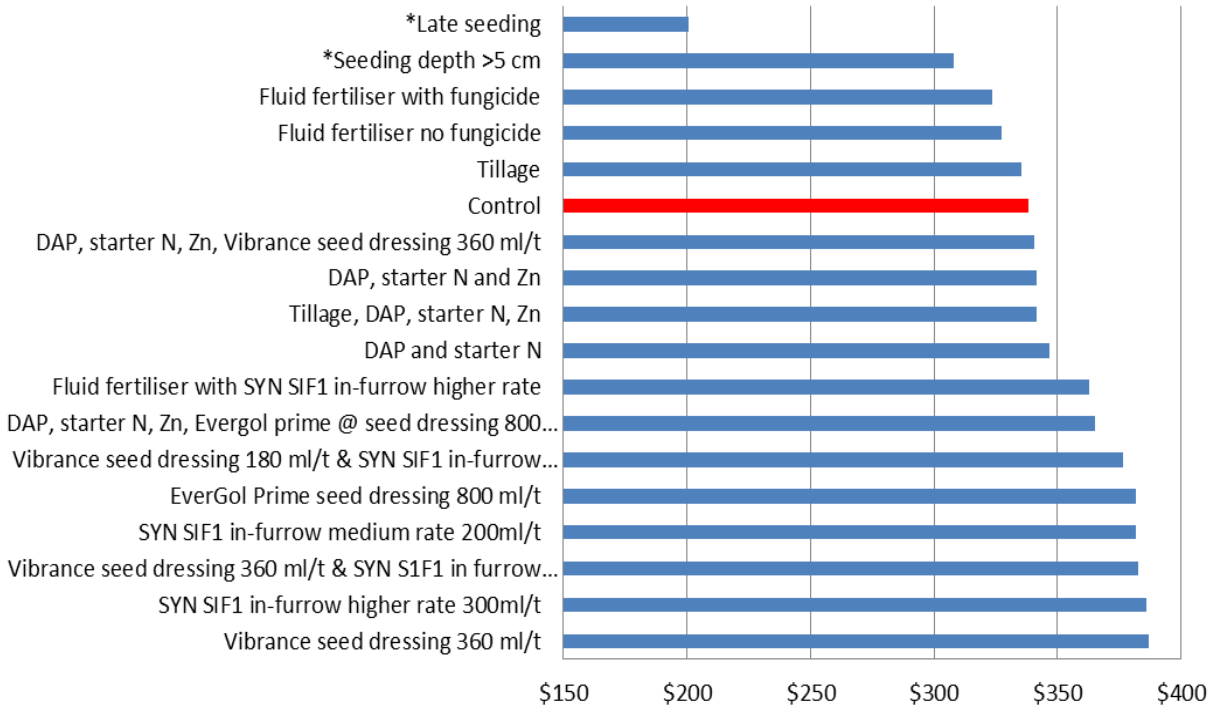
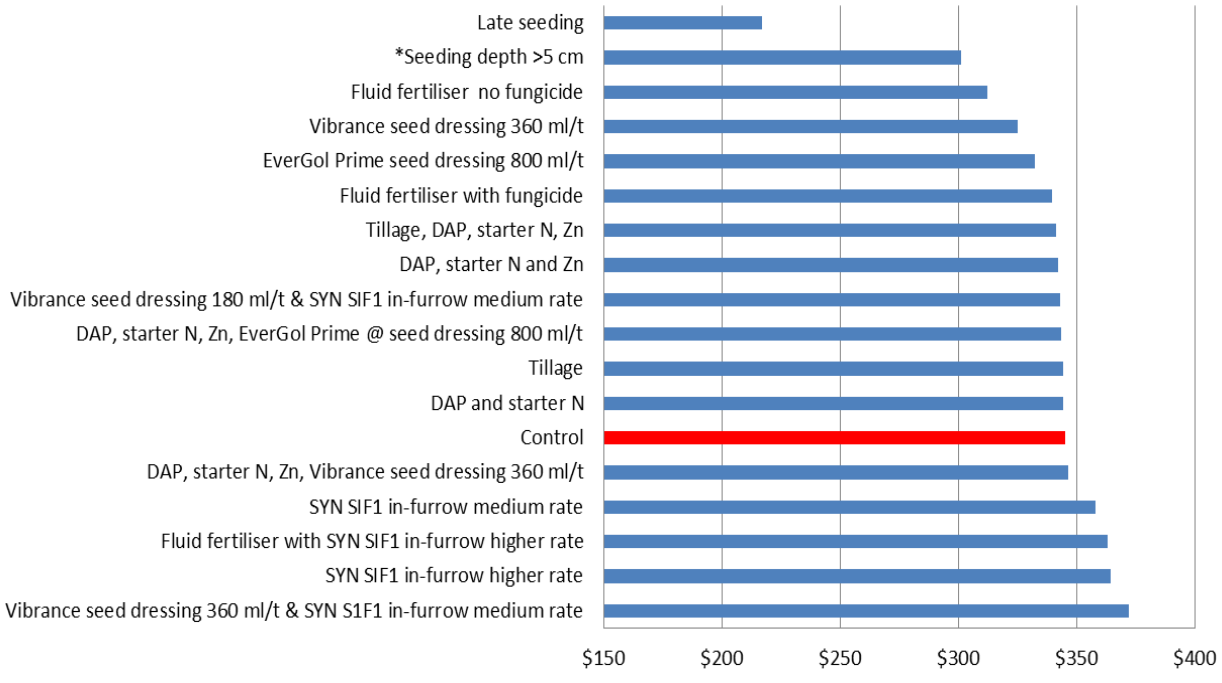


Figure 2: Gross Margins ($/ha) for Fungicides in Barley



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.