Rhizoctonia solani AG8: New breakthroughs in control and management

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Key messages

- The next generation of control options for *Rhizoctonia solani* (AG8), the causal agent of Rhizoctonia root rot, is in-furrow liquid injection. The efficacy of banding two new fungicides, Uniform® and EverGol® Prime, was evaluated as an alternative to seed treatments across three years of trials conducted in Western Australia (WA) by DAFWA and in South Australia (SA) by SARDI.
    - Uniform® applied either by liquid banding or coated fertiliser has been registered to control Rhizoctonia. Liquid banding treatments, including the split application of in-furrow and on the surface, produced greater and more consistent yield responses than Vibrance® seed treatment. Dual banding of Uniform® in-furrow 3-4 cm below the seed and on the surface behind the press wheel gave the most consistent yield and root health responses across seasons. Responses in barley were greater than wheat.
    - Yield responses achieved by banding EverGol® Prime in-furrow were not significantly different from EverGol® Prime seed treatments using comparable rates (gai). However, banding EverGol® Prime in-furrow combined with EverGol® Prime seed treatment resulted in better overall root health than in-furrow or seed only treatments.
- Rotation with canola, or a clean fallow, greatly reduce the inoculum of *Rhizoctonia* in soils and will benefit the following cereal crop. Barley, on the other-hand, significantly increases inoculum.
- Sub-seed furrow loosening is a well-established practice which reduces the effect of the disease.

Aims

To evaluate yield responses for wheat and barley field trials conducted in WA and SA from 2011 to 2013 with new fungicides, applied in-furrow, on the surface or as seed treatments, to reduce yield losses caused by *R. solani*.

To demonstrate the value of crop rotation or fallow, and cultivation below the seed, to manage *R. solani*.

Method

Fungicide efficacy trials

Twenty-one Syngenta in-furrow fungicide efficacy trials, sown to either barley or wheat, were established in WA by DAFWA and in SA by SARDI during 2011 to 2013. Independent to these trials, another eight in-furrow efficacy trials sown to barley were established using Bayer fungicides. All trial sites were selected based on rhizoctonia bare-patching in the previous year's cereal crop and/or a medium to high disease risk determined using PreDicta B on soil samples collected in autumn; all trials utilised native *R. solani* inoculum present in the paddock. The trials had a randomised block design with six replicate plots (20 m x 1.8 m) for each treatment. In WA, each treated plot was adjacent to an untreated plot, while in SA individual plots were split into treated and untreated halves. All treatments were compared with untreated controls plots.

Treatments for Syngenta trials included liquid banding of fungicide (Uniform®) on the soil surface and in-furrow 3-4 cm below the seed, in-furrow below the seed only or in-furrow below the seed combined with a seed treatment (Vibrance®) (Table 1). Different rates of Uniform® were also tested.

Treatments for Bayer trials included EverGol® Prime applied on seed and liquid banded in-furrow at different rates, or in-furrow below the seed combined with a seed treatment (Table 2).

WA and SA plots were sown using narrow points cultivating to a depth of 10 cm, and seeds were placed at 3 cm depth. In WA, Flexi-N +/- Uniform® or EverGol® Prime was injected to the bottom of the furrow below the seed at 100L/ha in 2012 and 2013, while a granular fertiliser was applied below the seed in 2011 and Uniform® or EverGol® Prime were injected mixed with water at the same volume/ha. In SA, plots received either liquid NP fertiliser or a mix of granular DAP + liquid UAN fertilisers in different years (all deep banded at full tillage depth) and fungicide was co-located separately in water at 75-80L/ha volume. The surface application treatment with Uniform® was applied as a

continuous 2cm wide band behind the press wheel in SA during sowing using a low volume narrow angle nozzle. In WA, the surface band treatment was applied as a liquid stream in a second pass following the first pass application of fungicide below the seed during seeding.

Crop rotation and management options

A two year trial was established in 2011 in Katanning to examine the influence of crop rotation and management on *R. solani* root disease. The trial had a split plot randomised block design with 2011 treatments of barley (Buloke), wheat (Mace), canola (Cobbler) and fallow (repeated herbicide applications), replicated four times in randomised blocks with each block containing four plots of 40m x 1.8m. In 2012 all plots were sown to Buloke barley. Each of the four plots/block contained a treatment of (1) untreated, (2) seed dressing (Dividend), (3) in-furrow application of Uniform® or (4) cultivation to a depth of 10cm below the seeding depth. The first three 2012 treatments were cultivated to seeding depth (~3cm) using knife-points. All plots were injected with Flexi-N (50L/ha) in 2012.

From 2010 to 2014, DAFWA monitored 188 paddocks for soilborne disease incidence on cereal roots and the pathogen inoculum levels in the soil at pre-sowing and post-harvest using PreDicta B (SARDI). Further details on focus paddock monitoring are in the paper by Martin Harries et al (2015) in these proceedings.

Results and Discussion

Fungicide efficacy trials

Individual trial data for EverGol® Prime, Uniform® and Vibrance® can be found in previous crop updates (Hüberli et al 2013 and 2014); data for EverGol® Prime has not been presented previously. This paper presents the meta-analysis and a summary of the trial data for yield responses in all trials in WA and SA for all four fungicides.

EverGol® Prime and Vibrance® have been evaluated as seed treatments to suppress *R. solani* in field trials conducted by DAFWA and SARDI from 2011 to 2013 (Table 1 and 2). A direct comparison between EverGol® Prime and Vibrance® cannot be made as they were independent experiments. On average these seed treatments offered a 5% improvement in yield of barley and wheat (Table 1 and 2). All seed treatments produced a positive response in one or more trials, but only EverGol® Prime at the high rate (80mL/100kg seed) was significant in the meta-analysis.

Table 1. Summary of average barley and wheat yield responses for treatments with Vibrance® (Vib seed treatment; mL/100kg) and Uniform® (Uni) liquid banded in-furrow (IF) and on the surface (Sur) at the specified rates (mL/ha).

Crop	Treatment	Years	Total trials	# trials +ve yield change	# trials where yield sig.[a]	Yield			
						Untreated (t/ha)	Treated (t/ha)	Net increase (t/ha)	$ increase/ ha[b]
Barley	Vib seed 360	3	10	6	1	2.34	2.37	0.02	6
	Vib seed 360 + Uni IF 200	3	10	9	5	2.34	2.53	0.18*	58
	Uni IF 300	3	10	8	5	2.34	2.55	0.21*	67
	Uni IF 400	2	6	5	5	2.65	2.95	0.30*	96
	Uni IF 150 + Uni Sur 150	2	6	5	3	2.65	2.93	0.28*	90
	Uni IF 200 + Uni Sur 200	1	3	3	2	3.03	3.48	0.46*	147
Wheat	Vib seed 360	3	11	10	3	2.18	2.25	0.07	20
	Vib seed 360 + Uni IF 200	3	11	9	6	2.18	2.31	0.13*	36
	Uni IF 300	3	11	9	8	2.18	2.33	0.15*	42
	Uni IF 400	2	6	6	4	2.22	2.39	0.17*	48
	Uni IF 150 + Uni Sur 150	3	7	7	6	2.07	2.30	0.22*	62
	Uni IF 200 + Uni Sur 200	1	3	3	3	2.79	3.11	0.32*	90

*Significant (P<0.05) net increases in yield compared to untreated
[a]Yield increase significantly greater than untreated based on individual site analyses.
[b]Dollar increase/ha calculated based on barley price of $320/t and wheat price of $280/t

All treatments with Vibrance® and Uniform® produced positive responses in some of the trials, but not all responses were significant (Table 1). Barley net gains were always higher than wheat. In the meta-analysis, significant yield gains were obtained for all in-furrow and surface banding treatments in both barley and wheat. Banding treatments with Uniform® were associated with more significant and bigger yield responses compared to Vibrance® seed treatment. The best results were obtained by the split application of Uniform® in-furrow and on the surface at 200mL/ha in each location for both barley (0.46 ± 0.22t/ha) and wheat (0.32 ± 0.11t/ha). This treatment was not statistically different from the split application of Uniform® at 150mL/ha in each location. The dollar increase/ha ranged from $58-147 for barley and $36-90 for wheat for the in-furrow treatments (Table 1), and the profitability can be tested when the price of Uniform® is released.

The root health scores showed that the split application treatments with Uniform® consistently resulted in plants having the best overall root health. The Vibrance® seed treatment combined with Uniform® banded below the seed had healthier crown roots than the banding only treatments.

Table 2. Summary of average barley yield responses for treatments with EverGol® Prime (EP) applied on seed (mL/100kg seed) and liquid banded in-furrow (IF; mL/ha) at specified rates.

Treatment	Years	Total trials	# trials +ve yield change	# trials where yield sig.[a]	Yield			
					Untreated (t/ha)	Treated (t/ha)	Net increase (t/ha)	$ increase/ ha[b]
EP seed 40	1	3	2	0	2.12	2.17	0.04	13
EP seed 80	3	6	6	2	2.37	2.51	0.14*	45
EP seed 40 + EP IF 30	1	2	1	1	2.62	2.74	0.13	42
EP IF rate 30	2	4	4	0	2.25	2.32	0.07	22
EP IF rate 60	3	6	3	1	2.37	2.46	0.09	29
EP IF rate 80	1	2	1	1	2.62	2.81	0.20*	64
EP IF rate 120	2	4	3	1	2.25	2.34	0.08	26

*Significant (*P*<0.05) net increases in yield compared to untreated
[a]Yield increase significantly greater than untreated based on individual site analyses.
[b]Dollar increase/ha calculated based on barley price of $320/t

All treatments with EverGol® Prime produced positive responses in some of the trials, but not all responses were significant (Table 2). The meta-analysis of all EverGol® Prime trials demonstrated that EverGol® Prime seed treatment at 80mL/100kg seed produced a significant net yield gain (0.14 ± 0.06t/ha) compared to untreated (Table 2). The best result was obtained by EverGol® Prime liquid banded in-furrow at 80mL/ha (0.20 ± 0.10t/ha), which was statistically significant but this treatment was evaluated in only two trials in one year. Yield responses across all seed and in-furrow treatments averaged 0.11t/ha or 6% and there was no yield advantage associated with banding treatments over the seed treatment using comparable rates (gai) of EverGol® Prime. The dollar increase/ha ranged from $22-64 for barley for liquid banded treatments (Table 2), and the profitability can be tested when the price of EverGol® Prime in-furrow is released.

There were significant reductions in crown and seminal root damage when EverGol® Prime was applied in-furrow (rate 1) in combination with EverGol® Prime seed treatment (40mL/100kg seed). Crown root damage was also significantly reduced for EverGol® Prime at 80mL/100kg seed.

Efficacy of Vibrance® and EverGol® Prime seed treatments against loose smut in barley and Uniform® against yellow spot in wheat have been compared in other DAFWA trials reported previously (Beard et al 2012; Hills et al 2014). The effect of Uniform® against stripe rust and yellow spot in wheat are presented in a separate paper in these proceedings by Trevor Klein.

Crop rotation and management options

Both barley and wheat produced significantly higher inoculum levels of *R. solani* in the anthesis soil sample in 2011 compared with those for either canola or clean fallow plots. In 2012, plots were sown to barley with in-furrow fungicide, seed dressing or cultivation below the seed (as detailed above). These 2012 treatments did not have a significant impact on inoculum levels at the anthesis sampling in 2012. However, the 2011 treatments continued to significantly influence the inoculum levels until the anthesis sampling in 2012, with 2011 barley plots having significantly higher inoculum levels than 2011 canola or fallow plots.

In 2012, barley sown on 2011 fallow plots had significantly less root disease at tillering compared to barley sown on the 2011 barley and wheat plots. At anthesis, the barley sown on the 2011 canola plots had significantly reduced root disease compared to the 2011 barley plots. The root disease results reflect the impact of 2011 rotation treatments on pre-sowing inoculum levels in soil for 2012. The 2012 cultivation and fungicide treatments did not have a significant effect on root disease measured at either tillering or anthesis. Patch size in 2012 was significantly reduced in the 2011 canola plots compared to barley plots, and the 2012 cultivation treatment significantly reduced patch area compared to untreated plots. Although grain yield was compromised, the 2012 cultivation treatment was the highest yielding treatment. Overall, barley grown on 2011 barley plots was significantly smaller than canola and fallow plots, and was less vigorous, as determined by NDVI.

The results of the rotation trial are supported by data from the 188 focus paddocks. Inoculum levels of *R. solani* pre-sowing compared to those post-harvest in any of the 5 years, were always reduced by canola, whereas under cereal crops inoculum increased substantially.

Conclusion

- Liquid banding of fungicides significantly improves the control of *R. solani* when used in conjunction with cultivation and agronomic practices which reduce inoculum levels, and provides growers with greater flexibility for application.
- Application method of Uniform® does affect the capacity to control *R. solani*; liquid banding of fungicide either in-furrow only or “split” 50-50 in-furrow and at the soil-surface offer significantly better control than the Vibrance® seed treatment.
- These results support the current recommendation for management of rhizoctonia bare-patch. When sowing to wheat or another cereal in a paddock with a high rhizoctonia risk, cultivate below the seed (at least 10 cm) at the time of sowing and use a registered fungicide. Both Vibrance® and EverGol® Prime are registered seed treatments to suppress Rhizoctonia root rot, and will provide adequate control of this disease when used in conjunction with cultivation and agronomic practices which reduce inoculum levels.
- A break crop of canola or clean fallow, in paddocks with severe rhizoctonia bare-patch, may reduce *R. solani* inoculum levels and reduce disease in the following cereal crop.
- In paddocks with rhizoctonia bare-patch, barley will exacerbate the disease substantially compared to other cereal crops.

Further reading

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Key words

Rhizoctonia solani AG8, root disease, soilborne pathogen, banding fungicides, liquid injection

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