Integrated disease management options to control rhizoctonia bare-patch in cereals

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KEY MESSAGES

- When sowing to wheat or another cereal in a paddock with a previous history of Rhizoctonia bare-patch, using cultivation below the seed (~10 cm) and a registered fungicide can reduce disease impact.
- A break crop of canola or a chemical fallow may be useful for reducing Rhizoctonia inoculum in the soil prior to sowing a cereal crop.
- In the near future, new in-furrow fungicide options, that improve the control of Rhizoctonia disease in barley and wheat, may become available to WA farmers.

BACKGROUND AND AIMS

Rhizoctonia bare-patch (*R. solani* AG8) is a major problem across WA's cereal growing regions and is estimated to reduce WA state-wide cereal yields by 1% to 5% annually at a cost of $27M in wheat and barley (Murray and Brennan, 2009, 2010). Until 2013, Australia had only one registered fungicide for use on seed (Dividend®). Now new options are available for use in the current season, including Vibrance® and EverGol Prime®. Current management practices recommended to minimise the impacts of Rhizoctonia bare-patch in WA are combinations of, cultivation with a fungicide seed-dressing and adequate nutrition.

In South Australia it has been shown that canola and other non-grasses can reduce the inoculum level of *R. solani* following cereals and thus, are effective break crops (Gupta *et al*., 2012). In WA, benefits from crop rotation have yet to be demonstrated.

Our aims were to determine the efficacy of the new fungicides to control Rhizoctonia in cereals. Also, the effect of rotation and current management options to control *R. solani* were examined.

METHOD

All sites established in WA in 2012 had visible patches in cereals the previous year and the pathogen was confirmed to be *R. solani* (AG8) by PreDicta-B® soil test. Trials were sown by cone-seeder and spayed regularly with foliar fungicide to remove confounding effects of differences in leaf disease.

Fungicide efficacy trials

Seventeen fungicide efficacy trials, sown to either barley or wheat, were established in WA by DAFWA and in SA by SARDI during 2011 and 2012. The trials had a randomised block design with six replicate plots (20 m x 1.8 m). In WA, each treated plot was adjacent to an untreated plot, while in SA individual plots were split into treated and untreated three row plots. Among the 9 to 10 fungicide treatments for each trial were seed dressings of Vibrance or EverGol Prime, some including different rates. All treatments were compared with untreated controls plots. Additional treatments were new experimental in-furrow fungicides for which results are not presented in the present paper. Plots were sown using knife points to the seed depth and were injected with Flexi-N below the seed in 2012, while a granular fertiliser was applied below the seed in 2011. In SA, plots received a granular fertiliser.

Crop rotation and management options trial

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 40 m x 1.8 m. In 2012, each of the four plots/block contained a treatment of (1) untreated, (2) seed dressing (Dividend), (3) in-furrow application of an unregistered fungicide or (4) tilling to a depth of 10 cm below the seeding depth. The variety used in all 2012 plots was Buloke barley. The first three 2012 treatments were tilled to a depth of the seed using knife-points. All plots were injected with Flexi-N in 2012.

Measurements

Plant emergence counts were conducted on all plots 3-5 weeks after sowing. Forty plants were sampled at tillering (8-10 weeks after sowing) and disease was assessed on a 0-5 root disease severity scale. NDVI were measured using Greenseeker. Patch size in WA trials was estimated for all plots in 2012 only, as in 2011 distinct patching in any trial was not present. At post-anthesis, head/m^2 and plant heights/m^2 were assessed. Plots were harvested and grain yield determined. For the crop rotation and management trial (Katanning), grain yield in 2012 was compromised due to a stampede of 500 sheep.

Inoculum levels of *R. solani* AG8 were assessed using PreDicta-B immediately prior to sowing and at anthesis for all plots in the rotation trial and for only the untreated and highest fungicide rate treatment in the efficacy trials. For the crop rotation trial, soil samples were also collected every 6 weeks over summer 2011-12 until just before sowing.

RESULTS

Vibrance and EverGol Prime efficacy

EverGol Prime and Vibrance have been evaluated as seed treatments to suppress Rhizoctonia in field trials conducted by DAFWA and SARDI in 2011 and 2012 (Table 1). A direct comparison between Evergol Prime and Vibrance cannot be made as they were independent experiments.

EverGol Prime 80 mL/100 kg seed was evaluated only in barley; it increased yield by an average 120 kg/ha or 5.4% (range 4% to 7.2%) across 4 barley trials. The increase was significantly greater than the untreated in the trial at Minnipa in 2011 (Table 1).

Vibrance 360 mL/100 kg seed increased grain yield by an average 80 kg/ha or 5.7% (range 0 to 17.7%) across 8 wheat trials. The responses were significantly greater than the untreated at 2 sites. In barley, the yield increases averaged 0.4% (range -4% to 6%) across 5 barley trials (Table 1).

Table 1. Summary of cereal yield responses to seed dressing treatments with EverGol Prime and Vibrance in 17 Rhizoctonia fungicide efficacy trials conducted by DAFWA and SARDI.

Fungicide	Crop	Site	Year	Yield			
				Untreated (t/ha)	Treated (t/ha)	Net (t/ha)	Per cent
EverGol Prime	barley	Lake Grace, WA	2012	0.78	0.82	0.04	5.1
		Karoonda SA	2012	2.66	2.8	0.14	5.5
		Port Julia SA	2012	2.93	3.05	0.12	4.0
		Minnipa SA	2011	2.64	2.83**	0.19	7.2
			Average	**2.25**	**2.38**	**0.12**	**5.4**
Vibrance	barley	Calingiri, WA	2012	1.18	1.25	0.07	6.0
		Karoonda SA	2012	2.62	2.51	-0.11	-4.0
		Port Julia SA	2012	3.02	2.95	-0.07	-2.5
		Keith SA	2011	2.61	2.7	0.09	3.7
		Minnipa SA	2011	2.93	2.9	-0.03	-1.2
			Average	**2.47**	**2.46**	**-0.01**	**0.4**
	wheat	Lake Grace, WA	2012	0.71	0.80*	0.08	11.6
		Karoonda SA	2012	1.37	1.61*	0.24	17.7
		Port Julia SA	2012	2.88	2.9	0.02	0.9
		Corrigin, WA	2011	2.84	2.84	0.001	0.04
		Ongerup, WA	2011	1.82	1.94	0.12	6.8
		Keith SA	2011	2.70	2.72	0.02	0.7
		Minnipa SA	2011	1.98	2.06	0.08	4.0
		Yumali SA	2011	1.33	1.39	0.06	4.2
			Average	**1.95**	**2.03**	**0.08**	**5.7**

* Significant ($P < 0.05$) or ** Significant ($P < 0.001$), compared to untreated plots

In all DAFWA trials, yield was increased (albeit not significantly) when compared to the untreated plots, this was in spite of the significantly lower rainfall on average during 2011 and 2012 at most WA trial sites as indicated by the low yields (Table 1)

Plants in treated plots were in general more vigorous than in untreated plots as determined from NDVI measurements, but only in the Vibrance at Lake Grace was this significant. Patch size was not significantly reduced in any of the three 2012 trials in WA, although patches were reduced by up to 26% compared to the untreated plots. Root disease at tillering was reduced ($P < 0.1$), compared to the untreated plots, in the trials at Ongerup and Lake Grace. Where Vibrance was applied, reductions of 23 and 30% in disease incidence were observed.

Rotation and management options

Both cereal crops significantly increased the inoculum level of *R. solani* between the pre-sow and the anthesis soil sample in 2011 (Figure 1). Inoculum levels in cereals continued to be significantly higher over summer 2012 compared with those for the canola and fallow plots. At the pre-sow sampling, in early June, barley plots were still significantly higher compared to canola, fallow and wheat plots. In 2012, plots were sown to barley with treatments of in-furrow fungicide injection, Dividend® seed dressing, or cultivation 10 cm below the seed (as detailed above). These 2012 treatments did not have a significant impact on soil DNA levels. However, the 2011 treatments continued to significantly influence the inoculum (DNA) levels until the anthesis sampling in 2012, with 2011 barley plots having significantly higher inoculum levels than 2011 canola or fallow plots (Figure 1).

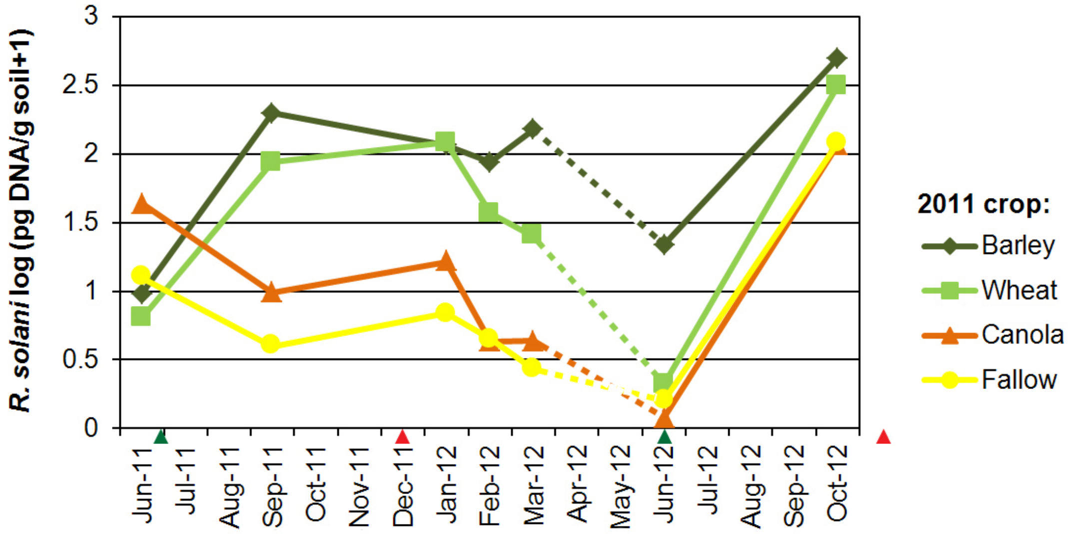

Figure 1. *Rhizoctonia solani* DNA levels in 2011 and 2012 crop rotation plots. All plots were sown to barley in 2012. <u>Note</u> – inoculum levels may have varied between the March 2012 and June 2012 measures following rainfall events in that period. Green triangle: sowing date; Red triangle: harvest date.

In 2012, barley sown on 2011 fallow plots had significantly less root disease at tillering compared to barley sown into the 2011 barley and wheat plots. At anthesis, the barley sown into the 2011 canola plots had significantly reduced root disease compared to the 2011 barley plots. These root disease results for the 2011 rotation treatments are indicative of the DNA levels in the soil for 2012 (Figure 1). The 2012 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 (Figure 2). 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 treatment grain yield obtained when a cultivation below the seed was applied was 11% or 50 kg/ha ($15/ha at $300/t). There have been reports of over 50% improvements when cultivation is used (Jarvis and Brennan, 1986).

CONCLUSION

- 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 to suppress

Rhizoctonia root rot, and will only provide adequate control of this disease when used in conjunction with cultivation and practices which reduce inoculum levels.

- A break crop of canola or chemical fallow, in paddocks with severe Rhizoctonia bare-patch, may reduce Rhizoctonia inoculum levels and reduce disease in the following cereal crop.
- In paddocks with Rhizoctonia, barley will exacerbate the disease substantially compared to other crops.
- Further research on new in-furrow fungicides for Rhizoctonia bare-patch control is planned for 2013 following the promising results during 2011 and 2012 from DAFWA and SARDI trials.

Figure 2. Katanning trial in 2012 which was sown to barley and shows patching attributed to *Rhizoctonia solani*. Red arrow, untreated plot; white arrow, 10 cm below seed cultivation plot.

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KEY WORDS

Rhizoctonia solani, root disease, soilborne pathogen, fungus, crop rotation, seed dressing, tilling.

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