Scald management in barley

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Take home messages

- *Monitor all varieties regularly for scald, regardless of disease ratings.*
- *A new virulent strain infected Hindmarsh crops in 2010. Hindmarsh will be more susceptible to scald in 2011 and will need to be managed accordingly.*
- *Later sown crops are less likely to be infected.*

Background

Scald *(Rhynchosporium secalis)* is a foliar disease that can devastate susceptible barley varieties. The disease can be seed-borne, but is predominately spread from infected stubble onto emerged leaves by wind and rain splash. It is more common in early sown susceptible varieties.

Scald will first appear as "hotspots" on the lower leaves before spreading up the canopy during the season. Yield loss from scald can be up to 50%, and, once the disease is established, it can be very difficult to control.

As is the case with other diseases, varieties differ in their resistance to scald. New varieties, such as Hindmarsh, have shown a good level of resistance, but as the area sown to Hindmarsh increases, new strains of the disease have become apparent. Hindmarsh resistance is likely to fail. This trial investigated the tolerance of five barley varieties to scald and compared the control practices that can be used.

Aim

1. To investigate whether barley varieties vary in their tolerance to scald.
2. To compare different management strategies for controlling scald in different barley varieties.

Method

Two replicated field trials were established in the Wimmera (Lubeck) and southern Mallee (Culgoa) to investigate how varieties differ in their tolerance to scald.. Another field trial was established at Culgoa to compare the management strategies for controlling scald in two barley varieties (Buloke and Hindmarsh).

Location:	Culgoa and Lubeck
Sowing date:	12 May (Culgoa) and 13 May (Lubeck)
Target seeding density:	140 plants/m²
Fertiliser:	50kg/ha MAP (at sowing)
Seeding equipment:	Knife points, press wheels (30cm spacings)

Table 1. Matrix of treatments for the 3 trials.

Trial Name	Varieties	Variables	Location
Scald Management	Hindmarsh Buloke	Nil Seed Dressing In-crop Fungicide *(GS31)* In-crop Fungicide *(GS31+GS37)*	Culgoa
Scald Tolerance	Hindmarsh (MR) Fleet (MR-MS) Buloke (MS) Commander (S) Gairdner (S-VS)	'+scald' (infected straw spread) '-scald' (no straw spread)	Culgoa Lubeck

Both the sites were soil sampled at sowing.

Table 2. Summary of the soil analysis taken prior to sowing.

Analysis	Culgoa	Lubeck
2009 crop	Barley	Oaten Hay
Soil type	Clay Loam	Wimmera Clay
Colwell P (mg/kg)	34	21
Organic Carbon (%)	0.98%	1.44%
Plant available water (mm) (0-100cm)	16	62
Total available N (kgN/ha) (0-100cm)	68	53
pH (water) – topsoil (0-10cm)	8.3	7.2

Scald Tolerance

The trial was sown using a split-plot design with four replicates. The varieties (5) were randomly allocated to main plots and fungicide treatments (2) and randomly allocated to split plots within them. Tilt (500ml/ha) was applied on 22 July, 2 and 22 September to the 'nil scald' plots only.

Roundup PowerMax (2L/ha) and TriflurX (1.5L/ha) was applied 2 hours prior to sowing. Agritone 750 (200ml/ha) + Ally (3g/ha) + wetter was applied on the 27 June for broadleaf control. Plots were top-dressed with 100kg/ha of Urea on the 15 June. 2mm rainfall was recorded at the site on the 18 June and 5mm on 26 June.

Scald Management

Two varieties (Buloke and Hindmarsh) were evaluated to compare how fungicide strategies may differ between varieties. Jockey (167g/L fluquinconazole) was applied to seed 24 hours prior to sowing at 4.5L/t (diluted with 1.5L/t water). Tilt (250g/L of active ingredient) was applied at a rate of 500ml/ha on selected treatments (GS31, GS31+37) on 22 July and 2 September (GS31+37 plot only).

Roundup PowerMax (2L/ha) and TriflurX (1.5L/ha) were applied 2 hours prior to sowing. Agritone® 750 (200ml/ha) + Ally (3g/ha) + wetter was applied on the 27 June for broadleaf control. Plots were top-dressed with 100kg/ha of Urea on the 15 June. 2mm rainfall was recorded at the site on the 18 June and 5mm on 26 June.

An analysis of variance was used to test for significant effects of treatments and interaction between treatments. Least significant differences were calculated at the 95% confidence level.

Results

Scald Tolerance

At the end of August, scald was first observed in low levels at both sites. The disease spread relatively slowly at Culgoa. By the end of October, traces of disease were found throughout 'positive scald' plots, especially Gairdner, but there were no dense hotspots.

At Lubeck, the disease was more uniform between varieties and, in early November, the number of hotspots within the 'positive scald' plots was significant. Disease assessment showed no significant differences between varieties. Generally, applying a fungicide was effective in reducing the severity of the disease and increasing yields (P<0.001) (Table 3).

Table 3. Disease severity (% leaf area affected) of scald at Culgoa and Lubeck.

Variety	Disease severity (%LAA)			
	Culgoa		Lubeck	
	'positive scald'	'nil scald'	'positive scald'	'nil scald'
Hindmarsh	8	1	18	2
Fleet	2	1	10	1
Buloke	8	1	11	1
Commander	8	1	13	2
Gairdner	36	4	18	4
Sig. Diff.	**NS**		**NS**	
	Fungicide			
Mean	**12**	**2**	**14**	**2**
Sig. Diff.	**P<0.001**		**P<0.001**	

Despite the relatively low levels of infection, differences in grain yield were observed (Table 4). All varieties except for Fleet lost yield when scald was not controlled. The remaining varieties all suffered a similar yield penalty with the presence of the disease. It is unknown why there was positive response to not controlling scald in Fleet. This result was not observed at the Lubeck site and is possibly due to other factors.

Table 4. The effect of scald on grain yields at Culgoa.

Variety	Yield (t/ha)		
	'positive scald'	'nil scald'	Difference
Hindmarsh	5.3	5.5	-0.2
Fleet	6.2	5.7	+0.5
Buloke	5.2	5.4	-0.2
Commander	5.5	5.9	-0.4
Gairdner	4.5	4.9	-0.4
Sig. Diff. **LSD (P<0.05)** **CV %**	**P = 0.057** **0.4** **5.4**		

At Lubeck, the number of hotspots were counted in each plot and the area affected was estimated. Hindmarsh had on average 3-4 hotpots per plot, but these hotspots were relatively small. Gairdner and Commander had a similar number of hotspots to Hindmarsh. However the area affected was much greater. In terms of grain yield, the varieties did not significantly differ from each other, though in Hindmarsh, Commander and Gairdner the yield loss appeared to be much greater. Yields varied among varieties and scald treatments, but no interaction was found.

Table 5. The effect of scald on grain yields at Lubeck.

Variety	Average number of hotspots in 'positive scald'*	Yield (t/ha)		
		'positive scald'	'nil scald'	Difference
Hindmarsh	3.5 (34%)	5.0	5.6	-0.6
Fleet	2.8 (16%)	3.9	4.2	-0.3
Buloke	2.6 (35%)	5.0	5.5	-0.5
Commander	3.3 (55%)	4.3	5.4	-1.1
Gairdner	3.5 (57%)	4.5	5.2	-0.7
Sig. Diff.		**NS**		
Variety		**P=0.005 (LSD = 0.6)**		
Fungicide		**P=0.013 (LSD = 0.4)**		
CV %		**12.1**		

**NB: value in brackets represents the percent of plot area affected by hotspots.*

No differences in retention, screenings or test weights were recorded at either site.

Scald Management

It was observed where no fungicide was applied to Hindmarsh that some plots had a greater severity of scald. This is reflected in the higher disease severity in the "nil" plots. All control practices reduced the severity of the disease. No differences were found between the various control practices (Table 6).

Table 6. Disease severity (% leaf area affected) of scald at Culgoa

Treatment	Timing	Disease severity (%LAA)	
		Buloke	Hindmarsh
Nil	-	6	13
Jockey	Sowing	5	1
Tilt (500ml/ha)	GS31	2	1
Tilt (500ml/ha) x 2	GS31+GS37	4	4
Significant Difference		**NS**	
Variety		**NS**	
Treatment		**P=0.044**	
LSD (P<0.05)		**6**	
CV %		**77%**	

At Culgoa, there were no differences between varieties in yield under any of the control practices, nor were there in terms of grain quality (table 7). Interestingly, there was a treatment effect in the disease severity but did not translate to grain yield. Given that scald occurs in hotspots which typically are not uniform, differences may not have been as pronounced in these trials.

Table 7. Grain yields from the various control treatments at Culgoa.

Treatment	Timing	Grain Yield (t/ha)	
		Buloke	Hindmarsh
Nil	-	5.2	4.7
Jockey	Sowing	5.3	4.9
Tilt (500ml/ha)	GS31	5.4	4.9
Tilt (500ml/ha) x 2	GS31+GS37	4.2	4.7
Significant Difference		**NS**	
Variety		**P<0.001**	
Treatment		**NS**	
LSD (P<0.05)		**0.2**	
CV %		**12.1**	

Interpretation

Conditions experienced in June and July were not conducive to severe scald infection. Incidences of scald are usually more common in winters with prolonged leaf wetness or frequent rainfall events. At Culgoa, in both June and July below average rainfall fell, and rain events were infrequent. This is likely to have reduced the incidence of disease at Culgoa, despite infected straw being spread. The Lubeck site was more conducive to the spread of scald, with more frequent rainfall events in winter; possibly the heavier canopy producing a more humid environment was also a factor.

A significant yield loss was measured at both Culgoa (0.30t/ha) and Lubeck (0.65t/ha) when scald was not controlled. Differences between varieties in their tolerance to the disease were not found, despite having different disease ratings. The Lubeck trial experienced severe lodging prior to harvest. This may be attributed to the variation between the treatments, thus reducing confidence in attributing reasons for the differences observed.

We know that controlling the disease early is the key to managing scald. The low level infection at the site, even though infected straw was spread, meant the differences between fungicide timing could not be identified. Given that the mean yield loss from the tolerance trial on the site was found to be 0.3t/ha less than the LSD, it was unlikely we could identify any differences.

The scald resistance present in Hindmarsh is no longer considered effective, due to the emergence of a virulent strain throughout south-eastern Australia. Initially, the virulent strain was restricted in distribution, but it has now become common in barley crops where Hindmarsh was grown in 2009 and 2010. If growing Hindmarsh in 2011, you will need to monitor regularly and apply a fungicide as hotspots develop.

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Management of scald in barley using seed, fertiliser and foliar fungicides

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Take home messages

- *Avoid growing barley varieties that are susceptible to scald*
- *Scald affected 57% of leaf area and caused 0.7t/ha grain yield loss in an experiment at Lubeck in 2010.*
- *Scald can be managed using a combination of seed treatment and foliar fungicides.*

Background

Scald, caused by the fungus *Rhynchosporium secalis,* is an important foliar pathogen of barley. It is found in many barley crops in Victoria and can cause significant grain yield and quality loss where susceptible varieties are grown. Foliar, seed and fertiliser fungicides can be used for scald management by suppressing disease severity. Optimum use of fungicides needs to be determined in order to minimise costs and maximise disease suppression.

Aim

To determine the effectiveness of foliar, seed and fertiliser fungicides, and combinations of these fungicides, for the suppression of barley scald.

Method

An experiment was conducted at Lubeck during 2010 to determine the best methods for managing barley scald in crop. The experiment was sown into a paddock with oat stubble from the previous season to minimise infection from barley diseases other than scald.

Location:	Lubeck
Replicates:	6
Sowing date:	13 May 2010
Crop type:	Yagan barley
Seeding equipment:	Direct drill, tractor mounted cone seeder, 22.5cm row spacing

Seed was sown using a tractor-mounted cone-seeder with plots 8 m x 1.6 m and 6 rows. Weeds were managed as required and no insecticide used. Barley stubble naturally infected with *Rhynchosporium secalis* was applied to the barley plots by hand to establish scald infection.

The barley variety Yagan was chosen because of its susceptibility to scald and effective resistance to spot and net forms of net blotch, leaf rust and powdery mildew. Plots were separated by wheat buffers to minimise inter-plot interference. Seeds were sown at a rate of 70kg/ha with 100kg/ha of MAP fertilizer (N: 10%, P: 21.9%, S: 1.5%) (Incitec Pivot Ltd.). Six treatments were applied (Table 1). The Nil treatment received no disease management. The fertiliser and seed fungicide treatments were applied at recommended label rates. The foliar fungicide treatments consisted of propiconazole at 250ml/ha as Tilt 250EC applied with a utility-mounted boom at 40 psi. Treatments were arranged in randomised complete blocks with six replicates.

Table 1. Treatment details for scald fungicide experiment at Lubeck in 2010.

Treatment	Description/product	Method/timing	Rate
1. Nil	No disease management	NA	NA
2. Fertiliser	Impact in-furrow (flutriafol)	Applied to fertiliser	400ml/100kg
3. Seed	Jockey (fluquinconazole)	Applied to seed	450ml/100kg
4. Seed and Foliar (double)	Jockey and propiconazole	Applied to seed, Z39 and Z55 250ml/ha	450ml/100kg, 250ml/ha and
5. Foliar (double)	propiconazole	Z39 and Z55	250ml/ha
6. Foliar (triple)	propiconazole	Z25, Z39 and Z55	250ml/ha

Disease severity (% leaf area affected) was visually estimated twice on the top three leaves of ten arbitrarily selected tillers in each barley plot.

Barley plots were harvested at maturity and grain weighed to determine yield. A sub-sample was retained to determine grain screenings, retention and 1000 grain weight.

Results

A severe scald epidemic developed in the untreated (Nil) plots with up to 57% of leaf area affected on the top three leaves and 0.7t/ha grain yield loss recorded (Table 1). This illustrates the risk associated with growing barley varieties that are very susceptible to scald and why they should be avoided.

Three applications of foliar fungicide or a combination of a seed treatment (Jockey) and two foliar fungicide applications provided the greatest reduction in scald severity. They also provided a significant increase in grain yield of between 0.6-0.7t/ha.

Two applications of foliar fungicide also provided significant reductions in scald severity but did not significantly increase grain yield above the control.

Application of the seed treatment (Jockey) on its own provided some reduction in scald severity but did not improve grain yield.

The fertiliser treatment fungicide (Impact in-furrow) did not reduce scald severity or increase grain yield.

Grain quality was not affected by scald infection at Lubeck in 2010 due to the exceptionally wet finish to the growing season which allowed good grain fill.

Table 2. Percentage leaf area affected by scald on the top three leaves, grain yield and grain quality of barley varieties. Yagan in response to foliar fungicide, seed and fertiliser treatment at Lubeck in 2010.

Treatment	Scald severity (%LAA) 11/10/2010	Yield (t/ha)	Retention (%>2.5%)	Screenings (%<2.2mm)
Foliar fungicide (propiconazole) @ Z25+Z39+Z55	0.4	3.9	97	2
Jockey + foliar (fluquinconazole + propiconazole) @ Z39 and Z55	1.6	3.8	95	1
Foliar fungicide (propiconazole) @ Z39+Z55	4.2	3.5	97	1
Jockey (fluquinconazole)	43.8	3.4	96	1
Impact Infurrow (flutriafol)	54.9	3.1	96	1
Nil	57.6	3.2	96	2
P-Value=	**<0.001**	**0.017**	**0.488**	**0.765**
LSD (P=0.05)	**5.4**	**0.5**	**ns**	**ns**

Interpretation

The sustained cool, wet weather during the 2010 growing season was exceptionally favourable for the development of barley scald.

This experiment determined that three applications of foliar fungicide or a combination of a seed treatment and two applications of foliar fungicide provided the greatest reductions in scald severity and improved grain yield.

The effectiveness of each of these methods relies upon fungicides being applied at critical stages in development of a disease epidemic. Seed treatments will provide reductions in scald severity in the early stages of crop development, while application of foliar fungicide will be most effective if applied before infection becomes severe.

Fertiliser treated with fungicide was not effective in this experiment and therefore is not likely to be a good management strategy for barley scald.

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