Stem rust control in wheat



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Take home messages

- In a stem rust outbreak, fungicide is best applied before infection of the crop is visible.
- In years with a very late outbreak of stem rust and with crops at advanced stage of grain fill (GS77 late milky dough) even if infected with stem rust, it is highly unlikely that the use of fungicides will result in improved yields.
- To give effective control against stem rust, the higher rates of fungicide recommended on the label should be applied.
- The most effective products for control of stem rust were Opus, Folicur and Prosaro in this trial.
- The performance of propiconazole against stem rust was poor.

Background

Stem rust in wheat (Puccinia graminis f.sp. tritici) was first reported in the southern Mallee by BCG on 1 November 2010, when most crops in the region had finished flowering and were at varying stages of grain fill.

Two trials were set up to investigate the economics and performance of foliar fungicides designed to combat stem rust. This was part of a nationally co-ordinated project funded by the GRDC to gather more data on both the efficacy and economics of spraying for stem rust. There has been a large increase in the number of fungicide products available to cereal growers since the last major outbreak of stem rust in 1973 and little or no field experience is recorded to help choose the best product or rate. Though an outbreak occurred in SA in 2006, the severe drought experienced that season reduced the impact of the disease.

Aim

To evaluate the efficacy of different foliar fungicides against stem rust (*Puccinia graminis f.sp. tritici*) in wheat. To account for possible shortages in foliar fungicide supply, products were tested over as wide a rate range as possible. (N.B. use of products and rates lower than label rates in this trial do not constitute a recommendation).

Method

Two trials were set up in the Mallee.

Trial 1 was established in an unsprayed commercial crop of Yipti (S - susceptible rating for stem rust) near Quambatook.

Treatments outlined in Table 1 were sprayed at the end of flowering (GS69) on 27 October 2010, before any infection was recorded.

Table 1. Fungicide treatment and application rate for Trial 1 at Quambatook. Label rates for stem rust controls are highlighted (N.B. Amistar Xtra is not registered for stem rust control in Australia).

Trt	Fungicide treatment and rate	Rate description	Active ingredient	
1.	Prosaro [®] 420SC 75 ml/ha + Hasten 1%	Low	Prothioconazole +	
2.	Prosaro 420SC 150ml/ha + Hasten 1%	Mid	Tebuconazole	
3.	Prosaro 420SC 300ml/ha + Hasten 1 %	High		
4.	Opus® 125SC 125 ml/ha	Low	Epoxiconazole	
5.	Opus 125SC 250 ml/ha	Mid		
6.	Opus 125SC 500ml/ha	High		
7.	Amistar Xtra® 280SC 200 ml/ha	Low	Azoxystrobin +	
8.	Amistar Xtra 280SC 400 ml/ha	Mid	Cyproconazole	
9.	Amistar Xtra 280SC 800 ml/ha	High		
10.	Tilt® 250EC 125 ml/ha	Low	Propiconazole	
11.	Tilt 250EC 250 ml/ha	Mid		
12.	Tilt 250EC 500 ml/ha	High	-	
13.	Tilt Xtra® 330EC 125 ml/ha	Low	Cyproconazole +	
14.	Tilt Xtra 330EC 250 ml/ha	Mid	Propiconazole	
15.	Tilt Xtra 330EC 500 ml/ha	High	-	
16.	Folicur [®] 430SC 72.5 ml/ha	Low	Tebuconazole	
17.	Folicur 430SC 145 ml/ha	Mid	-	
18.	Folicur 430SC 290 ml/ha	High	-	
19.	Opera [®] 147SC 250 ml/ha	Low	Pyraclostrobin +	
20.	Opera 147SC 500 ml/ha	Mid	Epoxiconazole	
21.	Opera 147SC 1000 ml/ha	High		
22 to 24	Untreated			

Trial 2, at Corack, was laid out in the same way as trial 1 but with only three products applied at three rates. The trial also included an untreated control (Table 2). The crop was sprayed at the late milky ripe stage (GS77) on 5 November 2010, when 60% of stems already showed some sign of infection.

Table 2. Fungicide treatment and application rate for Trial 2 at Corack. Label rates for stem rust control are highlighted (note: Amistar Xtra is not registered for stem rust control in Australia).

Trt	Fungicide treatment and rate	Rate description	Active ingredient	
1.	Prosaro 420SC 75 ml/ha + Hasten 1%	Low	Prothioconazole +	
2.	Prosaro 420SC 150ml/ha + Hasten 1%	Mid	Tebuconazole	
3.	Prosaro 420SC 300ml/ha + Hasten 1 %	High		
4.	Amistar Xtra 280SC 200 ml/ha	Low	Azoxystrobin + Cyproconazole	
5.	Amistar Xtra 280SC 400 ml/ha	Mid		
6.	Amistar Xtra 280SC 800 ml/ha	High		
7.	Folicur 430SC 72.5 ml/ha	Low	Tebuconazole	
8.	Folicur 430SC 145 ml/ha	Mid		
9.	Folicur 430SC 290 ml/ha	High		
10 -12.	Untreated			

All products were applied with a hand boom applied at walking pace (4 - 5 km/hr) according to the details outlined in Table 3.

Trial site	Application date	Growth stage	Water rate (l/ha)	Nozzles & pressure
Trial 1 Quambatook	October 27	GS69 (end of flowering)	160	DG 110-02, 2.0 bar
Trial 2 Corack	November 5	GS77 (late milky ripe)	160	DG 110-02, 2.0 bar

Table 3. Application details (date, growth stage, water rate and nozzle settings).

Stem rust was assessed 7, 14 and 25 – 26 days after application. Ten stems were sampled randomly from each plot (40 stems per treatment) and percentage of stem rust incidence and severity was assessed on different sections of the stem: ear, peduncle (stem below the ear), flag leaf, flag leaf sheath, flag-1, flag-1 sheath and flag-2 sheath using the USDA scale (the USDA scale is a widely accepted scale for assessing rust incidence and severity).

Results

Trial 1. Quambatook: Spraying before infection

In this trial, fungicides were applied before infection was observed. Stem rust developed to low levels after fungicide was applied. In untreated plots, stem rust reached 83% incidence (% stems infected) and just over 3% severity (% leaf area affected) on the leaf sheath by physiological maturity (GS89 – 90). The leaf sheath displayed the highest infection of all plant parts assessed and results are presented in Figure 1. The trial was also subject to low levels of leaf rust. However, the disease became less important as the leaves and lower leaf sheathes senesced.



Figure 1. Stem rust development (% incidence and severity) on the flag sheath of the untreated crop 0, 7, 14 and 25 days following trial treatment application, Quambatook. NB: incidence is the % of stems infected; severity is the % of flag sheath area affected by disease.

Influence of fungicide product and rate on stem rust incidence and severity

- All fungicides improved control of stem rust as the rate of active ingredient increased (Table 3).
- At the low rate (72.5ml/ha) Folicur did not significantly reduce the incidence of stem rust below that of the untreated control. However, control of the disease was improved significantly by increasing the rate to 145 or 290ml/ha.
- Increasing the rate of Tilt did little to reduce the incidence of stem rust with 58% of leaf sheaths showing signs of the disease at the highest rate compared with 60% at the low rate. The addition of cyproconazole to propiconazole in Tilt Xtra gave improved control of stem rust, particularly at the high rate of 500ml/ha. (N.B. 500ml/ha is the registered rate for Tilt and Tilt Xtra for stem rust).
- Increasing the rate of Prosaro gave significantly better control than at the low rate. Prosaro is registered at 150-300ml/ha for stem rust control and in this trial the 150ml/ha rate performed equivalently to the 300ml/ha rate.
- Opus gave the greatest control at the highest rate of 500ml/ha (label rate).
- Opera is Opus + pyraclostrobin but, in this trial, the extra ingredient did not improve control of stem rust above Opus.
- Amistar Xtra gave the best control of stem rust at the highest rate applied, with only 10% of stems detected with the disease.

Table 3. Influence of fungicide product on incidence (% of leaf sheaths with infection) and severity (% of assessed leaf area infected) of stem rust on the flag sheath at the three application rates tested 25 days after application (25 DAA) – GS89-90 (physiological maturity) 27 November 2010.

	% Stem rust infection on flag leaf sheath					
Fungicide	Low rate		Mid rate		High rate	
treatment	% incidence	% severity	% incidence	% severity	% incidence	% severity
Prosaro	53	0.7	23	0.4	20	0.5
Opus	65	1.3	43	0.8	28	0.5
Amistar Xtra	45	1.4	35	0.4	10	0.1
Tilt	65	2.5	60	1.7	58	1.5
Tilt Xtra	50	1.7	40	0.7	20	0.4
Folicur	93	3.1	55	1.5	38	1.0
Opera	60	1.2	58	1.6	40	0.8
Untreated	83	3.2				
Sign. Diff. Trt. at same rate	f. P<0.05, LSD: Incidence 23% P<0.05, LSD: Severity 0.9%					

Influence of fungicide product and rate on yield and margin

There was a significant yield difference between the untreated control and fungicide application at the high rate for Prosaro, Opus, Amistar Xtra, Folicur and Opera (Figure 2). There was no significant difference in yield for Tilt and Tilt Xtra from the untreated control, even though Tilt Xtra reduced the incidence and severity of stem rust significantly.



Figure 2. Wheat yield for the untreated control and the high rate of applied fungicide. Bars with the same letter are not significantly different from each other. The hatched bars represent fungicide use which is not registered for the use of stem rust.

As a result of these significant differences in yield, the margin return also differed between treatments (Table 4).

Table 4. Cost of fungicides used and margin over untreated, at the high rate of application. (N.B. Grain price \$317/t; 2.5% wheel damage was subtracted from the treated yield; shaded fungicides are registered for use in Victoria.)

Product at High rate of application	Cost \$/ha	Margin \$/ha
Control	0	0
Prosaro 300 ml/ha + Hasten 1%	21.8	98
Opus 500 ml/ha	18	70
Amistar Xtra 800 ml/ha	44	41
Tilt 500 ml/ha	8.8	17
Tilt Xtra 500ml/ha	20	19
Folicur 290 ml/ha	6.1	98
Opera 1000 ml/ha	36	37

Trial 2. Corack: Spraying after infection

In this trial, fungicides were applied when just over 60% of flag leaf sheaths showed infection at GS77 (a later growth stage than trial 1). The disease increased very rapidly, to the extent that, at physiological maturity (GS89-90), 35% of the flag leaf sheath area was affected by the disease where no fungicide had been applied (Figure 3). The peduncle (area immediately below the head) was also affected by disease in this trial with 31% area affected at maturity.



Figure 3. Stem rust development (% incidence & severity) on the flag sheath of the untreated crop 0, 7, 14 and 26 days following trial treatment application at Corack.

Influence of fungicide product and rate on stem rust severity

In comparison with the Quambatook trial, where sprays were applied before infection, at Corack the levels of control achieved with the high rates of fungicide were much lower when applied after infection had already taken hold. Increasing the rate of the three fungicides did not significantly reduce the severity of the disease. The only significant difference in this trial was that the high rate of Prosaro was more effective in reducing stem rust infection when compared with the low rate of Folicur (Table 5).

Table 5. Influence of fungicide product and rate on stem rust disease severity (% of assessed leaf area with stem rust necrosis) on the flag sheath at the three application rates tested 26 days after application (26 DAA), GS89-90 (physiological maturity), 2 December 2010.

Fungicide	% Stem rust infection on flag leaf sheath			
treatment	Low rate % Severity	Mid rate % Severity	High rate % Severity	
Prosaro	18	17	11	
Folicur	28	22	21	
Amistar Xtra	17	20	17	
Untreated	36			
Sign. Diff. Trt. at same rate		P<0.05, LSD: 9%		

Effect of fungicide on yield

There was no significant difference in yield from fungicide application after the disease had already infected the crop at Corack. It was uneconomic to apply fungicides in this trial.

Interpretation

These results support the few previous studies which indicate that, in order to protect the upper parts of the plant (flag leaf and sheath, peduncle and ear), fungicides need to be applied before these plant parts show appreciable levels of infection. In addition, where this has not been possible and the crop is at an advanced stage of grain fill (early dough stage onwards), response to fungicide appears highly unlikely.

At Corack, fungicides were not applied until after the disease had taken hold and at a late growth stage (GS77). There was little or no benefit to applying any of the fungicides at this site. By comparison, at Quambatook fungicides were applied before the disease was observed in the crop and most products were able to reduce stem rust infection compared with the untreated control.

At Quambatook, the highest rates of active ingredient were most effective for the control of this disease, being significantly superior to the intermediate and lower rates.

Folicur was widely used for stem rust control this season in the Mallee and these results show it to be effective at the label rate of 290ml/ha. However, the trials showed that Tilt was not very effective for stem rust control and produced lower levels of disease control when compared with other fungicides, even at the highest rates (the recommended label rate for stem rust being 500ml/ha).

The three formulated mixtures Amistar Xtra, Prosaro and Tilt Xtra gave very effective stem rust control.

In commercial crops of Yitpi (and other varieties susceptible to stem rust) if a stem rust outbreak is detected in 2011, the following is necessary for effective response from fungicide:

- a) Spray when the disease is first detected in the district don't wait until it is observed in your crop.
- b) Do not apply fungicides to advanced crops ie. if infection is detected and your crop is already at late-milk (GS77) or further advanced.

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