Fungicide strategies in wheat

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The following trial is part of a GRDC funded project (SFS 00006) examining the role of disease management and canopy management in cereal crops of southeast Australia. The trial had the aim of examining the value of foliar fungicides in the Mallee and Wimmera.

Summary

- For the second year in succession there was no response to foliar fungicides in the Mallee trial on wheat, water stress leading to poor canopy size preventing disease build up and reducing yield potential (yield range 0.68-0.82 t/ha).
- In the equivalent trial in the Wimmera at Lubeck using the same variety as in the Mallee (Mitre rated moderately susceptible to stripe rust) there were significant yield increases from applying fungicides for stripe rust control, with data showing greater benefits from a two spray approach rather than a one spray program.
- a two spray approach targeting disease build up pre flag leaf emergence (despite incurring an extra application cost) was more cost effective than a 1 spray program at flag leaf, provided the cost of each fungicide was low.
- For the Wimmera region the fickle nature of the climatic conditions during grain fill dictate that foliar fungicide choice has to be based on minimal cost (eg low cost triazole options), there is no evidence at present from the project that the more expensive strobilurin fungicides have a place in wheat in the Wimmera.

Background

With the large majority of wheat cultivars now deemed to be susceptible to stripe rust, in particular the new WA pathotype, this trial was set up to look at economic response to different foliar fungicide timings. In addition the trial continued the evaluation of the strobilurin fungicides, the first of which (Amistar Xtra) was registered for broad acre cereals in Australia in August 2004.

The 2003 trial results from this project showed that the strobilurins were most likely to have a greater effect on disease than the cheaper triazoles such as Bumper/Tilt where disease protection was required beyond the 4 weeks given by the triazoles, i.e. in longer season, high rainfall regions. The effectiveness of strobilurin fungicides has been associated with prolonged disease protection and associated green leaf retention. In those wheat trials in the mallee last season, based on untreated yields of 2.5t/ha, there was no yield advantage from applying a fungicide including strobilurins and the older triazole materials (trial based on cv Wylkatchem with no disease reported). In the Wimmera, with an untreated yield of 3.13 t/ha and stripe rust infection from ear emergence onwards, the response to fungicide averaged 2% with a range from minus 4% to plus 5%.

In 2004 the aim was to repeat this work using the moderately susceptible variety Mitre.

Methods

Mallee - Birchip

Mitre wheat was sown dry on 17th May 2004 at the main Birchip trial site. The planting population target was 175 plants/m^2. The crop was top dressed with Urea 60 kg/ha (28 kg/ha N) on the 12th August and then again on 31st August. Water stress was a constant feature of this trial being acute at the end of May and then from mid August onwards. With little rainfall in September and October crop canopy was severely reduced and traces of stripe rust in the untreated plots did not develop to assessable differences.

Fungicides were targeted at 4 different timings, GS32 (second node –flag minus 2 emerging), GS33 (third node – flag leaf minus 1 emerging), GS39 (flag leaf emergence) and ear emergence 59. The actual dates of application 2nd August (GS30-31), 4th August (GS31), 16th September (GS39) and 13th October (GS59-69). The treatments are listed in Table 1.

Wimmera - Lubeck

Despite the late break and later sowing on June 12th, stripe rust became evident in the Wimmera trial at early stem elongation GS31-32. Fungicides were applied very close to the target dates outlined for the Mallee site, though the later two applications were slightly later than planned. Fungicides were applied on September 15th (GS32 – second node), September 21st (GS33 - third node), 8th October (GS43/45 - flag leaf sheath extending) and 14th October (GS61- 65 flowering). Treatments were applied as per Table 1.

Table 1. Products, rates and timings for foliar fungicide evaluation

Trt No	Fungicides (ml/ha) and Timing GS32 (second node, flag minus 2 emerging)	GS33 (second node, flag minus 21 emerging)	GS39 (Flag leaf emerging)	GS59-69 (ear emergence)
1.	----	----	Folicur 145	----
2.	----	----	Folicur 145 +Az 250	----
3.	----	----	Folicur 145 +Az 500	----
4.	----	----	Folicur 145 +Az 1000	----
5.	----	----	Amistar Xtra 625	----
6.	----	----	Opus 250	----
7.	Folicur 145	----	Folicur 72.5	----
8.	Folicur 72.5 +Az 125	----	Folicur 72.5 +Az 125	----
9.	Folicur 72.5 +Az 250	----	Folicur 72.5 +Az 250	----
10.	Folicur 72.5 +Az 500	----	Folicur 72.5 +Az 500	----
11.	Amistar Xtra 312.5	----	Amistar Xtra 312.5	----
12.	Opus 125	----	Opus 125	----
13.	----	Folicur 145	----	Folicur 145
14.	----	Folicur 72.5 +Az 125	----	Folicur 72.5 +Az 125
15.	----	Folicur 72.5 +Az 250	----	Folicur 72.5 +Az 250
16.	----	Folicur 72.5 +Az 500	----	Folicur 72.5 +Az 500
17.	----	Amistar Xtra 312.5	----	Amistar Xtra 312.5
18.	----	Opus 125	----	Opus 125
19.	Untreated			
20.	Untreated			

Note: applied timings at Lubeck were slightly different to target timings at the Birchip site.

Explanatory notes on new fungicides: AZ = Amistar® 250 SC contains 250g/l azoxystrobin, thus 500ml/ha applies 125g/ha active ingredient. Folicur® contains 430g/l tebuconazole, thus 145 ml/ha applies 62.5g/ha active ingredient. Opus® contains 125g/l epoxiconazole, thus 250ml/ha applies 31g/ha active ingredient. Amistar Xtra® contains 200g/l azoxystrobin and 80g/l cyproconazole thus at 625 ml/ha applies 125g/ha azoxystrobin active ingredient and 50g/ha cyproconazole active ingredient.

Results

There were no assessable differences in disease at the Birchip site and despite the presence of stripe rust in the untreated; the results (Table 2) are a reflection of the water stress in the trial rather than of any fungicide effects.

Table 2. Birchip, Mallee - The influence of fungicide application at various rates and timings on yield (t/ha & % control) and quality (% Protein & % Screenings <2.2mm)

Product	**Applic'n timing**	**Rate**	**Yield & % control**		**Grain Quality**	
	GS	**(ml/ha)**	**t/ha**	**%**	**Protein**	**Screen**
Folicur	GS39	145	0.73	96	16.8	10
Folicur + Amistar	GS39	145+250	0.75	99	16.4	10
Folicur + Amistar	GS39	145+500	0.73	96	16.7	11
Folicur + Amistar	GS39	145+1000	0.78	103	16.3	7
Amistar Xtra	GS39	625	0.78	103	16.5	10
Opus	GS39	250	0.77	101	16.8	11
Folicur	GS32+39	72.5 x2	0.68	90	17.1	10
Folicur + Amistar	GS32+39	72.5+125 x2	0.69	91	16.5	8
Folicur + Amistar	GS32+39	72.5+250 x2	0.72	95	16.5	10
Folicur + Amistar	GS32+39	72.5+250 x2	0.74	97	16.7	10
Amistar Xtra	GS32+39	312.5 x2	0.70	92	16.9	11
Opus	GS32+39	125 x2	0.79	104	16.8	11
Folicu	GS33+59	72.5 x2	0.70	92	16.5	10
Folicur + Amistar	GS33+59	72.5+125 x2	0.82	108	16.8	8
Folicur + Amistar	GS33+59	72.5+250 x2	0.74	97	16.6	9
Folicur + Amistar	GS33+59	72.5+250 x2	0.76	100	16.6	9
Amistar Xtra	GS33+59	312.5 x2	0.74	97	16.9	8
Opus	GS33+59	125 x2	0.75	99	16.7	10
Untreated	-	-	0.76	100	16.6	11
LSD (5%) – (trt v trt)			**0.11**			
LSD (5%) (trt v control)			**0.10**		**4.8**	**9.4**

At the Wimmera site at Lubeck there were clear differences observed in stripe rust control and green leaf retention due to timing and fungicide product, these resulted in significant yield benefits of 3-11% (Table 3). Growing season rainfall at the site was well below the average of approximately 320mm with 210mm falling between April and October. The site was under severe moisture stress from mid September until early November with only 7.5mm falling in October

Table 3. Lubeck, Wimmera - The influence of fungicide application on yield (t/ha & % control), % stripe rust infection at flag leaf emergence and % green leaf area at flowering

Product	**Applic'n timing**	**Rate**	**Yield % control**		**% leaf affected by Stripe rust GS45**		**% Green leaf area GS69**	
	GS	**(ml/ha)**	**t/ha**	**%**	**Leaf 2**	**Leaf 3**	**Flag**	**Leaf 2**
Folicur	GS43	145	2.71	103	----	----	88	51
Folicur + Amistar	GS43	145+250	2.85	109	----	----	86	43
Folicur + Amistar	GS43	145+500	2.76	105	----	----	82	40
Folicur + Amistar	GS43	145+1000	2.81	107	----	----	80	46
Amistar Xtra	GS43	625	2.77	106	----	----	86	51
Opus	GS43	250	2.70	103	----	----	81	41
Folicur	GS32+43	72.5 x2	2.92	112	0.6	1.1	93	64
Folicur + Amistar	GS32+43	72.5+125 x2	2.81	107	0.2	0.3	94	69
Folicur + Amistar	GS32+43	72.5+250 x2	2.81	107	0.4	0.2	92	58
Folicur + Amistar	GS32+43	72.5+250 x2	2.90	111	0.4	0.3	92	61
Amistar Xtra	GS32+43	312.5 x2	2.84	108	0.2	0.1	95	65
Opus	GS32+43	125 x2	2.87	110	0.3	0.1	94	63
Folicur	GS33+59	72.5 x2	2.79	107	1.3	7.2	95	70
Folicur + Amistar	GS33+59	72.5+125 x2	2.86	109	0.2	3.1	93	68
Folicur + Amistar	GS33+59	72.5+250 x2	2.91	111	0.7	3.9	94	68
Folicur + Amistar	GS33+59	72.5+250 x2	2.88	110	0	1.9	93	73
Amistar Xtra	GS33+59	312.5 x2	2.90	111	0.2	2.5	94	69
Opus	GS33+59	125 x2	2.86	109	0.3	3.5	95	72
Untreated	-	-	2.62	100	6.7	13	85	42
LSD (5%) (trt v trt)			**0.14**					
LSD (5%) (trt v control)			**0.12**				**3.3**	**9.4**

Interpretation

At the Wimmera site the low spring rainfall combined with frost and heat stress during October reduced potential yields. It also dramatically reduced the stripe rust inoculum (that was evident from GS32 -second node) and the subsequent yield responses from fungicides.

Figure 1. Mean yield response (6 fungicide treatments) from same level of active ingredient applied in differently timed 1 & 2 spray programs – Lubeck, Wimmera cv. Mitre

Despite these conditions there was a significant yield benefit from fungicide application (0.1% significance) with a significant advantage (0.1% significance) associated with applying the same amount of active ingredient in two sprays rather than one. On average there was a 9.1% (0.24 t/ha) yield benefit from applying 2 sprays of fungicide at GS32 & 43 and an average of 9.4 % (0.25 t/ha) yield benefit with GS33/59 2 spray programmes. If the same amount of active was applied as a single application at GS43 the benefit was reduced to 5.6%. (0.15 t/ha) (Figure 1.)

Whilst there was a statistically significant benefit to fungicides over the untreated, there was no additional yield effect from strobilurin fungicides over the triazoles (Folicur and Opus), from either the addition of Amistar or Amistar Xtra alone. However, the addition of Amistar to Folicur had significantly greater impact at the GS33/59 timings than the GS32/43 timings. There was a correlation between green leaf area at flowering and yield ($r^2 = 0.64$ on leaf 2) but this again did not show any additional benefit to strobilurin addition.

Where stripe rust was left to develop from GS32 to GS43 there was approximately 15% leaf area loss on leaf 3 and 7% on leaf 2 by the time flag leaf was fully emerged. Where stripe rust was left uncontrolled until GS43 (4 days after flag leaf emergence on the main stem) it also correlated to inferior green leaf retention at flowering/grain fill. Thus there was already green leaf loss on leaf 2 and 3 by the time the single flag leaf application was applied.

At the Birchip site fungicides applied to water stressed plants with low levels of stripe rust showed no benefit to fungicide application in terms of yield or quality.

At Lubeck, whilst there were clear links between fungicide application, resultant disease control and yield, the value of those yield increases in absolute terms was relatively small. Thus yield increases of 0.15-0.3 t/ha do not pay for much fungicide input, particularly when application cost is taken into account. If one assumed a value for wheat of $150/tonne then Figure 2 illustrates the net margin $/ha after input application costs for the Folicur and Amistar Xtra treatments.

Clearly Figure 2 illustrates that whilst fungicides produced yield increases the relative income benefit was quickly nullified if the input cost was too high.

The main conclusions one can draw from this work is that with a moderately stripe rust susceptible variety such as Mitre in the Wimmera, it is cost effective to control stripe rust before flag leaf if stripe rust comes into the crop at early stem elongation (GS31-32), however the fickle nature of the climatic conditions during grain fill dictate that foliar fungicide choice has to be based on minimal cost, i.e low cost triazoles such as triadimefon (e.g.Triad or Turret) or reduced rate triazoles such as tebuconazole or propiconazole. From two seasons work there is no evidence from the project trials to support the use of strobilurin fungicides such as Amistar Xtra in wheat in the Wimmera region.

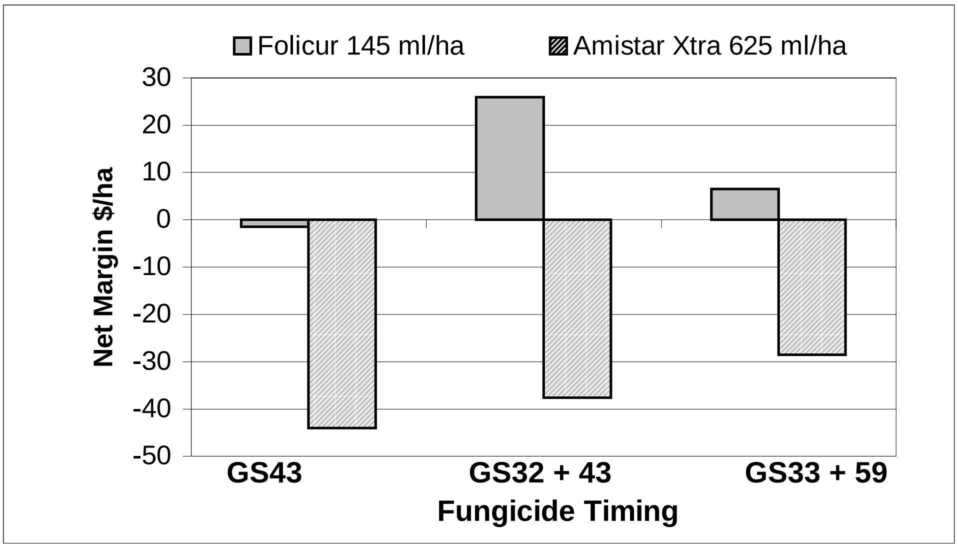

Figure 2. Net Margin $/ha for different spray programmes of Folicur and Amistar Xtra (applying the same amount of active ingredient) relative to the untreated after product and application costs have been applied – Lubeck, Wimmera cv Mitre.

Note: Folicur 145ml/ha costed at $11/ha, with Amistar Xtra 625ml/ha at $62.5/ha. Application cost based on boom spraying was costed at $4/ha (average farmer cost).

There was no value from the use of foliar fungicides in the Mallee trials at Birchip, which suggests that expenditure on these inputs should be primarily based on a wait and see approach, conditions for grain fill and overall yield potential being such that fungicide can rarely be justified in this environment.

Commercial Practice

In both the Mallee and Wimmera grow wheat varieties with a minimum of MS (moderately susceptible) rating to stripe rust.

Stripe rust in the Mallee: wait and see what develops and only apply a fungicide if disease is rapidly spreading through the crop.

Stripe rust in the Wimmera: apply a triazole fungicide when the disease is first observed and be prepared to protect the flag leaf if the disease persists or re-appears at this stage.

Stripe rust can be controlled cost effectively with triazole fungicides (triadimefon, propiconazole, tebuconazole). At this stage the use of more expensive strobilurin fungicides is not cost effective in the Wimmera or Mallee.