Managing Yellow Leaf Spot

with Fungicide and Genetic Resistance

July 2014

Can it be managed?

Yellow Leaf Spot (YLS) is a rain dispersed, stubble borne fungal disease that occurs predominantly when wheat is grown in short rotation, particularly in a wheat on wheat situation. Yield losses are generally less than 15% but can be much higher in favourable conditions[1,2]. Although there are fungicides registered for YLS control, will using these produce a measurable yield improvement? If there is a yield increase, will it be economic or is it just a 'feel good' exercise? How does the resistance or susceptibility of a variety influence the response to the fungicide?

Yellow leaf spot infection present on wheat at GS39.

What did we do?

As part of the SA Grain Industry Trust Fund (SAGIT) and Australian Grain Technologies (AGT) ongoing investigation into the effect fungicides have on the productivity and profitability of individual varieties, a trial was conducted in 2013 near Rudall on the Eyre Peninsula, SA. YLS infection was high from 2012 wheat stubble and no rust was present, so we were able to effectively investigate the role of fungicide application and genetic resistance in YLS control.

Sixteen fungicide treatment regimes were applied to five wheat varieties, chosen to include a range in resistance to YLS (Table 1). The fungicide treatments combined seed coating and foliar spray applications at three growth stages: GS31 (1st node detectable), GS39 (flag leaf fully emerged) and GS69 (completion of anthesis), and an untreated control. Although fungicide treated fertiliser (eg. Impact) was the preferred option, Jockey Stayer seed treatment was used instead due to logistical limitations associated with trial management. Propiconazole 250g/L applied at 500ml/ha was used for the foliar spray treatments. All plots were monitored for disease, and scored for YLS at two growth stages, GS39 and GS69.

Table 1. YLS resistance ratings of wheat varieties used in the trial.
Source: SARDI Cereal Variety Disease Guide 2014.

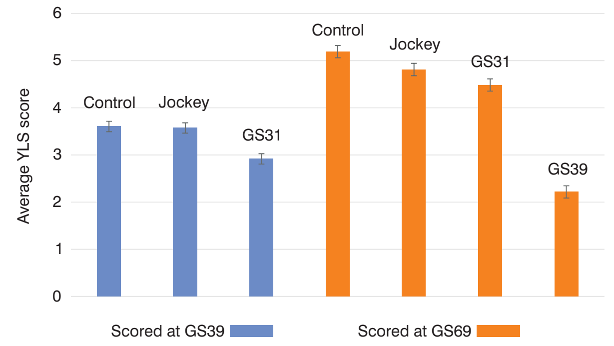
Variety	Corack⌽	Mace⌽	Shield⌽	Grenade CL Plus⌽	Scout⌽
YLS resistance rating	MR	MR-MS	MS-S	S	S-VS

MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible, VS=Very Susceptible

What happened?

The first visual scores for YLS damage were taken four weeks after the GS31 foliar application (when plants were at approximately GS39). Those plots sprayed at GS31 had less YLS damage than the Jockey treated and untreated plots. When flag leaf damage was scored four weeks after the GS39 spray (at GS69), the advantage of the GS31 spray had been reduced, while those sprayed at GS39 had significantly less flag leaf damage than all other plots

Figure 1. Average YLS score for all varieties scored at GS39 and GS69 (1=lowest level of infection, 9=highest level of infection).



(Figure 1). This suggests that Propiconazole fungicide may only be active up to approximately four weeks after application, which is consistent with label recommendations and GRDC information[1]. Therefore, a second foliar treatment may be required to ensure effective control of YLS, particularly in extended damp conditions.

Most of the fungicide treatments resulted in a positive effect on either yield, test weight or screenings; and in general, the inclusion of Jockey improved the effect of subsequent foliar treatments. However, using Jockey on seed with no follow up foliar application, using a single foliar treatment at GS69, and combining these two treatments all showed negligible positive effect (data not shown).

Figure 2. Average effect of fungicide application on grain yield.

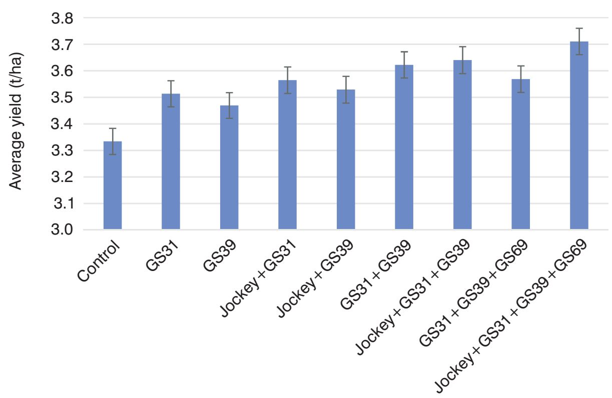


Figure 2 displays treatments that produced significant yield advantage over the control. Yield improvement was seen after applying a single foliar application at either GS31 or GS39, however the best yield response was from plots that received the complete regime of four treatments, yielding on average 377kg/ha higher than the un-treated control.

Figure 3. Average effect of fungicide application on test weight and screenings.

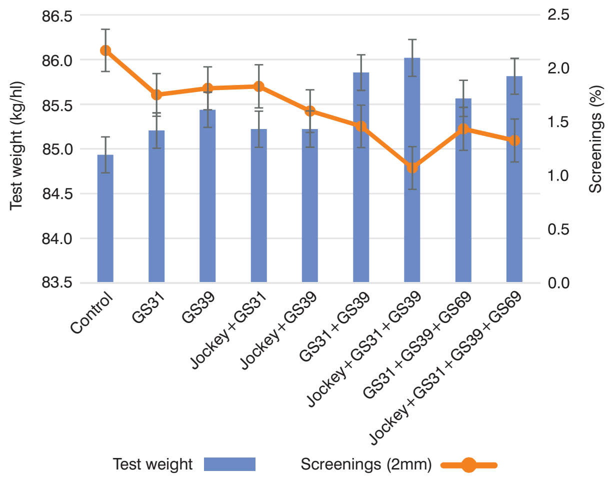


Figure 3 shows that many of the fungicide treatments increased test weight and decreased screenings compared to the untreated control. The greatest positive response to both test weight and screenings was observed in the treatment regimes that included two foliar applications, (at GS31 and GS39), and therefore these growth stages seem to be the most critical for fungicide application.

So, if yield and test weight can be increased, and screenings decreased by using fungicide in the presence of YLS, what does this mean economically?

Table 2 outlines the costs of each fungicide treatment, while Table 3 shows the net returns of each treatment. When averaged across all varieties, applying foliar fungicide at both GS31 and GS39 gave the best result, increasing yield returns by $41/ha on average.

Table 2. Cost of fungicide treatments.

Application	Cost ($/ha)	Cost of application ($/ha)	Total cost per application ($/ha)
Jockey Stayer seed treatment	24.75*	at seeding	24.75
Propiconazole foliar treatment	5.75	10	15.75

*Jockey @ $550/10L x 4.5L/tonne seed = $24.75/ha assuming 100kg/ha seeding rate

Table 3. Cost of application, yield response and economic gain for fungicide treatment combinations.

Treatment	Cost of application ($/ha)	Yield response (kg/ha)	Return* ($/ha)	Return after treatment ($/ha)
GS31	15.75	180	45.54	29.79
GS39	15.75	135	34.16	18.41
Jockey+GS31	40.50	230	58.19	17.69
Jockey+GS39	40.50	195	49.34	8.84
GS31+GS39	31.50	288	72.86	41.36
Jockey+GS31+GS39	56.25	306	77.42	21.17
GS31+GS39+GS69	47.25	235	59.46	12.21
Jockey+GS31+GS39+GS69	72.00	377	95.38	23.38

*Return based on 10 year average APW price of $253/tonne

When the varieties were viewed individually, the most pronounced effects were observed in Scout⌽ and Shield⌽. Although all varieties showed some degree of response to fungicide application, yield benefits for the other varieties were less consistent across treatments. With the exception of Corack⌽ (rated MR), the yield of all varieties was increased through the application of foliar fungicide at GS31. The financial impact of these treatments on each variety is shown in Table 4.

Spraying foliar fungicide at both GS31 and GS39 increased returns (after spraying costs) by approximately $140/ha in Scout⌽ and Shield⌽. Conversely, this two-spray treatment had no financial benefit in the other varieties.

Many of the treatment regimes showed economic losses for varieties Corack⌽, Mace⌽ and Grenade CL Plus⌽; and the economic gains that these varieties did produce were only minor in comparison to that of Scout⌽ and Shield⌽. It is unclear why Grenade CL Plus⌽, which is rated as susceptible to YLS, did not have a positive response to fungicide treatment like that of other susceptible varieties Scout⌽ and Shield⌽.

The effect on test weight was similar to yield: Scout⌽ and Shield⌽ were the only varieties to have a significant change in test weight associated with fungicide treatment. The test weight of both Scout⌽ and Shield⌽ increased by approximately 2.8 units using the Jockey+GS31+GS39 treatment, and by more than 2 units using the GS31+GS39 treatment (data not shown).

There was no significant treatment by variety effect on screenings. In all varieties there were fewer screenings in response to fungicide treatment, with the lowest screenings being observed for the Jockey+GS31+GS39 treatment.

Table 4. Fungicide treatment effect on yield and net return of 5 varieties with differing levels of resistance to YLS.*
Values displayed for fungicide treatments are relative to the untreated control value.

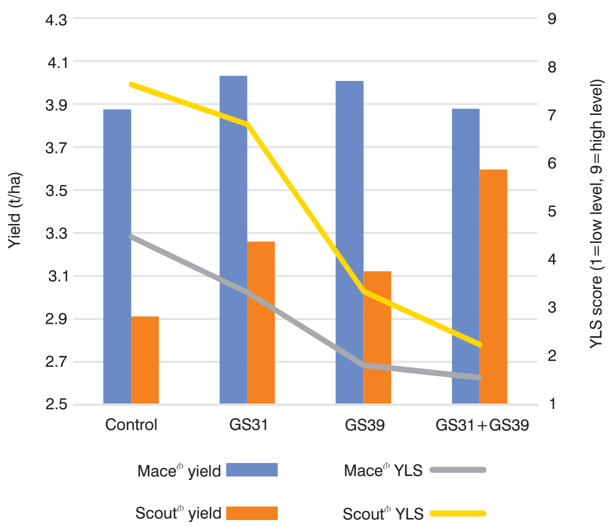
Treatment regime	Corack⌽ (MR)		Mace⌽^ (MR-MS)		Shield⌽^ (MS-S)		Grenade CL Plus⌽^ (S)		Scout⌽^ (S-VS)	
	Yield (kg/ha)	Net return ($/ha)	Yield (kg/ha)	Net return ($/ha)	Yield (kg/ha)	Net return ($/ha)	Yield (kg/ha)	Net return ($/ha)	Yield (kg/ha)	Net return ($/ha)
Control	3649	923	3874	980	3124	790	3110	787	2911	737
GS31	-29	-23	+156	+24	+217	+39	+206	+36	+348	+72
GS39	+113	+13	+133	+18	+129	+17	+92	+8	+211	+38
Jockey+GS31	+110	-13	+203	+11	+208	+12	+136	-6	+495	+85
Jockey+GS39	+251	+23	+61	-25	+352	+49	+76	-21	+234	+19
GS31+GS39	-24	-38	+3	-31	+661	+136	+118	-2	+684	+142
Jockey+GS31+GS39	+120	-26	+115	-27	+340	+30	+360	+35	+597	+95
GS31+GS39+GS69	+102	-21	+126	-15	+623	+110	-19	-52	+340	+39
Jockey+GS31+GS39+GS69	+303	+5	+325	+10	+635	+89	+256	-7	+364	+20

*Net return based on 10 year average APW price of $253/tonne, minus cost and application of fungicide
^ Denotes varieties that have an AH quality classification in Southern Zone, and therefore may be eligible for higher returns

Conclusions

Application of fungicide reduced visible effects of YLS for all varieties, and treatment regimes that included a foliar application at GS31 were particularly effective. Although this cosmetic improvement was observed regardless of the resistance level of the variety, large (and therefore likely repeatable) economic improvements from fungicide application were only observed in the more susceptible varieties Shield$^{\phi}$ and Scout$^{\phi}$. Even under the maximum fungicide regime, these susceptible varieties still had higher levels of YLS infection than the more resistant variety Mace$^{\phi}$ and failed to reach its profitability under their best treatment (Table 4, Figure 4). Interestingly, even for the more resistant varieties Mace$^{\phi}$ and Corack$^{\phi}$, targeted fungicide application was able to slightly improve profitability in the presence of high YLS infection. However, the financial benefit of these treatments was not consistent, and even the best treatment was just one sixth ($23-24/ha) of the return observed for the best fungicide treatment on Scout$^{\phi}$ and Shield$^{\phi}$ ($136-142/ha). Given that this study has been carried out in just one location, where YLS infection was high, the risk of a negative return (loss) following fungicide application on Mace$^{\phi}$ and Corack$^{\phi}$ to control low-moderate YLS infection is likely. Additional environments and years are being investigated to confirm these effects under differing infection levels.

Figure 4. Effect of fungicide treatment on yield and YLS score taken at GS69 for Mace$^{\phi}$ and Scout$^{\phi}$.



Take home messages

- Propiconazole application is effective at reducing the incidence of YLS infection in wheat
- In this study, the most cost effective treatment was spraying foliar fungicide at both GS31 and GS39
- Protecting susceptible varieties such as Scout$^{\phi}$ and Shield$^{\phi}$ with fungicide may lead to very large financial benefits
- Fungicide application is not able to eliminate YLS infection, so choosing resistant varieties may be a more effective solution when high YLS is expected
- Under high YLS infection, resistant varieties may benefit marginally from fungicide application, but this needs to be confirmed with further study to ensure farmers do not experience negative returns from fungicide application

Acknowledgements

This project was funded jointly by AGT and the SA Grain Industry Trust Fund (SAGIT).

References

[1] GRDC Yellow Leaf Spot fact sheet, September 2011

[2] GRDC Media release 20 April 2011: Growers need strategy to manage yellow leaf spot

Contacts

For further information please contact:

Haydn Kuchel, Wheat Breeder: 0428 817 402
James Edwards, Wheat Breeder: 0427 055 659
Dan Vater, SA/Vic Marketing Manager: 0427 188 919
Andrew Egarr, Research Agronomist: 0435 608 182

www.ausgraintech.com