The economics and risks of early sprays for yellow leaf spot- *Pyrenophora tritici-repentis*

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Key words

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Take home message

- Stand alone early fungicide sprays at early emergence (Z13) and mid tillering (Z24) did not offer consistent and significant yield responses or positive returns on investment
- Early fungicide sprays (Z13, Z24) coupled with later multiple fungicide sprays may offer improved disease control and yield response over conventional timings
- Yield response from yellow leaf spot (YLS) is more commonly only maximised with multiple sprays of fungicides
- Using fungicides in a more "protective" approach using multiple sprays may be worthy of further investigations
- Yield loss from YLS may not be as great as previous thought- maximum yield response from four trials in 2011 was 23%
- Seedling or early infection of wheat may be better managed through managing inoculum than using fungicides

Background

Yellow leaf spot is a foliar fungal disease that affects many Australian wheat varieties. As with other common foliar diseases such as stripe rust (*Puccinia striiformis*) or Yr, they consume photosynthetic leaf area generally late in the crop and hence limit the ability of the plant to achieve maximum yield potentials.

However unlike Yr there had been a notable absence of YLS in wheat crops over the past 10-12 years after a severe epidemic in the late 1990's. Much of our recent experience and knowledge of managing leaf disease in cereals is in Yr. But a series of eight trials on YLS over the past two seasons hint that the management of this disease with fungicide could be quite different to Yr.

YLS requires periods of free moisture of 6 hours or more on the leaf for infection to occur. This is in contrast to Yr that only requires high humidity for infection (GRDC, 1992). The drier years through the last decade without the required extended wet periods has most likely limited YLS ability to establish and develop.

However 2010 saw much of the NSW cropping belt experience higher than average annual rain where the extended periods of rain enabled YLS to develop rapidly in wheat crops reaching epidemic levels in spring. The level of YLS quite likely dominated over Yr as the key leaf disease in wheat in 2010.

It was evident in retained stubbles in autumn of 2011 that YLS had huge starting inoculums' and that a repeated wet season similar to 2010 could see significant infection of the disease again. The authors experience following the last major YLS epidemic was that in the following years there were also often alarming seedling infections due to the high inoculum loadings.

Conventional thinking on many of the foliar leaf diseases is that protecting leaves younger than the Flag -2 will not often result in yield or quality advantages. The advisory literature for YLS control also seems to be inconclusive, but there does seem to be some support for applying fungicides to crop stages earlier that Z32 but not at very early stages.

GOA planned two separate trial programs to look at the management of the disease in 2011. One key attribute of the trials planned was the management of early YLS infection- the details of which are covered below.

In total, GOA has established five trial sites to investigate the management of YLS, two of these are in collaboration with Rohan Brill from NSW DPI.

Aims

The broad aim of the trial work was to investigate the management of YLS, particularly managing early infections. One trial was designed to test fungicide timings for their effectiveness. A second trial was designed to demonstrate the effects that managing stubble and hence disease inoculum, has upon seedling infections.

Methods

All of the trials detailed in this paper were applied to commercial farmer sown paddocks of EGA Gregory⒟ wheat. Gregory⒟ is classed as moderately resistant to stripe rust so to remove chance of treatment responses being a result of Yr control.

All sites were direct drilled into the previous year's stubbles.

All sites were managed at sowing and post sowing by the farmer the same as the rest of the paddocks with no fungicides other than applied seed dressing. No commercial seed dressings offer any control over YLS.

Individual trial protocols

Stubble management for the control of seedling YLS infections

Two sites were selected- Warren and Geurie. Both sites were Gregory stubble from 2010 and were to be direct drilled with Gregory wheat again in 2011.

Trial design was a randomised complete block design with three replicates with plot sizes of 5m * 12mt. All four treatments were applied as close to sowing as possible to minimise any other impacts of the treatments such as moisture loss.

Treatment	Details
Nil	Stubble left standing
Slashed	Plot mown with a push lawn mowers and all stubble retained
Slashed and removed	Plots mown with catcher attached. Stubble removed from the site

Burnt	Plots had small firebreak constructed by raking, plot burnt #

Plots were 5mt wide so windrow created from firebreak was not in the harvested area which was only 1.8mt wide

Table 1 *Treatments pre sowing stubble management for control of YLS, 2011*

Site	Sowing method	Row Spacing-cm	Interval-treatment-sowing
Warren	Tine & Press-wheel	30	2 hours
Geurie	Disc	25	48 hours

Table 2 *Sowing equipment, row spacing and interval between treatments and sowing for pre sowing stubble management for control of YLS trials, 2011*

After the initial treatment no other trial treatment or fungicides were applied.

Fungicide timing for the control of YLS

Four sites were selected for these trials on Gregory stubble of 2010 except one of the trials at Trangie which was on canola stubble (WoC).

Site	Sowing method	Row spacing cm	Previous Crop 2010
Warren	Single disc	50	Gregory wheat
Trangie (WoW)	Single disc	25	Gregory wheat
Trangie (WoC)	Single disc	25	Canola (Gregory. '09)
Geurie	Single disc	25	Gregory wheat

Table 3 *Sowing equipment, row spacing and previous crop type fungicide timing trials for YLS control, 2011*

Trial layout was in a randomised complete block design with 3 replicates. Plot sizes were all 3m wide and either 10m or 12m long depending of farmers sowing configuration. Plot where arranged perpendicular to sowing direction.

Treatment	Timing	Comments
1	UTC	Applied to all sites
2	Z39	
3	Z32	
4	Z32 & Z39	
5	Z24	
6	Z24 & Z39	
7	Z24 & Z32	
8	Z24, Z32 & Z39	
9	Z13	Not applied to Trangie sites- trials established

10	Z13 & Z39	after Z15 crop stage
11	Z13 & Z32	
12	Z13,Z32 & Z39	
13	Z13 & Z24	
13	Z13, Z24 & Z39	
14	Z13, Z24 & Z32	
15	Z13, Z24, Z32 & Z39	
16 (Treatment 9 at Trangie sites)	Preventative	Apply fungicide if rain event is imminent and the plots had not received a treatment in the preceding 10 days

Table 4 *Treatment list for fungicide timing trials all sites 2010-11*

The fungicide used was Propiconazole (250 g/L) at 500ml per hectare applied by a hand held boom applying 70lt of water per ha, applied through AIXR01 nozzles at 50cm spacing at 3 bar pressure. Rain water was used as the carrier in all treatments.

Disease incidence was assessed by visual appraisal and recorded and varying intervals depending upon the site and protocol.

Yield was assessed by harvesting with a plot header harvesting 1.8m of the 3 or 5m wide plot for the length of the plot. This ensured a buffer (unharvested) section of treated crop was left between each treatment, avoiding any edge or drift effects of neighbouring treatments.

Grain quality was assessed by NIR and standard testing methods for screenings.

All results were analysed by statistical software packages using ANOVA and the LSD method for treatment comparisons. Unless otherwise stated the confidence level is 95%.

Results

Stubble management for the control of seedling YLS

Geurie

Table 5 below demonstrates two treatments slash/removed and burning resulting in significantly higher tiller numbers per meter of row. A number of treatments also resulted in significantly less leaf infection of YLS than the UTC. Slash and remove and the burn treatments were significantly higher than UTC for yield.

Treatment	Tiller/1m row		LAI						Yield t/ha	
			L1		L2		L3			
UTC	34.333	c	56	B	9.3	BC	0.43	AB	3.34	C
Slash	47.25	bc	74.5	A	16.17	AB	0.03	AB	3.48	BC
Slash and remove	61	b	59.83	B	18.33	AB	0.53	A	3.75	AB
Burn	80	a	9.03	C	0.9	C	0	B	3.84	A
	LSD (0.05) = 18.6174		LSD (0.05) = 11.911		LSD (0.05) = 8.515		LSD (0.05) = 0.532		Lsd (0.05) = 0.29	
	CV = 16.75		CV = 11.96		CV = 38.14		CV = 106.46		CV = 4.16	

Table 5 *Effects of various stubble treatments on YLS infection and tiller number and final yield, Geurie 2011*

Warren

Table 6 below shows consistent and significant trends of lower leaf infection resulted after various stubble treatments pre sowing.

Unfortunately 40mm of rain fell three days after sowing this trial which resulted in the soil slumping and crusting that resulted in poor emergences. For this reason, the trial was not harvested and emergence counts not included.

Treatment	L1		L2		L3	
UTC	32	a	14.07	a	2.9	a
Slash	19.77	b	5.77	b	0.4	b
Slash and remove	4.77	c	2.07	c	0.23	b
Burn	0.77	c	0.37	c	0.13	b
	LSD (P=.05) = 10.244		LSD (P=.05) = 3.403		LSD (P=.05) = 1.095	
	CV = 35.79		CV = 30.6		CV = 59.78	

Table 6 *Effects of various stubble treatments on YLS infection Warren 2011*

Fungicide timings for the control of YLS

Warren

Table 7 shows only three treatments were significantly different to the untreated control (UTC) for yield. A number of treatments resulted in significantly different levels of leaf infection. The UTC resulted in levels of infection with YLS of 63% & 97% for the flag leaf and flag -1 respectively. The top three yielding treatments had average levels of 40% and 65%.

Fungicide Timing	% Flag leaf infection 21/10/11		% F-1 leaf infection 21/10/11		Yield t/ha	
Z13, 32 & 39	48.67	DEFG	69.83	DEF	2.5167	A
Preventative (5x)	29.67	H	58.5	F	2.5133	A
Z13, 24 & 39	42	G	65.67	EF	2.4867	A
Z32 & 39	47.67	EFG	76	CDE	2.38	AB
Z13, 24, 32 & 39	43.67	FG	68	EF	2.2967	AB
Z13 & 24	54	BCDEFG	87.33	ABC	2.2974	AB
Z24, 32 & 39	51	CDEFG	71.33	DEF	2.2767	AB
Z13, 24 & 32	58.33	ABCDE	88.33	AB	2.25	AB
Z39	61.83	ABC	87.83	ABC	2.21	AB
Z13 & 32	54.33	BCDEF	90.5	AB	2.2167	AB
Z24 & 39	60	ABCD	80.17	BCD	2.22	AB
UTC	**62.67**	**ABC**	**97.33**	**A**	2.1633	B
Z13 & 39	59.33	ABCDE	88.67	AB	2.1033	B
Z32	65.5	AB	90.33	AB	2.08	B
Z24 & 32	51	CDEFG	85.83	ABC	2.0667	B
Z24	68.17	A	94.5	A	2.0767	B
Z13	64.83	AB	93.17	A	2.0667	B
	CV = 34.5		CV = 16		CV = 8.38	
	Lsd (0.1) = 0.75		Lsd (0.1) = 12.2		Lsd (0.1) = 0.15	

NB Shaded cells are significantly different to UTC

Table 7 *Effects of various fungicide timings upon YLS leaf area infection and the resultant yield, Warren 2011*

Trangie (WoW)

Table 8 shows six of the nine treatments in this trial were significantly better than the UTC for yield. The only treatments that were not better were a single Z39 or a combination Z32 & Z39 spray. Only one treatment, a Z24 spray, was significantly higher for screenings than the UTC. Of the six treatments significantly better for yield four had significantly lower leaf infections.

Fungicide timing	% Flag infection 25/10/2011		% F-1 infected 25/10/2011		% Flag -2 infection 25/10/2011		Yield		Screening %	
Preventative (4X)	11	BC	23	D	56	D	5.96	A	3.0	BC
Z24 & 39	15	BC	37	BCD	82	BC	5.74	AB	2.7	C
Z24 & 32	12	BC	39	BCD	73	C	5.67	AB	2.9	BC
Z24, 32 & 39	9	BC	18	D	52	D	5.61	AB	3.8	AB
Z24	30	A	69	A	97	AB	5.44	BC	4.5	A
Z32	17	BC	57	ABC	86	ABC	5.41	BC	3.0	BC
Z32 & 39	9	C	32	CD	75	C	5.34	BCD	3.8	ABC
Z39	18	BC	48	ABC	84	ABC	5.06	CD	3.5	ABC
UTC	**37**	**A**	**67**	**A**	**100**	**A**	**4.83**	**D**	**3.3**	**BC**
	Lsd (0.1) = 9.8		Lsd (0.1) = 22.29		Lsd (0.1) = 16.12		Lsd (0.05) = 0.52		Lsd (O.05) = 1.04	
	CV = 39.18		CV = 36.16		CV = 14.48		CV = 5.51		CV = 17.78	

NB Shaded cells are significantly different to UTC

Table 8 *Effects of various fungicide timings upon YLS leaf area infection and the resultant yield and screenings at Trangie (WoW) 2011*

Trangie (WoC)

Table 9 below shows no treatments in this trial were significantly different to the UTC for yield. There were three treatments that resulted in significantly lower screenings than the UTC. YLS infections were assessed on the 25/10/2011 but there were difficulties in distinguishing between natural senescence of leaves and YLS infection. These results are not shown.

Fungicide timing	Yield t/ha		Screening %	
UTC	**4.55**	**A**	**3.09**	**A**
Z39	4.65	A	2.4633	AB
Z32	4.64	A	2.2633	B
Z32 & Z39	4.48	A	2.1667	B
Z24	4.59	A	2.9	AB
Z24 & Z39	4.50	A	2.68	AB
Z24 & Z32	4.57	A	2.24	B
Z24, Z32 & Z39	4.53	A	2.3733	AB
Preventative (4X)	4.53	A	2.8233	AB
	Lsd (0.05) = 0.37		Lsd (0.05) = 0.77	
	CV = 4.67		CV = 17.45	

NB Shaded cells are significantly different to UTC

Table 9 *Effects of various fungicide timings upon the resultant yield and screenings at Trangie (WoC) 2011*

Geurie

Table 10 shows four treatments were significant better than UTC for yield. There was no significant difference in screenings. There were significant differences in the levels of leaf infection with YLS. Of the four significantly better for yield they also had lower infections in flag -2. Correlations between YLS infection and yield were strongest for flag -2 than for flag leaf and flag -1.

Fungicide timing	% flag leaf infected 25/10/11		% F-1 infected 25/10/11		% F-2 leaf infected 25/10/11		Yield t/ha		Screenings %	
Preventative (5X)	2.3	E	5.77	F	38.8	E	3.78	A	3.4333	C
Z13, 24 & 32	6.93	BCD	31.33	DE	75	CD	3.5733	AB	3.5	BC
Z13, 32 & 39	5.87	BCD	30.8	DE	70.33	D	3.54	ABC	3.9667	ABC
Z13, 24, 32 & 39	5.5	CDE	23	E	82.33	BCD	3.5333	ABC	4.2	ABC
Z24 & 39	4.77	DE	32.17	CDE	85.67	ABC	3.4633	ABCD	3.7667	ABC
Z13 & 24	7.77	BCD	47.83	AB	96.67	A	3.4167	BCDE	3.9	ABC
Z32 & 39	6.2	BCD	33	CDE	69.33	D	3.3767	BCDE	3.7	ABC
Z13, 24 & 39	6.57	BCD	33.17	CDE	85.33	ABC	3.36	BCDE	4.2667	ABC
Z39	6.93	BCD	36.33	BCD	90	AB	3.3333	BCDE	4.2667	ABC
Z13 & 39	9.03	AB	36	BCD	93.33	AB	3.2833	BCDE	4.2667	ABC
Z24 & 32	5.27	DE	31.5	CDE	88.33	ABC	3.29	BCDE	4	ABC
Z13	8.7	BC	43.5	ABC	95.33	AB	3.2433	CDE	4.4667	AB
Z24, 32 & 39	5	DE	23.57	E	69.33	D	3.2033	DE	3.8667	ABC
Z24	7.63	BCD	43.5	ABC	94.33	AB	3.1967	DE	4.6	A
Z32	7.07	BCD	46.67	AB	87.33	ABC	3.1533	DE	4.5333	A
UTC	**12.23**	**A**	**54.5**	**A**	**92**	**AB**	3.1533	DE	4.1667	ABC
Z13 & 32	8.73	BC	38.07	BCD	92	AB	3.1233	E	3.6188	ABC
	Lsd (0.1) = 3.38		Lsd 90.1) = 12.14		Lsd (0.1) = 13.44		Lsd (0.05) = 0.33		Lsd (0.05) = 0.99	
	CV = 35.54		CV = 25.22		CV = 11.73		CV = 5.86		CV = 14.69	

NB Shaded cells are significantly different to UTC

Table 10 *Effects of various fungicide timings upon YLS leaf area infection and the resultant yield and screenings at Geurie 2011*

Discussion

Stubble management for the control of seedling YLS

At the Geurie site there was a significant treatment effect upon tiller number per meter. It is surmised that a large part of this variation was differences with emergence not tillering per plant.

The Geurie site was sown with a single disc John Deere opener into quite heavy stubble of last year (~5t/ha- wheat). The heavy stubbles left in the UTC and the slashed treatments resulted in significant levels of “hair-pinning” resulting in poor seed soil contact and hence emergence. Where stubbles were reduced by either removal or burning, better seed/soil contact resulted and better emergences achieved. The slashed and removed treatments resulted in 79% more tillers per meter row than UTC and the burnt treatment a 134% increase.

However it could not be confidently stated that all the variation in tiller number was a result of the seed soil contact and reduced emergence. Some part of the increased tiller number could be attributed to reduced disease levels.

As the resultant levels of stubble was reduced following the treatment, the level of seedling infection also reduced. At the Geurie site, the lower the level of stubble generally the lower the level of infection but these differences were not always significant. At the Warren site the difference were much more consistent and in the case of leaves 1 and 2 identical.

One possible explanation for the differences in the effectiveness of treatments between sites is the sowing machinery. At Warren, the trial area was sown with a tine and press wheel arrangement, Geurie was a disc opener. The low disturbance of the disc opener resulted in no stubble being buried in the sowing operation. The tine machine on the other hand actually buried an amount of stubble and in the case of the slashed and removed treatments the plots were not easily distinguished from the burnt treatments after sowing. As more stubble was buried the infection source was reduced and reduced infections.

The trial design did not allow for any fungicides to be applied seeing if they had any interaction with these stubble treatments. However one of the fungicide timing trials were situated directly adjacent to the Geurie trial and as detailed above had a series of fungicide treatments. A clear observation was that even early fungicides at Z13 or Z24 failed to reduce disease in stubble standing plots as well as had been achieved with the burnt treatment.

The stubble treatments applied at the Geurie site resulted in significantly different yields with lower stubble treatments yielding higher. As discussed earlier this impact however could not be directly and solely attributed to the effects the treatments had upon YLS management due to the differences in emergence. However in terms of the resultant yield from a farming system perspective a 15% yield or $100/ha[1] advantage was gained by burning stubble over UTC in this trial.

And in fact the simple act of burning the stubble out yielded the best treatment in the adjacent fungicide trial by 0.4t/ha for the cost of a match compared to $67.50 in fungicide.

Fungicide timings for the control of YLS

Of the four trials established in 2011 only three of them had a significant positive response to fungicide treatment in yield. The three trials that responded to treatment were those in higher risk situations, where the crop was sown into infected stubbles from the previous year leading to higher disease pressure. The maximum yield response was 23% over UTC.

The fourth site (Trangie WoC) was planted onto a canola stubble of 2010 and wheat of 2009, and although the disease was present in the trial, none of the treatments resulted in any response in yield and only a minor response in screenings. It is suggested the lower disease pressure due to the break crop limited the ability of the disease to establish. An interesting point to note is that the commercial paddock had a sufficient enough degree of infection that spraying was considered by the managers.

This responsiveness of the individual sites agrees with our current understanding of the disease and the mechanism that it uses to carry over between crops and infect new crops. The GRDC publication "Management to reduce the risk of yellow spot" states "in most instances a one year rotation out of wheat is highly effective at reducing the occurrence of yellow spot"

Early sprays at Z13 or Z24 in these trials, as standalone applications gave no significant yield responses with the one exception at Trangie (WoW) with a Z24 timing.

In all three sites the disease was present at an obvious level at these early timings. The fact that there was no response would tend to fit with current theory on yield contribution within the wheat plant. The critical leaf structures such as the ear, stem, flag leaf and flag -1 and 2 are not present and not susceptible to infection. For the disease to affect yield at this early stage it would require the infection to be severe enough to limit tiller production or severely compromise the health of the plant. Although such a severe infection is possible it is unlikely in all but a few exceptional seasons. For the disease to be so severe, extended wet periods would be required and as such other issues would most likely develop as well such as water logging or lack of sunlight that may well limit growth more so than the disease itself.

The more conventional fungicide timings of Z32 and Z39 also failed to result in a significant response as standalone approach except a single Z32 spray at the Trangie (WoW) site.

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[1] Assuming wheat at $200/t farm gate and no cost to burning stubbles

Within the three sites that responded it was generally only multiple treatments with three or more timings that gave a significant response in yield over untreated control. The exception to this was the Trangie WoW where two treatments with two applications performed equal to the top.

The fact that simply multiple timings have most often resulted in the most significant responses and that no strong pattern or key timings are obvious suggest that the numbers of sprays applied may be more important in determining the yield response from fungicides than the timing within these approaches.

Triazole fungicides will not control the sporalating bodies of YLS on either stubble (pseudothecia) or as lesions on living tissue as they do with Yr. Following an effective application of fungicide on Yr the infection has to re enter from unsprayed areas or initiate from uncontrolled infections and complete a number of life cycles to reach critical levels again. YLS infections reinitiate from the numerous sporulating bodies both on the stubble and the plant as soon as ideal conditions return and unprotected leaves are available. And because of the large number of infection sources multiple generations are not needed to again reach critical levels.

It therefore leads to reason that single spray strategies will be limited in their effectiveness; a multiple application approach should address the infection pattern more appropriately. However a more novel approach was tested in these trials as well. A preventative approach was to apply a fungicide ahead of any conditions (rainfall) that were suitable for YLS infection to occur. This was in contrast to a program approach where applications were made at set crop stages the timing of which may have been after infection events and beyond periods were kickback may have controlled these infections.

This preventative approach in all responsive sites either topped the trial or was equally effective as the top treatments. This puts some credit to the approach but it is unclear if it was the proactive approach with fungicides preventing infection or simply the number of high numbers of applications that achieved the response.

This approach probably requires further investigation possibly in a controlled environment to prove the theory.

Economically, the success of this approach and the others are a little different. When you take into account the additional costs for multiple sprays yield maximisation is not always the best goal. The tables below detail all treatments and their economics. It should be noted that only the ROI for the statistically significant should be considered as all other results are statistically no different to UTC and therefore all offer negative returns.

Fungicide Timing	Yield t/ha	Increase over UTC	% Increase over UTC	Net position $	ROI
Z13, 32 & 39	2.52	0.35	16%	$71	75%
Preventative (5x)	2.51	0.35	16%	$70	4%
Z13, 24 & 39	2.49	0.32	15%	$65	60%
Z32 & 39	No difference to UTC			-$27	NA
Z13, 24, 32 & 39				-$54	
Z13 & 24				-$27	
Z24, 32 & 39				-$41	
Z13, 24 & 32				-$41	
Z39				-$14	
Z13 & 32				-$27	
Z24 & 39				-$27	
UTC	2.16	NA		$0	
Z13 & 39	No difference to UTC			-$27	
Z32				-$14	
Z24 & 32				-$27	
Z24				-$14	
Z13				-$14	

NB Shaded cells are significantly different to UTC

Table 11 *Treatment effects effect upon yield and their net return/ return on investment Warren 2011*

Fungicide timing	Yield t/ha	Increase over UTC	% Increase over UTC	Net return $	ROI
Preventative (4x)	5.96	1.13	23%	$173	320%
Z24 & 39	5.74	0.91	19%	$156	577%
Z24 & 32	5.67	0.84	17%	$141	522%
Z24, 32 & 39	5.61	0.78	16%	$116	285%
Z24	5.44	0.61	13%	$109	804%
Z32	5.41	0.58	12%	$103	764%
Z32 & 39	No difference to UTC			-$27	NA
Z39				-$14	
UTC	**4.83**				

NB Shaded cells are significantly different to UTC

Table 12 *Treatment effects effect upon yield and their net return/ return on investment Trangie (WoW) 2011*

Fungicide timing	Yield t/ha	Increase in yield over UTC	% Increas over UTC	Net return $	ROI
UTC	**4.55**	0.00	0%	$0.00	NA
Z39	No differnce to UTC			-$13.50	
Z32				-$13.50	
Z32 & Z39				-$27.00	
Z24				-$13.50	
Z24 & Z39				-$27.00	
Z24 & Z32				-$27.00	
Z24, Z32 & Z39				-$40.50	
Preventative				-$54.00	

NB Shaded cells are significantly different to UTC

Table 13 *Treatment effects effect upon yield and their net return/ return on investment Trangie (WoC) 2011*

Fungicide timing	Yield t/ha	Increase in yield over UTC	% Increase over UTC	Net Return $	ROI
Preventative	3.78	0.63	20%	$57.84	86%
Z13, 24 & 32	3.57	0.42	13%	$43.50	107%
Z13, 32 & 39	3.54	0.39	12%	$36.84	91%
Z13, 24, 32 & 39	3.53	0.38	12%	$22.00	41%
Z24 & 39	No different to UTC			-$27.00	NA
Z13 & 24				-$27.00	
Z32 & 39				-$27.00	
Z13, 24 & 39				-$40.50	
Z39				-$13.50	
Z13 & 39				-$27.00	
Z24 & 32				-$27.00	
Z13				-$13.50	
Z24, 32 & 39				-$40.50	
Z24				-$13.50	
Z32				-$13.50	
UTC	3.15	NA			
Z13 & 32	No different to UTC			-$27.00	

NB Shaded cells are the only treatments significantly different to UTC

Table 14 *Treatment effects effect upon yield and their net return/ return on investment Geurie 2011*

Conclusions

These trials demonstrated the level of infected stubble at sowing has had a huge impact upon the level of seedling infection with YLS. Treatments pre sowing that lower stubble and hence lower inoculum were considerably cleaner. Adjacent fungicide trials where an early treatment was applied it failed to arrest the disease as well as was achieved where the stubble was burnt.

There may even be some small hint that opener type may have some bearing upon seedling infection of YLS.

Furthermore it was demonstrated at the Trangie sites that paddock history played and important part in minimising the disease impact. A one year break crop of canola resulted in no response in yield to even four applications of fungicide. At the same locality, under the same seasonal conditions in another paddock planted into infected stubble saw 23% yield increase and was the most responsive site in terms of which treatments.

YLS has proved to be much more difficult to achieve yield response with fungicides than can be seen in Yr infections. With Yr infection a single well timed spray can often achieve 80% plus of maximum yield. No single treatment with fungicide controlled the disease and certainly early timings at Z13 and Z24 without follow up application were not effective. Responses up to 23% in yield were achieved but only with multiple sprays with generally three or more timings.

It should be noted that although the disease was present and at high levels in some of these trials the season was not a wet year in terms of total rainfall or even the number of events during the growing season. It was only the high inoculum levels that probably led to such high levels of YLS. The response to treatments that were tested here may possibly be even less in an epidemic year such as 2010 and 1998.

Multiple sprays, although costly, still showed positive returns upon investment in these trials where the sites were responsive. Most treatments only returned $1 profit for $1 invested which is not great with the exception of the one site Trangie which returned up to $5-6 for every dollar invested for these approaches.

However sites where inoculum and risk was lower this approach proved costly, actually resulting in negative returns on investment. Growers should be careful not to employ such a high cost option without consideration of the disease risk and pressure.

In summary

- Do not plant wheat into higher risk situations with high levels of infected stubble
- If you do have to plant into these situation consider managing the stubble to lower levels- the greater the reduction the better- burning is best
- Remember that fungicides are not as effective in reducing YLS as Yr. Do not rely on them as you would for Yr.
- If you do have to rely on fungicides multiple sprays may be needed to achieve responses.

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