6.6 DISEASE MANAGEMENT VARIETY INTERACTION TRIAL (INVERLEIGH VIC)

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The following trial is part of a new GRDC funded project (SFS 00015) examining the integration of the principles of disease management and canopy management in cereal crops.

Summary:

- In a trial with severe stripe rust, Teesdale (R rating) suffered only trace levels of disease and generated the greatest profit with no need for fungicide (7.32 t/ha untreated). All fungicide applications lost money with this variety.
- Kellalac (rated MR-MS) yielded 4.83 t/ha untreated, but with the optimum fungicide programme (Bayleton GS32 followed by Opus GS39) yielded 5.92 t/ha, an increase of 1.09 t/ha.
- Mitre rated MS-S for stripe rust yielded 3.40 t/ha untreated, but with the optimum fungicide programme (again Bayleton followed by Opus) yielded 5.34 t/ha.
- As a stand alone treatment Opus applied at flag leaf (GS39) was significantly more effective (in terms of both yield and margin) than the upfront products Jockey and Impact when applied to both Mitre and Kellalac.
- Yield was only maximized with these two varieties when two fungicide applications were applied.
- With two applications there was no significant yield difference between whether the first fungicide was an upfront measure (Jockey/Impact) or a foliar spray (Bayleton 1000ml/ha) at GS32/33; however there was a slight trend for the GS32 Bayleton applications to be slightly superior to the upfront products.
- The beneficial use of fungicide applied before the flag spray in Mitre and Kellalac was closely related to better disease control in the two leaves below the flag (F-1 & F-2).
- Yield responses due to fungicide application were surprisingly not correlated to % screenings.
- There was little influence of fungicide treatment on grain protein despite large differences in yield
- There was a small advantage to Impact over Jockey in this trial that could be related to differences in disease control
- The cost benefit ratio of the optimum fungicide programme with Kellalac was 3:1 ($3 back for $1 spent) and 6:1 with Mitre.

Methods:
Three varieties of differing resistance to stripe rust were sown on May 30th 2005 with an identical treatment list, in order to examine the profitability of different disease management strategies against differing cultivar resistance. The trial, following peas, was established under moist conditions on a clay loam at Inverleigh, west of Geelong (courtesy of Mr J. Hamilton).

Varieties: (ratings against stripe rust)
Mitre - MS-S very susceptible
Kellalac - MR-MS moderately resistant - susceptible
Teesdale - R resistant

Treatments:
GS32 Mitre (6th September) and Kellalac/Teesdale (13th September)

GS39 Mitre (22nd September) and Kellalac/Teesdale (4th October)

Active ingredient levels: Opus 125 SC contains 125g/l ai, Impact 250 SC contains 250g/l ai and Bayleton contains triadimefon 125 g/l ai.

Treatments:
All three varieties were treated with seven different fungicide regimes based on three timings of fungicides.

Trt No.	At Seeding – June 1st	GS32 (second node) – Sept 6th / Sept 13th	GS39 (flag leaf) – 22nd September / 4th October
1	----	----	----
2	Jockey (450ml/100kg)	----	----
3	Jockey (450ml/100kg)	----	Opus 250 ml/ha
4	Impact in furrow (0.4 l/ha)	----	----
5	Impact in furrow (0.4 l/ha)	----	Opus 250 ml/ha
6	----	Bayleton 1000ml/ha	Opus 250 ml/ha
7	----	----	Opus 250 ml/ha

Results

i) Disease Assessments

Stripe rust infection was first noted in late August/early September. At the time of the GS39 fungicide application the levels of disease had built up significantly, particularly in Mitre (Table 6-10).

At this assessment timing the superior performance of Impact over Jockey was clearly recorded on leaf 2 (flag -1) & leaf 3 where the products had not been followed up. Note that the GS32 application of Bayleton, whilst inferior on leaf 3, was giving superior disease control on leaf 2 over both Impact and Jockey. The influence of the Opus GS39 spray was as expected most pronounced on the flag leaf itself.

Table 6-10: Influence Of Fungicide Treatment On % Stripe Rust Infection On The Top Three Leaves (Flag, Leaf 2 (Flag – 1) And 3 (Flag – 2) At GS37-51 (Mitre GS49-51, Kellalac GS39 & Teesdale GS37) – 6th October

Treatment	Mitre			Kellalac			Teesdale	
	Flag	Leaf 2 F - 1	Leaf 3 F - 2	Flag	Leaf 2 F - 1	Leaf 3 F - 2	Leaf 2 F - 1	Leaf 3 F - 2
Untreated	25.9	29.4	50.0	0.1	5.6	16.0	0	0
Jockey	35.4	29.2	32.7	0.2	5.3	12.3	0	0
Jockey fb Opus GS39	9.8	14.9	19.1	0.0	5.2	12.9	0	0
Impact	26.4	14.0	17.1	0.1	2.9	6.8	0	0
Impact fb Opus GS39	4.9	10.7	18.5	0.1	3.0	6.7	0	0
Bayleton GS32 fb Opus GS39	5.9	7.1	23.7	0.1	4.1	10.2	0	0
Opus GS39	11.2	27.4	52.8	0.5	9.2	22.3	0	0
LSD % (p = 0.05)								
Variety	**1.1**	**1.2**	**2.1**	**1.1**	**1.2**	**2.1**	**1.2**	**2.1**
Fungicide	**1.6**	**1.9**	**3.3**	**1.6**	**1.9**	**3.3**	**1.9**	**3.3**
Variety/Fungicide	**2.8**	**3.3**	**5.7**	**2.8**	**3.3**	**5.7**	**3.3**	**5.7**

N.B. The later application of the GS39 spray in Kellalac and Teesdale (October 4) meant that at the time of this assessment this spray would not have had its effect.

Table 6-11: Influence Of Fungicide Treatment On % Stripe Rust (& Leaf Rust Kellalac Only) Infection On Flag Leaf & Leaf 2 (Flag -1) At Early Ear Emergence GS75 Grain Fill– 10th November

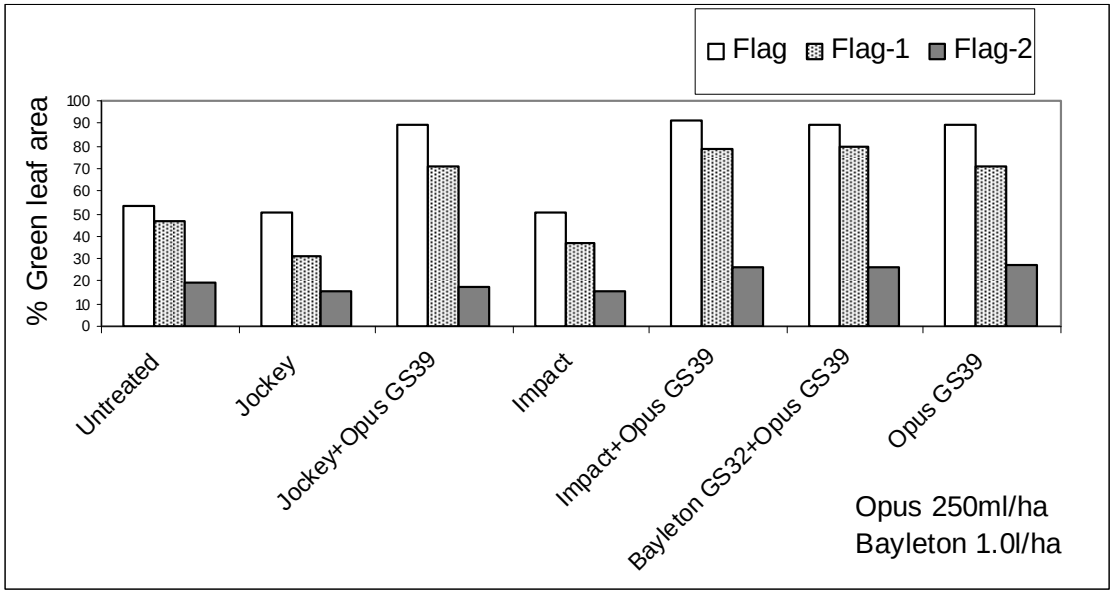
Treatment	Mitre		Kellalac Stripe rust		Kellalac Leaf rust	
	Flag	Leaf 2 F - 1	Flag	Leaf 2 F - 1	Flag	Leaf 2 F - 1
Untreated	46.8	49.2	19.9	64.9	25.0	8.2
Jockey	49.9	65.2	25.0	64.9	13.5	9.7
Jockey fb Opus GS39	10.7	27.3	27.1	70.3	17.5	12.9
Impact	48.2	59.7	15.8	64.3	22.3	11.3
Impact fb Opus GS39	8.8	22.3	7.3	34.4	21.2	2.5
Bayleton GS32 fb Opus GS39	11.2	20.6	10.4	35.9	21.0	3.4
Opus GS39	11.1	30.3	11.5	45.1	21.9	4.7
LSD % (p = 0.05)	**6.0**	**8.5**	**4.1**	**10.6**	**4.4**	**2.3**

The impact of the flag leaf spray was evident in the stripe rust scores of both Mitre and Kellalac, though differences were less apparent with leaf rust, particularly on the flag leaf.

Table 6-12: Influence Of Fungicide Treatment On % Green Leaf Area On Flag Leaf & Leaf 2 (Flag -1) At Mid Grain Fill GS75 – 10th November

Treatment	Mitre			Kellalac		
	Flag	Leaf 2 F - 1	Leaf 3 F - 2	Flag	Leaf 2 F – 1	Leaf 3 F - 2
Untreated	53	47	19	55	9	2
Jockey	50	31	16	61	10	2
Jockey fb Opus GS39	89	71	18	55	4	0
Impact	51	37	16	62	10	1
Impact fb Opus GS39	91	78	26	71	62	13
Bayleton GS32 fb Opus GS39	89	80	26	69	59	17
Opus GS39	89	70	28	67	43	5
LSD % (p = 0.05)	**6**	**9**	**11**	**5**	**9**	**7**

Figure 6-11: Green Leaf Area Associated With Different Stripe Rust Strategies In Mitre (MS-S Rating) Assessed Mid Grain Fill GS75



With Mitre, all treatments incorporating a flag leaf fungicide (Opus) significantly improved green leaf retention in comparison to untreated crops and those receiving purely upfront fungicide coverage. Interestingly with this assessment there was little difference in green leaf retention between the single Opus at GS39 and those treatments incorporating two applications of fungicide, a result that was reflected in similarly small yield differences (Figure 6-12) Overall, there is an extremely good correlation between this green leaf area assessment and final yield.

Interestingly the additional advantage of a GS32 spray over a GS39 application was greater with Kellalac than it was with Mitre, in terms of green leaf retention and yet there was no evidence that rust control was implicated. These green leaf scores also correlated strongly to final yield outcomes (Figure 6-13).

ii) Yield & Quality data

The trial was harvested on the 21st December. Yields are outlined in Figure 6-12, Figure 6-13 and Figure 6-14.

Table 6-13: Influence Of Fungicide Treatment On % Head Stripe Rust Infection (% Spikelets Infected Per Head) Mid Grain Fill GS75 – 10th November (Mitre Only)

Treatment	% heads infected
Untreated	31.5
Jockey	16.8
Jockey fb Opus GS39	----
Impact	19.7
Impact fb Opus GS39	18.5
Bayleton GS32 fb Opus GS39	18.8
Opus GS39	13.8
LSD % (p = 0.05)	**7.7**

Head infection was significantly reduced by all fungicide treatments, despite the fact that none of the sprays was applied to the head itself.

Figure 6-12: Influence Of Fungicide Treatment On Mitre (MS-S Rating For Stripe Rust) Yield (t/ha) And Green Leaf Area (Flag GS75)

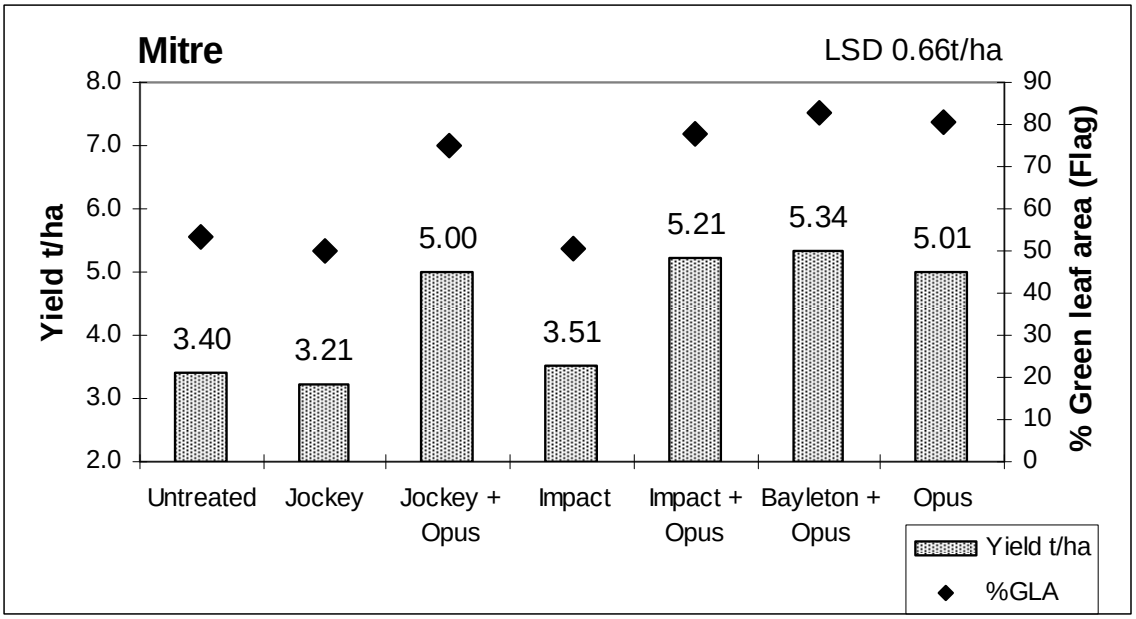


Figure 6-13: Influence Of Fungicide Treatment On Kellalac (MR-MS Rating For Stripe Rust) Yield (T/ha)

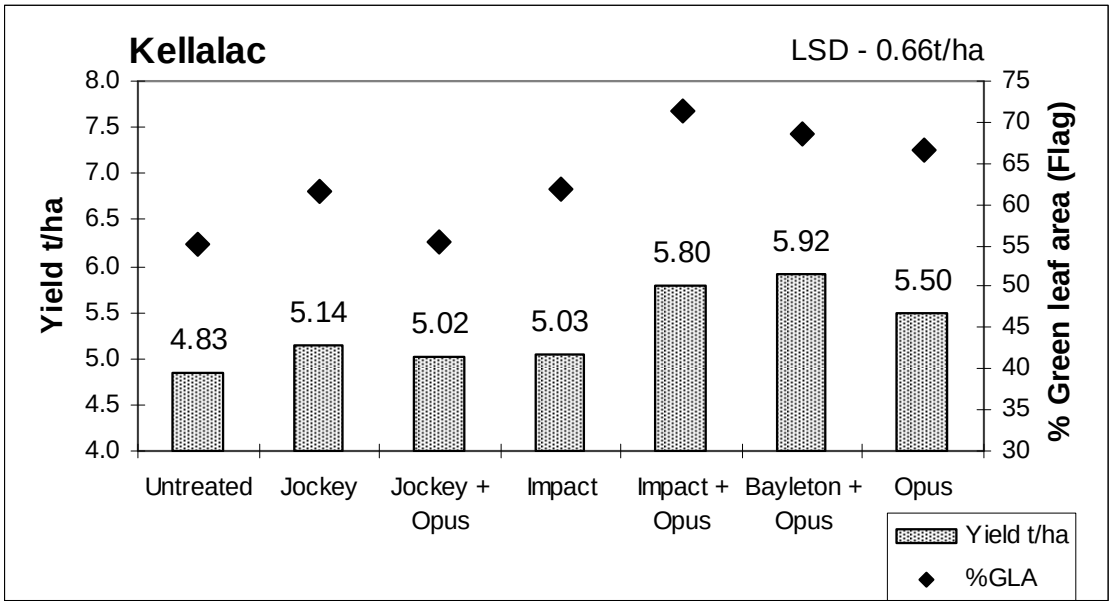
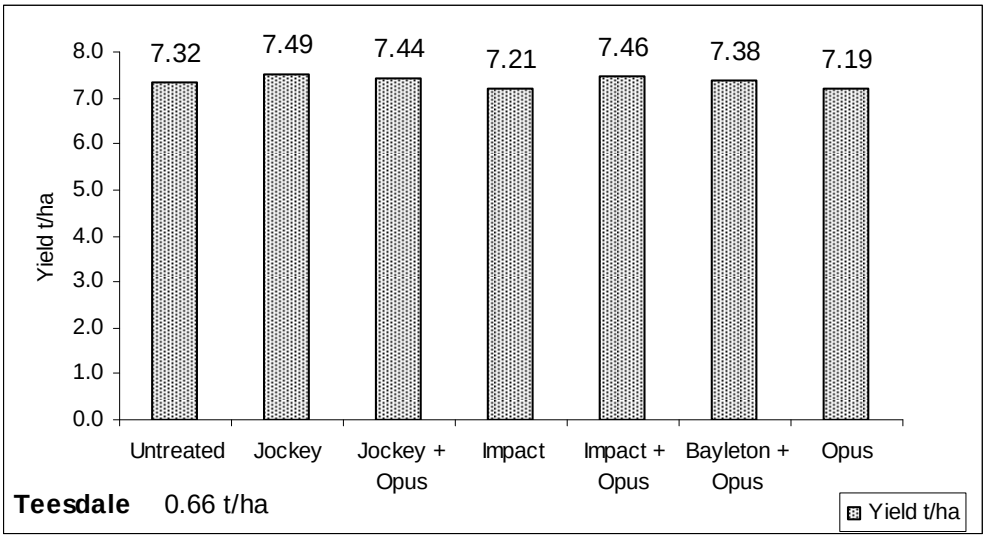


Figure 6-14: Influence Of Fungicide Treatment On Teesdale (R Rating For Stripe Rust) Yield (t/ha)



Influence of treatment on yield

There was a significant interaction between fungicide treatment and variety, with as expected, greater yield response to fungicide as the cultivar became more susceptible to disease. As a stand alone treatment, Opus applied at flag leaf was more effective than the upfront products Jockey and Impact.

However with Kellalac and Mitre yield was only maximized when two fungicide applications were applied. There was no significant yield difference between whether the first fungicide was an upfront measure (Jockey/Impact) or a foliar spray at GS32/33, however there was a slight trend for the GS32 sprays to be slightly superior to the upfront products. This difference is likely to have been caused by the fact that the upfront treatments did not fully persist until GS39 creating more disease pressure on the leaves below the flag leaf.

The value of the first fungicide was evident in the disease control on the two leaves below the flag leaf and was apparent in Mitre and Kellalac – (0.2-0.4 t/ha depending on treatment).

Influence of variety on yield

The resistant variety Teesdale gave the highest yields comparing the three varieties both treated and untreated, a result favoured by the relatively cool season suiting longer season cultivars . There was no significant response to fungicide with Teesdale, whilst Kellalac gave a maximum response of 1.09 t/ha and Mitre gave a maximum response 1.96 t/ha. The highest yields when treated with fungicide were Mitre approximately 5.34t/ha, Kellalac approximately 6 t/ha and Teesdale 7.5 t/ha.

Influence of fungicide treatment on quality

Table 6-14: Influence Of Variety & Fungicide Treatment On % Screenings (scr.) & % Protein (pro.)

Treatment	Mitre		Kellalac		Teesdale	
	% Scr.	% Pro.	% Scr.	% Pro.	% Scr.	% Pro.
Untreated	6.5	11.6	8.6	11.2	10.1	10.0
Jockey	7.5	12.6	8.5	11.2	11.4	9.6
Jockey fb Opus GS39	5.0	11.5	7.8	10.7	9.7	9.5
Impact	8.5	12.5	10.3	10.7	9.8	9.6
Impact fb Opus GS39	4.3	11.4	7.2	11.1	9.2	9.6
Bayleton GS32 fb Opus GS39	5.3	11.2	8.4	10.5	9.2	9.6
Opus GS39	5.6	12.4	8.9	11.5	10.0	10.0
LSD % (p = 0.05)	**3.3**	**0.6**	**3.3**	**0.6**	**3.3**	**0.6**
NSD – No significant differences	**NSD**	**	**NSD**	**	**NSD**	**NSD**

There were no significant differences in screening levels between fungicide treatments irrespective of variety. There were significant differences in the level of protein but there were few consistent trends related to yield.

Table 6-15: Influence Of Variety & Fungicide Treatment On Test Weight (kg/hl) & Thousand Seed Weight (TSW) g

Treatment	Mitre		Kellalac		Teesdale	
	Kg/hl	TGW	Kg/hl	TGW	Kg/hl	TGW
Untreated	63.4	24.66	74.1	26.33	77.8	38.33
Jockey	58.9	22.07	74.7	27.66	77.1	36.33
Jockey fb Opus GS39	69.2	27.25	75.8	27.50	77.2	37.99
Impact	58.7	23.57	74.4	27.99	77.6	35.24
Impact fb Opus GS39	69.4	28.24	75.1	29.32	77.0	37.49
Bayleton GS32 fb Opus GS39	69.1	28.33	75.4	28.66	76.3	36.58
Opus GS39	71.4	29.08	77.0	29.08	77.5	39.08
Average	**65.7**	**26.17**	**75.2**	**28.08**	**77.2**	**37.29**
LSD % (p = 0.05)	**4.4**		**4.4**		**4.4**	
	***		**NSD**		**NSD**	

NSD – No significant differences

Treatments involving a follow up spray at GS39 gave higher test weights for Mitre, although not significantly different for Kellalac and Teesdale. The same trend was evident for TGW.

Conclusions

Taking account of fungicide costs (both application and product) revealed that untreated Teesdale generated the equal highest margins (Table 6-16). With both Mitre and Kellalac the most cost effective treatments were two applications of fungicide based on a GS32 Bayleton followed by Opus, however as stand alone treatments the flag leaf spray of Opus was substantially more cost effective than either Jockey or Impact. The application of Bayleton at GS32 followed by GS39 Opus was slightly more cost effective than the Impact followed by Opus. Impact had an edge over Jockey in this trial in terms of green leaf retention, yield and margin.

Table 6-16: Influence Of Variety And Fungicide Strategy On Margin After Fungicide Cost $/ha – Inverleigh 2005

Treatment	Margin after fungicide costs ($/ha)		
	Mitre VS	Kellalac MS	Teesdale[17] R
Jockey	-62	-2	-53
Jockey + Opus GS39	158	-7	-35
Impact	-4	23	-49
Impact + Opus GS39	216	91	4
Bayleton GS32 +Opus GS39	223	118	-51
Opus GS39	204	55	-66
Untreated	0	0	0
Untreated Gross output (yield x grain price $/ha)	**575**	**702**	**1025**
Untreated Yield t/ha	**3.40**	**4.83**	**7.32**

[17] classed as feed grain $140/tonne

Notes:
Jockey seed treatment 450ml/100kg based on $20/ha, Impact 0.4 in furrow based on $20/ha, Opus 250 ml/ha GS39 costed at $15/ha and Bayleton 1000 ml/ha costed at $5/ha. Wheeling damage from foliar sprays based on 2.5% yield loss with $7.50/ha application cost for foliar sprays.
Mitre grain price based on AH $164/tonne adjusted for % screenings and protein
Kellalac grain price based on APW $ 150/tonne adjusted for % screenings and protein

Commercial Practice:

In the longer growing HRZ environment of southern Victoria, strategies for susceptible to moderately resistant varieties should be based on foliar fungicide targeted at protecting the flag leaf. The need to precede this fungicide with an upfront treatment such as Jockey or Impact should be related to the susceptibility of the variety, the rotation position and how well the grower is equipped to spray fungicides at GS32 (second node). Where varieties have some degree of resistance to stripe rust e.g. MS, MR-MS, then because there is a degree of natural resistance it maybe better to base the first fungicide on foliar spray at GS32 rather than upfront option, unless there is an early autumn break.

Other factors which favour an upfront treatment (Jockey or Impact) are where other diseases need to be controlled, such as take-all, in wheat on wheat situations. If growers are dependent on spray contractors or have wet ground in spring (early - mid September) then again it maybe more appropriate to target the superior upfront measures which can persist through until this stage in the season.

Overall, however, where growers are well equipped and variety resistance is slightly stronger than the most susceptible then foliar fungicides offer a more flexible approach, where fungicide application can be based on seasonal disease pressure.