Is there value in managing Septoria avenae blotch in oats in low disease pressure scenarios?

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Key messages

- Dry spring conditions in 2019 limited late-season disease development or spread.
- Low disease pressure and dry spring conditions resulted in fungicides providing no yield benefit.
- Fungicides were not able to improve grain quality and as a result were not economically viable.
- Disease pressure will dictate the need for fungicide application and the best timing. Ultimately spring rainfall will determine continued disease development and the return on investment from a fungicide application.

Background

Septoria is an aggressive disease in oats which is particularly damaging early and very late in the growing season. Earlier trials have shown that significant yield and grain quality gains can be made when favourable spring conditions are present, as infection levels increase rapidly when there is a wet canopy and mild-warm temperatures. Due to the potential for disease multiplication in later growth stages, fungicide management often needs to be prophylactic at the time of application. In previous trials, fungicides with long residual activity such strobilurins have been shown to give additional improvements in yield and grain over curative strategies using standalone DMI chemistries. Strategies using single and multiple DMI applications have also been shown to give substantial benefits over untreated controls. This trial series aims to identify whether benefits in yield and grain quality can be achieved from fungicide applications when oats are sown into lower disease risk scenarios, such as after a break crop (pasture or canola).

Aims

- Determine the best fungicide product and timing strategy to reduce fungal leaf disease in oats.
- Quantify economic merits of fungicide strategies in low disease pressure scenarios.
- Evaluate the economic return from foliar fungicide applications on oats and whether the additional cost of premium products increase yield, grain quality and subsequently grower returns.

Method

Two field trials were conducted in commercial Bannister oat crop at Highbury Western Australia and a commercial Wandering crop at Tarin Rock. Highbury was sown on 17 April onto a canola stubble and Tarin rock was sown on 25 April following a clover pasture. Plots were 12m x 3m, fungicide treatments were applied using a 2.5m hand-boom at a water rate of 100L/ha. Spray applications occurred at Highbury at second to third node at Z32-33 (22/07/2019) and at mid-late booting Z45-47 (12/08/2019). Tarin rock applications occurred at second node Z32 (23/07/2019) and mid-late booting Z45-47 (5/09/2019). No earlier fungicide applications were made to the paddocks. Commercial rates of single and double applications were used to reflect 'real world' strategies. Treatment timings are outlined in Table 1 and include combinations of; **Opus** (Epoxiconazole 125g/L), **Opera** (Pyraclostrobin 85g/L + Epoxiconazole 62.5g/L) and **Tilt** (Propiconazole 250g/L). Assessments of leaf disease severity were made before each application and 28 days after the second application.

The plots were harvested on 12 November at Highbury and 21 November at Tarin Rock using a plot header. Yields were recorded per plot and grain quality was assessed on harvested grain. Grain quality assessments included grain moisture (%), protein (%), hectolitre weight (kg/hl), screenings (% <2.5mm screen) and Septoria-stained grains (%).

Table 1. Fungicide treatments and application timings used in the 2019 trials

Z32	Z45
	Tilt (500ml)
Tilt (500ml)	
Tilt (500ml)	Tilt (500ml)
	Opera (500ml)
Opera (500ml)	
Tilt (500ml)	Opera (500ml)
	Opus (500ml)
Opus (500ml)	
Tilt (500ml)	Opus (500ml)
Untreated Control	Untreated Control

Results – seasonal conditions

The 2019 season started with very dry conditions and minimal stored soil moisture. At both sites growing season rainfall was well below long-term averages. Highbury had some localised falls just before seeding on 17 April. This allowed for an early germination in some areas of the paddock, including the area where this trial was located. Significant rainfall occurred in June which was followed by average falls in July and August. The Tarin Rock site germinated predominantly after the June rains although some portions of the paddock emerged in May. The result was a year that was much drier than average coming into August and September. Rainfall was very sparse in August and September which was not favourable to the development of the disease. A dry period in late September and early October resulted in rapid senescence of the crop and no disease development. When rain did fall in mid-October the plants were mostly senesced and unable to take advantage of new moisture availability.

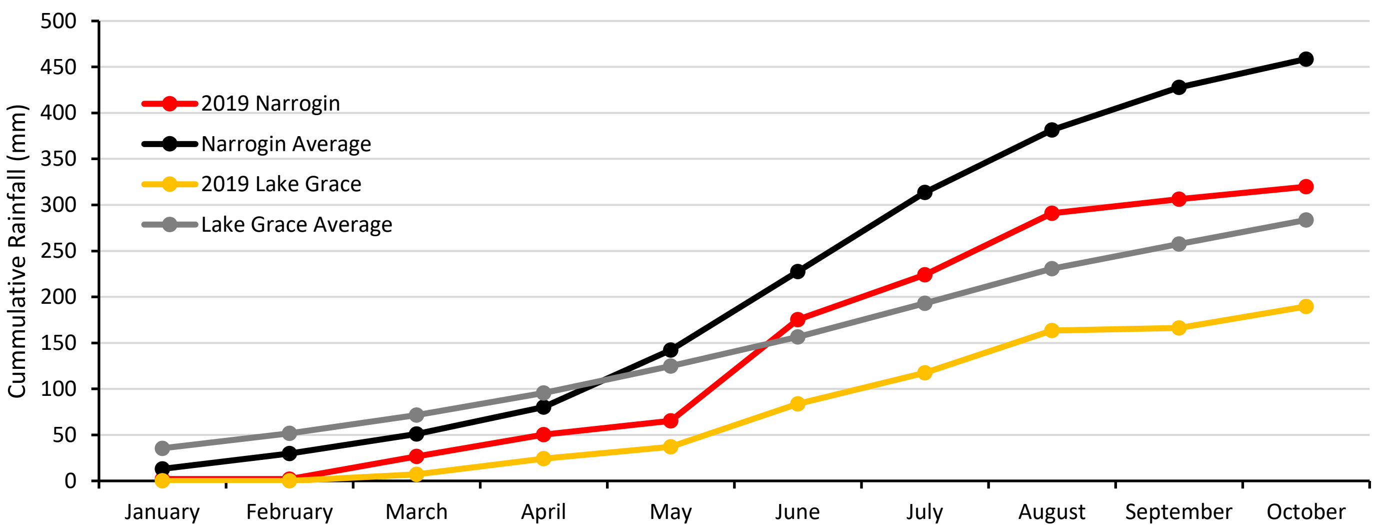

Figure 1. Cumulative rainfall from the Narrogin and Lake Grace weather stations for the 2019 seasons compared to the long-term averages

Results – Highbury 2019

Leaf disease assessments

Leaf disease at the site was low throughout the season. Infection was present, and levels did increase slowly over the July to September period suggesting that given the right conditions (warm and wet spring) these levels had potential to increase to yield damaging levels (Figure 2). Levels increased slightly on the upper leaves between the August and September timings however infection levels rose sharply in the lower leaves indicating an earlier infection event.

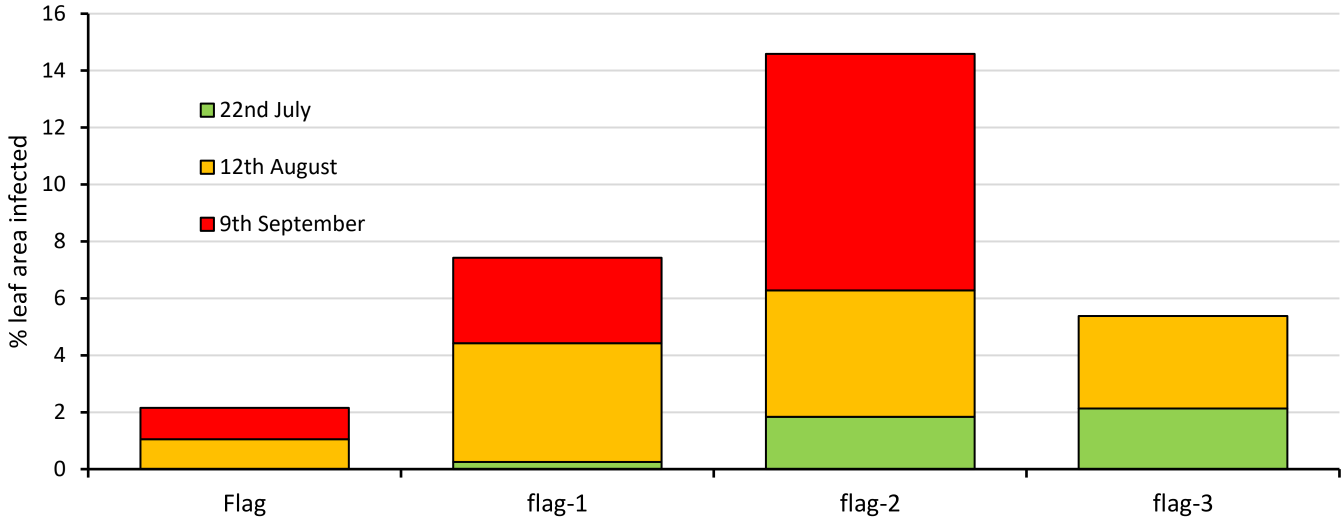

Figure 2. Change in percentage leaf area over time of the untreated control infected by Septoria at Highbury in 2019.

The dry finish to the season resulted in a lack of disease severity and low disease progression through the canopy. Final assessments at 28 days after the Z45-47 spray revealed an average infection on the top three leaves of the untreated control of 4.2% (Table 2). The dry conditions moving into September resulted in rapid plant senescence and no further assessments of disease severity were made. However, an observation 42 days after spraying indicated similar disease severity to that present at the initial 28-day assessment. Leaf assessments made 28 days after Z45-47 showed that single, late applications of fungicide were less effective than single early or two spray strategies at reducing the total amount of disease. However, it must be noted that disease levels were low in all treatments including untreated controls. The lack of rainfall after the Z45-47 spray meant that there was little support for disease development and subsequently no requirement for late season protection from new disease. Infection present at the time of spraying in the mid-lower canopy had resulted from rainfall before the Z45-47 spraying. Similarly, there was no difference in the amount of disease control between early sprays and two spray strategies as the later spray was not as necessary. Notwithstanding this, there were still significant control gains made by the late sprays over the untreated control (Table 2) which reflects the slight increase in infection levels shown in Figure 2.

Table 2. Percentage leaf area infection and fungicide interaction 28 days after Z45-47 application at Narrogin

Septoria severity (% leaf area diseased) 28 days after Z45-47 applications								
	Flag		Flag-1		Flag-2		Average	
Tilt + Opus	0.3	a	0.5	a	0.7	a	**0.5**	**a**
Tilt + Opera	0.4	a	0.6	ab	0.9	a	**0.6**	**a**
Opera + Nil	0.3	a	0.8	ab	0.9	ab	**0.7**	**ab**
Opus + Nil	0.3	a	1.0	abc	0.6	a	**0.7**	**ab**
Tilt + Tilt	0.4	a	0.7	ab	1.0	abc	**0.7**	**ab**
Tilt + Nil	0.6	a	1.3	bc	1.2	abc	**1.1**	**abc**
Nil + Opus	0.3	a	1.2	abc	2.9	cd	**1.5**	**bc**
Nil + Opera	0.5	a	1.4	bc	2.8	bcd	**1.6**	**c**
Nil + Tilt	0.6	a	1.8	c	3.3	d	**1.9**	**c**
Untreated control	1.1	b	3.0	d	8.4	e	**4.2**	**d**

Grain yield

Given the seasonal conditions grain yield was high at the Highbury site with the untreated control averaging 4.96t/ha. Yield was variable between replicates and within treatments and this ultimately resulted in no significant difference between any fungicide treatment or any fungicide treatment and the untreated control. The low levels of disease particularly on the flag leaf and the lack of finishing rains suggests that disease was unlikely to be a contributor to any of the yield variation.

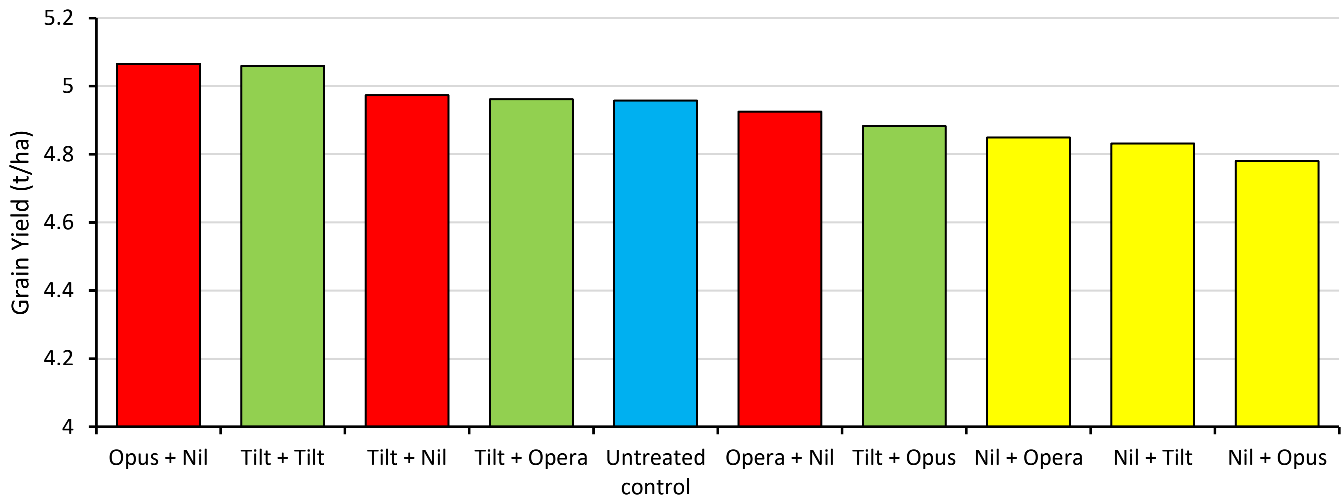

Figure 3. Grain yield (t/ha) by fungicide treatment and timing in Highbury 2019 (blue=no application, red=Z32 application, yellow=Z45 application, green = double application)

Grain quality and Septoria-stained grains

There was no interaction between fungicide treatment and any grain quality components. Septoria levels were low at the site and there was no interaction between fungicides or timings and the untreated control.

Table 3. Grain quality and stained grains at Highbury in 2019.

Grain Quality								
	Protein		Screenings		Hectolitre weight (kg/hL)		Stained grain	
Tilt + Opus	9.0	a	3.1	a	51.3	a	6.5	a
Tilt + Opera	8.7	a	2.9	a	52.7	a	6.3	a
Opera + Nil	9.3	a	4.2	a	51.0	a	6.0	a
Opus + Nil	8.6	a	3.2	a	51.8	a	8.8	a
Tilt + Tilt	9.0	a	3.3	a	52.2	a	7.8	a
Tilt + Nil	8.6	a	2.6	a	52.7	a	10.3	a
Nil + Opus	9.0	a	3.6	a	49.1	a	10.0	a
Nil + Opera	8.7	a	2.7	a	54.0	a	11.5	a
Nil + Tilt	8.7	a	3.0	a	53.3	a	10.3	a
Untreated control	8.8	a	2.6	a	52.2	a	9.0	a

Economics

With no significant yield gains from any treatment, the additional costs incurred by the fungicides and their application resulted in all fungicide treatments returning a loss compared to the untreated control. Two spray strategies inclusive of Opera were the most expensive followed by those inclusive of Opus. Single spray strategies resulted in the smallest loss from Tilt followed by Opus or Opera. However, given the high yield potential at the site (4.93t/ha) only a marginal increase in yield from a fungicide treatment would be needed to cover the costs of application. Costs could be covered by a 1% increase in yield for the cheapest treatments (~50kg/ha) and for a risk management approach aiming to triple the return on investment, a yield increase of 8% is required for the most expensive treatment (~400kg/ha).

Table 4. Percentage yield increase required for return on investment (ROI) for each fungicide strategy

Percentage Yield Increase Required for ROI*				
	Total Costs	Breakeven	Double Investment	Triple Investment
Tilt + Opera	38	2.7	5.3	8.0
Tilt + Opus	36	2.5	5.0	7.6
Tilt + Tilt	30	2.1	4.2	6.3
Opera + Nil	23	1.6	3.2	4.8
Nil + Opera	23	1.6	3.2	4.8
Opus + Nil	21	1.5	2.9	4.4
Nil + Opus	21	1.5	2.9	4.4
Tilt + Nil	15	1.0	2.1	3.1
Nil + Tilt	15	1.0	2.1	3.1
Untreated control	0	0.0	0.0	0.0

*Assumptions: Decile 5 oat1 price $290 (2014-2019). Application Cost $9/ha. Tilt $6, Opus $12, Opera $14. Site yield average 4.93t/ha

Results – Tarin Rock 2019

Leaf disease assessments

Infection levels were very low at the Tarin Rock site with total infection levels on any leaf not exceeding 2% of total leaf area at any time of measurement. Infection on the flag leaf by 4 October was negligible as the dry conditions did not allow for spread into the upper canopy. On many plants there was no infection present on the flag leaf. The relatively low level of oats grown in the region and the establishment of the crop on a pasture paddock was reflected in the early infection levels.

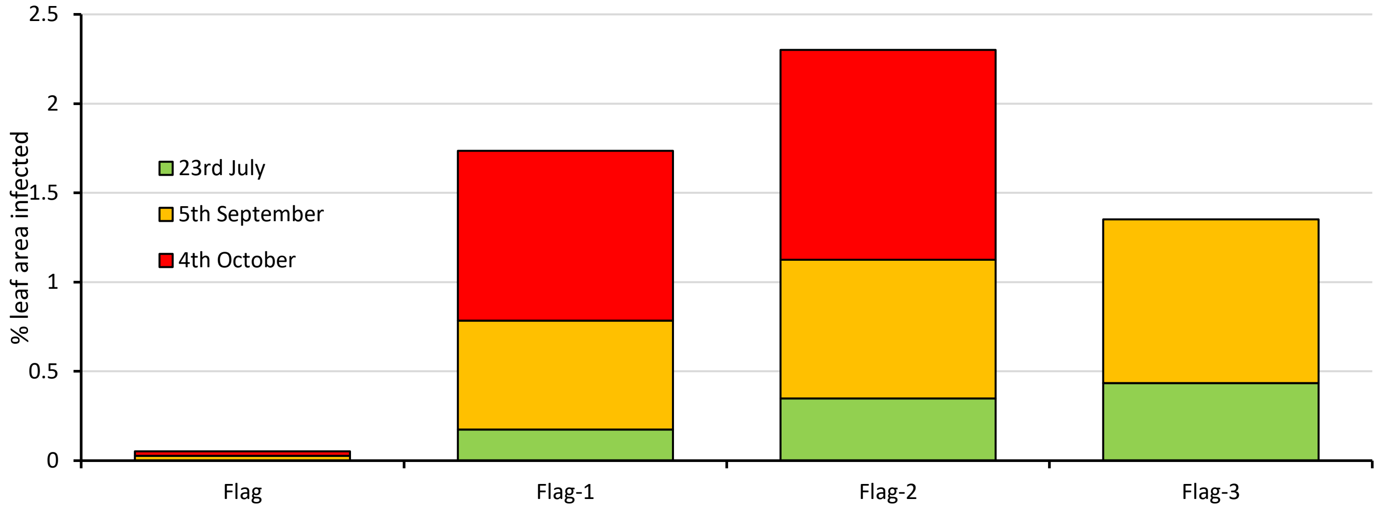

Figure 4. Change in percentage leaf area of the untreated control infected by Septoria over time at Tarin Rock in 2019

Infection levels in the untreated control averaged 0.7% of total leaf area, which is extremely low. Application of fungicides reduced disease levels when averaging the top three leaves in all situations except for a Z32 application of Tilt. There was no difference in the level of control between all other fungicide strategies. While there were significant differences in disease response to fungicide, the very low severity in the untreated control makes it difficult to draw any clear conclusions on the performance of one tactic over another (Table 4).

Table 5. Percentage leaf area infection and fungicide interaction 28 days after Z45-47 application at Tarin Rock

Septoria severity (% leaf area diseased) 28 days after Z45-47 applications								
	Flag		Flag-1		Flag-2		Average	
Tilt + Opus	0.1	a	0.1	a	0.2	a	**0.1**	**a**
Tilt + Opera	0.0	a	0.2	ab	0.6	ab	**0.3**	**a**
Opera + Nil	0.1	a	0.2	ab	0.4	a	**0.3**	**a**
Opus + Nil	0.0	a	0.3	ab	0.6	ab	**0.3**	**ab**
Tilt + Tilt	0.0	a	0.1	a	0.4	a	**0.2**	**a**
Tilt + Nil	0.1	a	0.6	bc	0.9	bc	**0.5**	**bc**
Nil + Opus	0.0	a	0.1	a	0.3	a	**0.1**	**a**
Nil + Opera	0.1	a	0.1	a	0.5	a	**0.2**	**a**
Nil + Tilt	0.0	a	0.1	a	0.4	a	**0.2**	**a**
Untreated control	0.0	a	0.9	c	1.1	c	**0.7**	**c**

Grain yield

Grain yields were higher than expected considering that rainfall was below average at the site. Yields in the untreated control averaged 2.32t/ha. Yield variation between replicates and within treatments resulted in no significant difference in yield between any fungicide treatment and the untreated control. Yield variability within the trial area was likely the result of differences in water availability late into the season. There were clear indications of old tree sites throughout the paddock which were scattered through the trial area and appeared to hold moisture longer causing the areas to stay green longer. This only became obvious as the crop senesced prematurely.

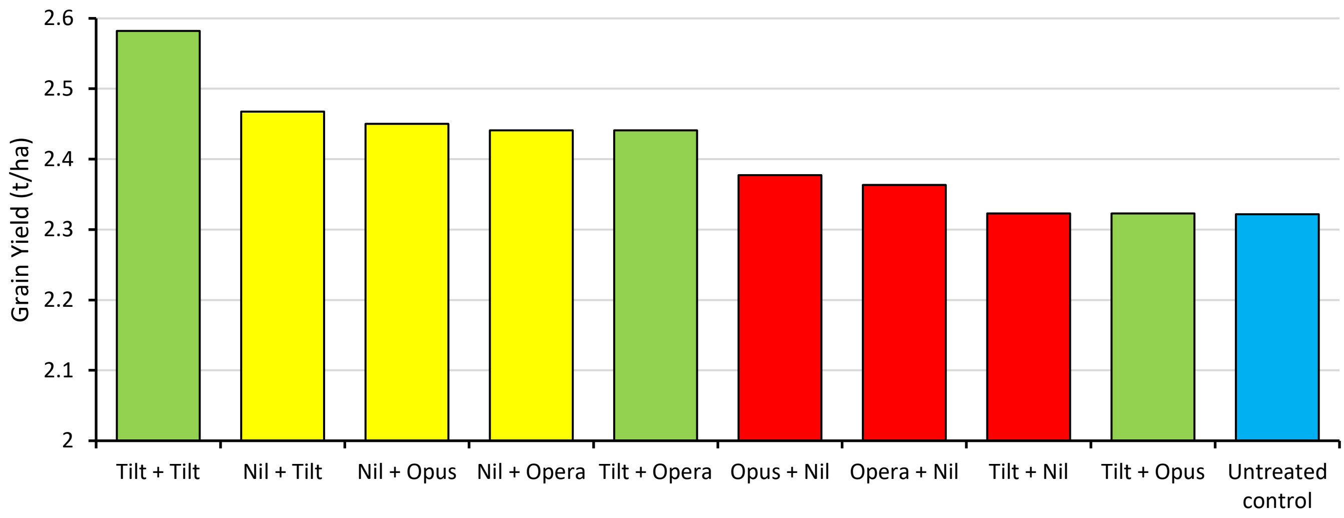

Figure 5. Grain yield (t/ha) by fungicide treatment and timing at Tarin Rock 2019 (blue=no application, red=Z32 application, yellow=Z45 application, green= double application)

Grain quality and Septoria-stained grains

There was no interaction between fungicide treatment and any grain quality components. Septoria levels were low at the site and there were no interactions between fungicides or timings and the untreated control.

Table 6. Grain quality and stained grains at Tarin Rock in 2019.

	Grain Quality							
	Protein		Screenings		Hectolitre weight (kg/hL)		Stained grain	
Tilt + Opus	11.7	a	8.2	a	49.30	a	1.3	a
Tilt + Opera	11.3	a	7.1	a	49.33	a	0.8	a
Opera + Nil	11.7	a	8.7	a	49.32	a	0.0	a
Opus + Nil	11.4	a	8.3	a	49.93	a	0.8	a
Tilt + Tilt	11.4	a	8.7	a	49.19	a	1.5	a
Tilt + Nil	11.6	a	7.6	a	49.15	a	0.3	a
Nil + Opus	11.4	a	7.6	a	50.30	a	0.0	a
Nil + Opera	11.8	a	7.2	a	49.73	a	0.5	a
Nil + Tilt	11.9	a	8.9	a	50.19	a	0.8	a
Untreated control	11.5	a	7.8	a	48.98	a	0.5	a

Economics

With no significant yield gain or impact on grain quality, the economic relationship mirrored the Highbury site but the requirements for a breakeven through to a triple return on investment were much more difficult to achieve. A 2.4% yield increase on the cheapest treatment would be needed to breakeven and a yield increase of 18.3% would be needed to triple the return on investment made from the expensive strategies. An improvement in grain quality and subsequently price would slightly reduce the amount of yield increase required.

Table 7. Percentage yield increase required for ROI for each fungicide strategy

	Percentage Yield Increase Required for ROI			
	Total Costs	Breakeven	Double Investment	Triple Investment
Tilt + Opera	38	6.1	12.2	18.3
Tilt + Opus	36	5.8	11.6	17.4
Tilt + Tilt	30	4.8	9.7	14.5
Opera + Nil	23	3.7	7.4	11.1
Nil + Opera	23	3.7	7.4	11.1
Opus + Nil	21	3.4	6.8	10.1
Nil + Opus	21	3.4	6.8	10.1
Tilt + Nil	15	2.4	4.8	7.2
Nil + Tilt	15	2.4	4.8	7.2
Untreated control	0	0.0	0.0	0.0

Assumptions: Decile 5 oat2 price $258 (2014-2019). Application Cost $9/ha. Tilt $6, Opus $12, Opera $14. Site yield average 2.41t/ha

Conclusions

The sites were selected to reflect a standard oat rotation onto a break crop from the previous season (canola at Highbury and pasture at Tarin Rock). Traditionally, oat disease work has been carried out on high disease pressure scenarios where oats are either planted onto oat stubbles or oat stubble is introduced. Previous trial work and anecdotal evidence have shown an improvement in grain yield and quality when the conditions favour disease development. The low-pressure rotation and subsequent dry spring conditions in 2019 were the ultimate drivers in the low level of disease expression and the lack of yield response to fungicide applications.

Infection levels late in the season increased slightly over mid-season infection levels, however rapid senescence and lack of late rainfall prevented the disease from aggressively infecting the upper canopy at either site. Yields were variable within the sites but showed no significant response to fungicide application.

In previous trials under high disease pressure, interactions between grain quality and strobilurin fungicide applications showed an improvement in hectolitre weight and screenings. These observations did not occur in this trial series with both sites showing no difference in grain quality between fungicide treatments and the untreated control. In the absence of significant levels of disease and sufficient soil moisture to retain green leaf area no fungicide response or differentiation between products was evident.

Hectolitre weights and screenings at the Highbury site meant that, in general, samples achieved the Oat1 standard. The Tarin Rock site had higher screenings and lower hectolitre weight than the Highbury site and samples were at an Oat2 standard. The variety grown, greater growing season rainfall and earlier germination are likely to have reduced the stress on the plant during grain fill allowing for better quality at the Highbury site.

With no variation in grain quality or grain yield, all fungicide treatments were uneconomical in the 2019 season. Expensive fungicide strategies hold more merit in higher yield potential areas as the percentage increase in yield to breakeven on costs is much lower. The costs involved with premium fungicides in low rainfall zones result in a much higher level of risk required to gain a return on investment. If grain quality improvements were achieved through the use of premium fungicides and the oats moved from an Oat2 to Oat1 grade, then this would significantly reduce the risk profile.

These results suggest there is a need to deploy fungicide applications in oats strategically. Disease development in the canopy will dictate the need for an application, this will be driven by the level of inoculum present in lower canopy, susceptibility of the variety grown and favourable disease weather (warm moist conditions). This remains difficult with *Septoria avenae*, usually requiring prophylactic application before its aggressive development later in the season. Assessments should be made on the lower canopy to identify the potential risk of the spread of the disease into the upper canopy. The impact of disease control will depend on the timing of applications and the finish of the season. The indications from these trials is that in rotation crops with low initial inoculum or in seasons or regions with lower likelihood of spring rainfall, return on investment from fungicide application is less certain.

A better understanding of disease thresholds in typical spring conditions is required to create strategies that can optimise yield and grain quality. An accurate risk matrix could be developed from these results to give growers a better understanding of the potential return on investment from their fungicide decisions.

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