4. Septoria Tritici Blotch (STB) Control in Wheat

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FAR Australia

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TAKE HOME MESSAGES

- Reduced sensitivity of the Septoria tritici blotch (STB) pathogen Zymoseptoria tritici to triazole fungicides is likely to be an increasing problem, following the discovery of more resistant biotypes (R8 strain or Isoform 11) on the mainland in 2016.
- The presence of this strain and its proportion in the population will influence disease management strategies differentially.
- In Tasmania, early season disease control in the field with flutriafol (2017 trials) and tebuconazole (2016 trials) has been reduced by the more resistant biotypes of the pathogen, whilst on the mainland trial sites the activity of flutriafol appears to have been maintained in 2017 for the control of STB.
- The performance of a new SDHI based seed treatment and to a lesser extent fluquinconazole (Jockey) has been better than flutriafol in Tasmanian trials.
- Triazole/strobilurin mixtures based on epoxiconazole and azoxystrobin (e.g. Radial, Tazer Xpert), along with new as yet unregistered combinations of triazole & SDHI have given excellent control of STB.
- In 2016 the advantage of these products was evident in disease control and yield response in wheat but in 2017 the yield response to these products was similar to that observed with Opus and Prosaro (registered in wheat but not registered for STB control).
- Single spray timings of foliar fungicide for control of STB made during the tillering phase gave less effective disease control than applications made between GS31 – GS39.
- The most effective control of STB on a canopy leaf layer is achieved by applying fungicide to that leaf shortly after it has fully emerged but before infection becomes established.
- Where more than one fungicide is used in wheat avoid using the same triazole active ingredient twice in a season, irrespective of diseases to be controlled. If it is not possible ensure it is mixed with another mode of action (strobilurin) at one of the timings.
- Since strobilurins are at higher risk of resistance avoid using products containing these active ingredients more than once in a season.

Introduction

The following report is based on a GRDC funded project and is a collaboration between FAR Australia, Southern Farming Systems, Mackillop Farm Management Group and SARDI. The report covers the key aspects of research conducted in 2017 with references to data from 2016. The report looks at the following aspects of STB disease control:

Section 1.	***Influence of "at sowing" fungicide products on the mainland and in Tasmania***
Section 2.	***Foliar fungicide performance against STB***
Section 3.	***Fungicide timing for STB control***
Section 4.	***Integrated Disease Management (IDM) - influence of cultivar resistance on fungicide strategy***

It is important to recognise that fungicide strategies for the control of STB in the field are now being influenced by mutations in the pathogen population that show reduced sensitivity to some triazole fungicides, particularly flutriafol and tebuconazole. At present these effects are most evident in Tasmania where there is a more severe mutant strain (Isoform 11 or R8 strain) that is at higher proportions in the population than on the mainland. However the Isoform 11 or R8 strain is now being found on research sites in SE Australia including trial locations in this project.

Keywords

Septoria tritici blotch (STB) Zymoseptoria tritici, Fungicide resistance, Integrated Disease Management (IDM), Quinone outside Inhibitors (QoIs), Strobilurins, Triazoles.

Background

Septoria tritici blotch (STB) continued to be a problem in 2017 despite the drier conditions encountered compared to 2016. This was likely the result of stubble infection from 2016 and varietal susceptibility. Whilst the adoption of Integrated Disease Management (IDM) remains central to prolonging the activity of fungicides, 2017 research results illustrated geographic region was a key consideration in the adoption of fungicide management strategies. In Tasmania where the use of fungicides is more intensive as a result of a longer more disease prone season, the field performance of commonly used fungicides, such as flutriafol and tebuconazole, are being compromised by more resistant strains of the STB pathogen. These more resistant strains show reduced sensitivity to fungicide applied in the field meaning that although they still give some control, they are not as effective as they once were. It was confirmed at the 2017 Adviser Updates (NSW DPI) that the more resistant strains found in Tasmania are now being found on the mainland at low levels in the population. As a result FAR Australia, working with Southern Farm Systems and Mackillop Farm Management Group, have been evaluating the performance of these fungicides on both the mainland and in Tasmania. This paper builds on the paper presented at the 2017 GRDC updates looking at the 2017 results from the GRDC funded project FAR 00004A, that was set up to look at the control of STB and leaf rust in the field.

Research conducted on Septoria Tritici Blotch (STB) in 2017

Field research was conducted at four sites in the 2017 season: Hesse and Westmere in southern Victoria, Hagley in Tasmania and Conmurra in south east South Australia. In contrast to 2016 growing season rainfall (April – November) for 2017 was lower in all of these regions, a factor which would have restricted the ability of the disease to be as damaging.

At the time of writing this paper 2017 harvest data was in the process of being analysed or trials were not yet ready for harvest (Tasmania), therefore the following paper is primarily based on disease data collected from FAR Disease Management Centre at Hesse in southern Victoria, where yield data was available.

Table 1. Growing season rainfall (GSR) at the research locations where control of STB is being assessed.

Trial Site Region	2016	2017
Hesse, Victoria	430	379
Hagley, Tasmania	827	430
Conmurra, South Australia	675	476
Westmere, Victoria	561	436

Results & Discussion

Section 1. Influence of at "sowing" fungicide products on the mainland and in Tasmania

Work in southern Victoria where STB has been problematic since 2010 has shown that flutriafol applied in furrow is still giving relatively good control despite the discovery of STB strains that reduce the performance of flutriafol. Results at FAR Australia's Disease Management Centre in 2016 & 2017 revealed field control from flutriafol was similar (or superior data not shown) to fluquinconazole (Jockey) (Figure 1).

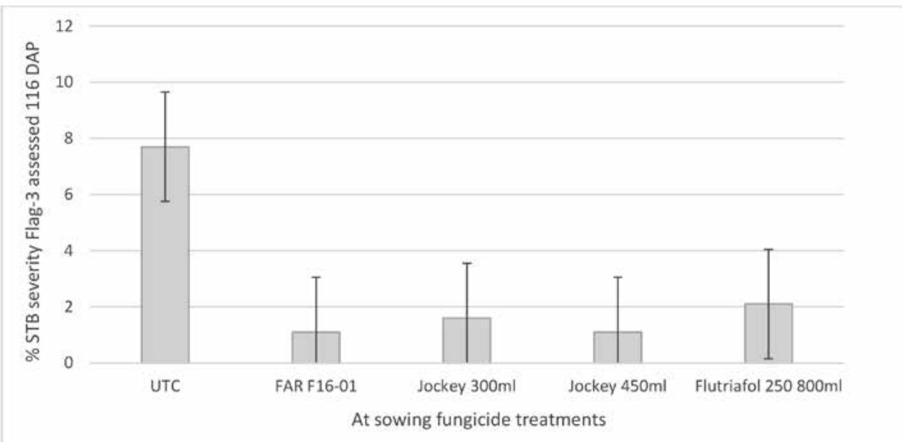


Figure 1: Influence of "at sowing" fungicide applications on % STB infection recorded on F-3 at GS37-39 on 31 August 116 days after planting – cv Bolac⁽ᴰ⁾, Gnarwarre, southern Victoria 2016 FAR F16-01 (Experimental seed treatment), Jockey 300mL (/100kg of seed), Flutriafol 250 800ml/ha (applied to MAP).

At present it is thought that the level of the R8 strain or isoform 11 strain (the strain that carries one of the more serious mutations for reduced sensitivity to triazoles) is at relatively low levels in the mainland population of STB. This may help explain why flutriafol's field performance still appears reasonably good. However assuming that this strain of the disease is equally fit (adapted to the environment) as other strains of the STB pathogen it is likely that this strain will increase in importance and as a result increasingly reducing the efficacy of triazole fungicides, in particular flutriafol and tebuconazole. This is what looks to have has happened in Tasmania where the frequency of the R8 or Isoform 11 strain in the STB population is much higher than it is on the mainland. This strain in Tasmania is at such high levels in the population that the performance of triazoles in the field is now being compromised. However, the reduction in the performance of triazoles is not occurring equally. In trials data flutriafol and tebuconazole are affected to a greater extent than other triazoles, such as the seed treatment fluquinconazole (Jockey) or the foliar applied triazole epoxiconazole (Opus). Fungicides with an alternative mode of action such as the SDHI seed treatment FAR F17-01 are also unaffected by this mutant strain and have performed extremely well in 2017 at the Tasmanian site (Figure 2).

It should be emphasised that the fungicide products tested are all approved for use in wheat and were tested for control of STB and leaf rust that occurred together in this experimentation. It should also be emphasised that not all products tested have an individual label recommendation for STB control, even though they are all approved for use in wheat. The infection of leaf rust was not noted to be as severe in 2017 and therefore is unlikely to have influenced the yield results to the same extent as it did in 2016.

Overall, from the trial locations where testing is taking place it would appear that disease management strategies in Tasmania need to be modified to take account of changes that have already occurred in the STB pathogen population. However, on the mainland if the proportion of more resistant isolates increases then changes in disease management strategies will be forced upon growers and advisers as some active ingredients become less effective. For now though, whilst we are not seeing the effects of changes in the STB population to the same degree on the mainland, it is important that we collectively act by adopting as many IDM options as possible before resorting to fungicide use and wherever possible alternating our fungicide strategies so we do not depend on the same active ingredients.

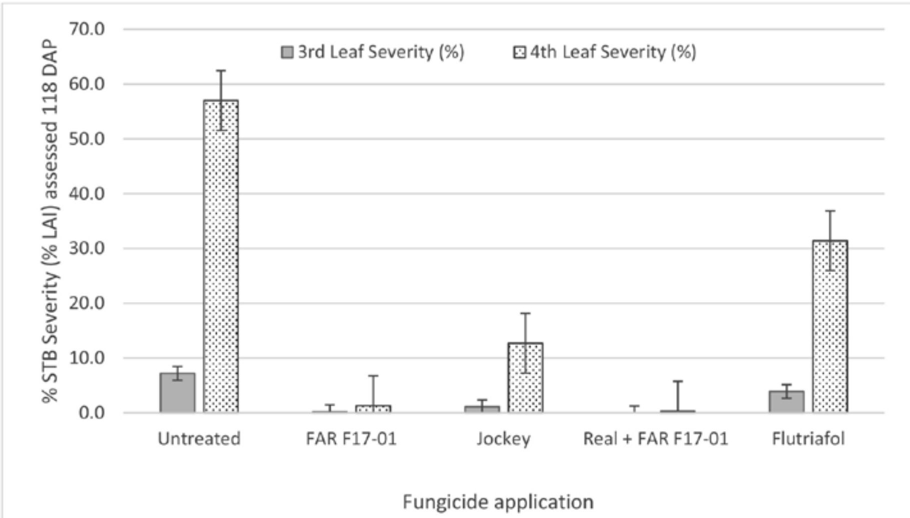


Figure 2: Influence of "at sowing" fungicide applications and Opus 500mL/ha applied at GS24 on % STB infection severity recorded on third and fourth oldest leaf at the late tillering stage (GS25) on 23 August 118 days after planting – cv SQP Revenue(), Hagley, Tasmania.

Based on 50 lesions tested from 10 samples from untreated areas of the trial the following STB mutations were found: 100% frequency CYP 51 Isoform 8 based (mutation Y416S), 76% CYP 51 Isoform 10 based (mutation Y137F) &100% frequency CYP 51 Isoform 11 based (6 mutations including double deletion 459/460)

Section 2. Foliar fungicide performance against STB

The significant differences in product performance resembled results generated in 2016 under higher disease pressure with triazole and strobilurin mixtures (Radial, Amistar Xtra based on the strobilurin azoxystrobin) and SDHI's performing more strongly than some of the triazoles applied alone (Figure 3 & 3a). Of the triazoles used in wheat, Opus 125 SC® (epoxiconazole) and Prosaro 420 SC® (tebuconazole & prothioconazole) were significantly superior to Folicur 430 SC (tebuconazole) and the coded triazole FAR F1-16. In terms of yield response all fungicides applied at their full rate gave a significant yield response, however there were no significant yield advantages to the strobilurin and SDHI triazole mixtures over Opus and Prosaro in 2017 as there had been in 2016 when both yields and disease pressure were higher. In SA (Figure 3a) the performance of products was not quite as effective as that observed in Victoria but the overall pattern of response was similar with Opus, Radial, Aviator Xpro and Ceriax being the most effective, however the advantage of Ceriax (three way mixture of SDHI, strobilurin and triazole not yet registered) at this site was more pronounced.

It should be emphasised that although Opus and Prosaro are approved for use in wheat but there is currently no label recommendation for STB control.

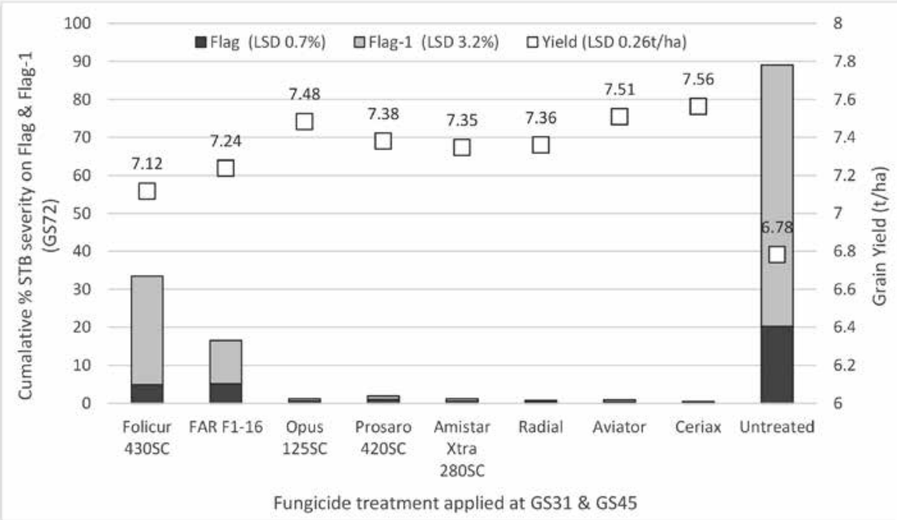


Figure 3: Influence of foliar fungicides (full label rate) on STB % severity and yield (t/ha) of wheat – cv SQP Revenue^, FAR Disease Management Centre, Hesse, Southern Victoria.

Φ Of the products listed in Figure 3 the only Aviator product registered as Aviator XPro and it is not registered in wheat. Ceriax is not registered and Folicur is no longer registered. These products are used for research purposes only.
Based on 50 lesions tested from 10 samples from untreated areas of the trial the following STB mutations were found: 86% frequency CYP 51 Isoform 8 based (mutation Y416S), 69% CYP 51 Isoform 10 based (mutation Y137F) &6% frequency CYP 51 Isoform 11 based (6 mutations including double deletion 459/460)

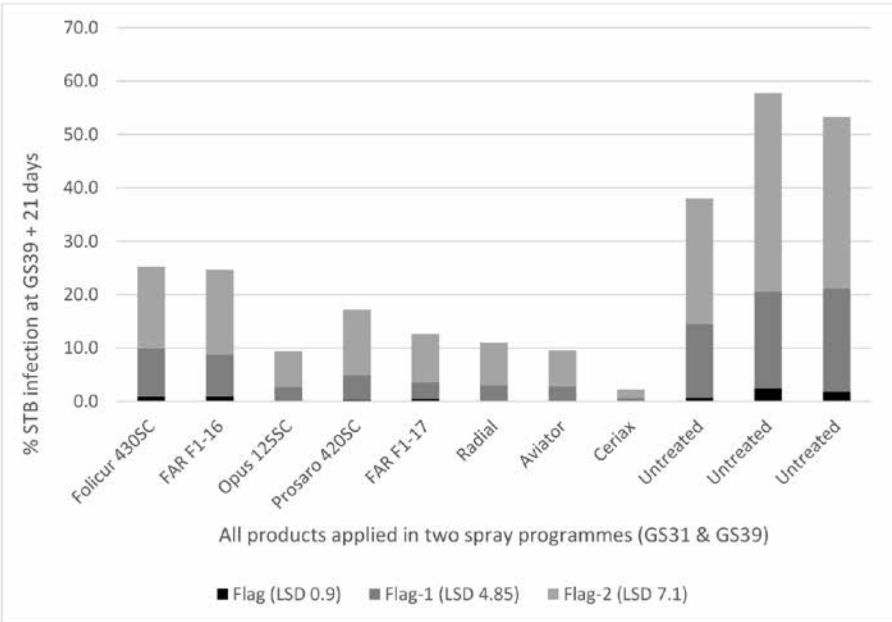
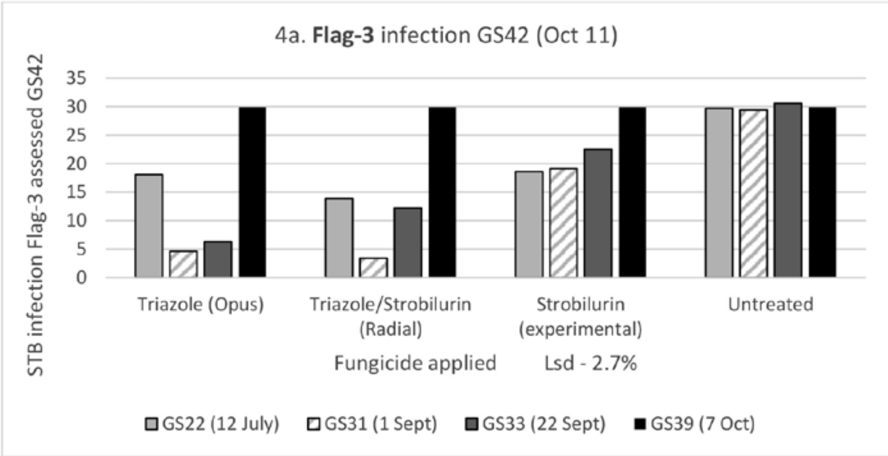


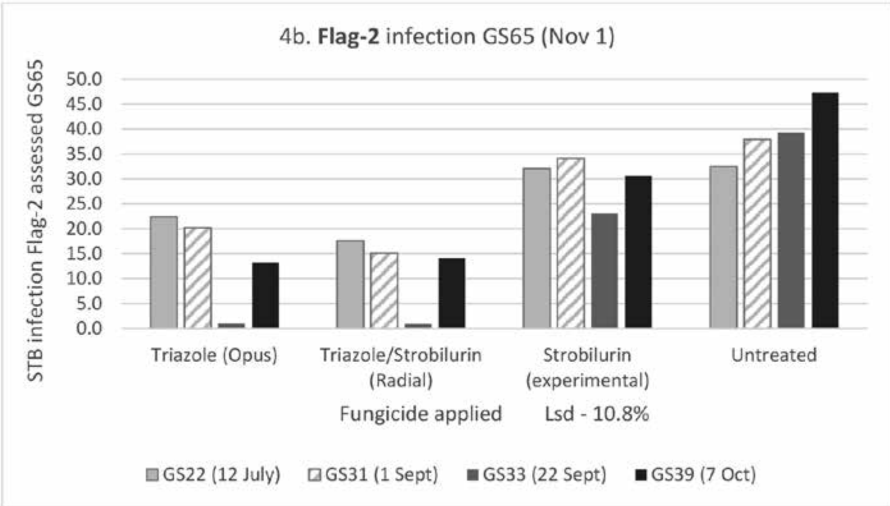
Figure 3a: Influence of foliar fungicides (full label rate) on STB % severity and yield (t/ha) of wheat – cv SQP Revenue^, Mackillop Farm Management Group & SARDI, Conmurra, SA.

Φ Of the products listed in Figure 3 the only Aviator product registered as Aviator XPro and it is not registered in wheat. Ceriax is not registered and Folicur is no longer registered. These products are used for research purposes only.
The trial was badly waterlogged so yields for the site were very variable and are not presented.

Section 3. Influence of fungicide timing for STB control

STB is a stubble borne disease with the majority of the spore release from the stubble taking place in the autumn and winter under wet humid conditions. This initial spore release from the stubble is airborne and gives rise to the characteristic STB symptoms on the lower leaves of the crop later in the winter/early spring. Further infection from these blotch lesions takes place under wet conditions with secondary spores that spread up the plant by rain splash or the rubbing of wet leaves in the wind. These secondary spores are unable to travel long distances which means that the infection base you have in spring is likely to be your source of further infection, unlike the rusts where airborne spores can move into the crop later in spring. This raises the question as to when foliar fungicides should be sprayed in the spring to secure the best disease control and greatest economic response. To help answer that question, single applications of fungicide were applied during tillering GS22 (12th July), first node GS31 (1st September), GS33 (22nd September) and flag leaf emergence GS39 (7th October). Spraying early should control the disease at an early stage of the epidemic although the leaves protected will be less important to grain fill. Spraying later allows greater early infection on the lower leaves but applies fungicide to the first of the physiologically more important leaves for grain fill (flag-2 and flag-1). Figure 4a, 4b & 4c shows the influence of the different fungicide timings on STB infection on flag-3, flag-2 and flag-1 at the flowering stage of the crop.





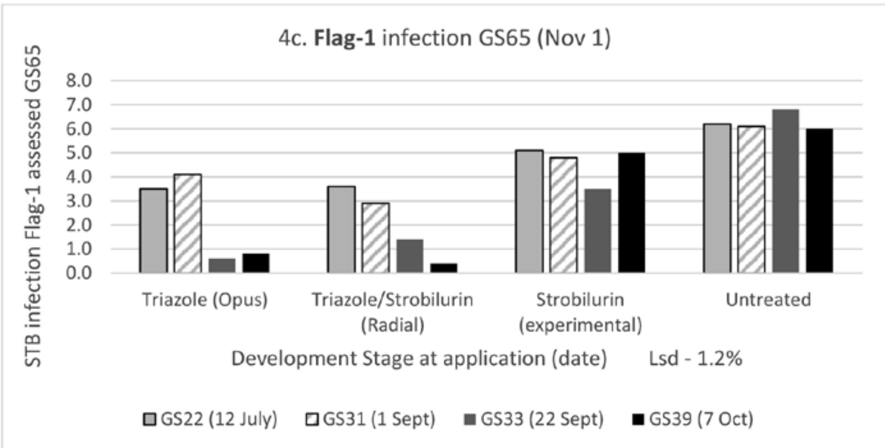


Figure 4a, 4b & 4c: Influence of single foliar fungicide spray timings with different modes of action (triazole – epoxiconazole and Radial that contains a mixture of two modes of action triazole - epoxiconazole and experimental strobilurin - azoxystrobin) on % STB infection on F-3, F-2 & F-1 top three leaves under the flag (assessed GS42 or GS65) – cv SQP Revenue⒫, SFS Westmere, Southern Victoria.

Based on 50 lesions tested from 10 samples from untreated areas of the trial the following STB mutations were found: 73% frequency CYP 51 Isoform 8 based (mutation Y416S), 80% CYP 51 Isoform 10 based (mutation Y137F) & 0% frequency CYP 51 Isoform 11 based (6 mutations including double deletion 459/460)

Results revealed that sprays based on the triazole Opus and the triazole/strobilurin mixture Radial gave similar control of STB and were significantly superior to the experimental strobilurin based on azoxystrobin, indicating the poor control given by strobilurin alone and the importance of using formulated mixtures with triazoles from both an efficacy and anti-resistance perspective. Fungicide applied at GS33 and GS39 gave the optimum control of STB on the two leaves under the flag leaf (flag-1 & flag-2), but the GS31 spray on 1st September was applied before these two leaves emerged and was therefore ineffective for STB control on these leaves. However the GS31 spray did provide control of disease on the next leaf down in the canopy flag-3 which was fully emerged at application. The data shows that the most effective control of STB on a canopy leaf layer is achieved by applying fungicide to that leaf shortly after it has emerged and before any infection has become established.

The yield results from the trial (Figure 5) indicate the best timing for a single fungicide spray was between GS31-39 when the top four leaves of the canopy are emerging and that a triazole and a triazole/strobilurin mix gave superior yields to an experimental application of strobilurin alone. Fungicides applied during tillering whilst applied at an early stage of the epidemic were ineffective at providing adequate disease control. Early control where required is better provided by in furrow or seed treatment measures.

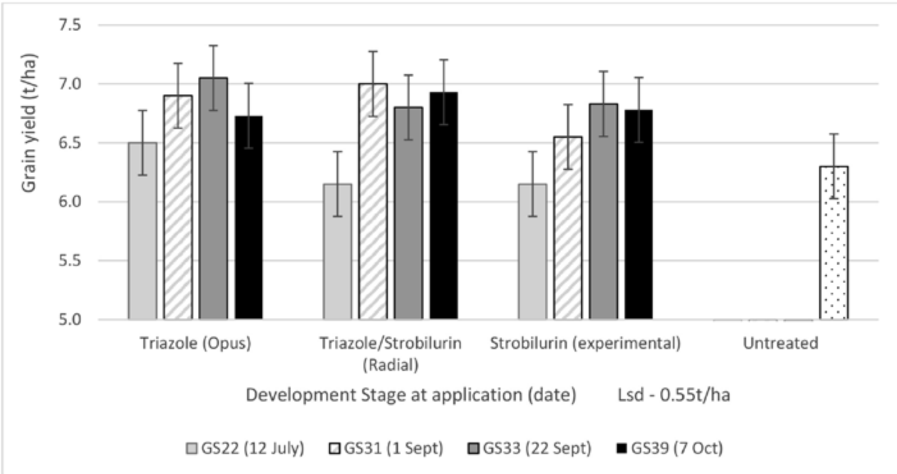


Figure 5: Influence of single foliar fungicide spray timings with different modes of action on yield (t/ha) – cv SQP Revenue(l), SFS Westmere, Southern Victoria.

Section 4. Integrated Disease Management (IDM) - influence of cultivar resistance on fungicide strategy

Adopting better genetic resistance is a key strategy for reducing STB infection in wheat and reducing the exposure of fungicides to the further development of pathogen resistance. 2017 results from GRDC project FAR 00004-A illustrated the positive impact of genetic resistance on disease management strategies. Beaufort (rated susceptible STB), Accroc (moderately susceptible STB) and SQP Revenue (susceptible STB) were evaluated with nine different levels of fungicide management. The results illustrated that Accroc and Revenue significantly reduced disease pressure in relation to Beaufort and produced no significant differences in STB infection whether one, two and three spray fungicide programmes were applied (Figure 6). However, with Beaufort under higher disease pressure increasing the number of foliar fungicides progressively reduced STB infection in the lower canopy, particularly with the GS31 & 39 sprays. With Accroc and SQP Revenue the slight improvement in genetic resistance resulted in lower disease pressure and no significant differences in disease control between one, two and three spray fungicide programmes, whilst with Beaufort there was a clear advantage in the lower and upper canopy disease control between one and two spray programmes.

With the slightly more resistant cultivars SQP Revenue and Accroc there was an indication that disease development was delayed compared to Beaufort but that severity increased later in the season, since there were significant advantages to two sprays over one on flag-1 at the later assessment taken on November 17 during grain fill (data not shown). The increased STB genetic resistance of SQP Revenue and Accroc over Beaufort was manifest in smaller yield responses (Figure 7), that were approximately half of that observed in Beaufort, however despite this all three cultivars gave the optimum economic response to two fungicide applications applied at GS31 (1st node) and GS39-45 (flag leaf emergence - booting). In part this result is thought to be related to rainfall events favourable for STB infection in September that occurred after the first fungicide was applied on 10 September and before the second spray was applied on 3 October (Figure 8).

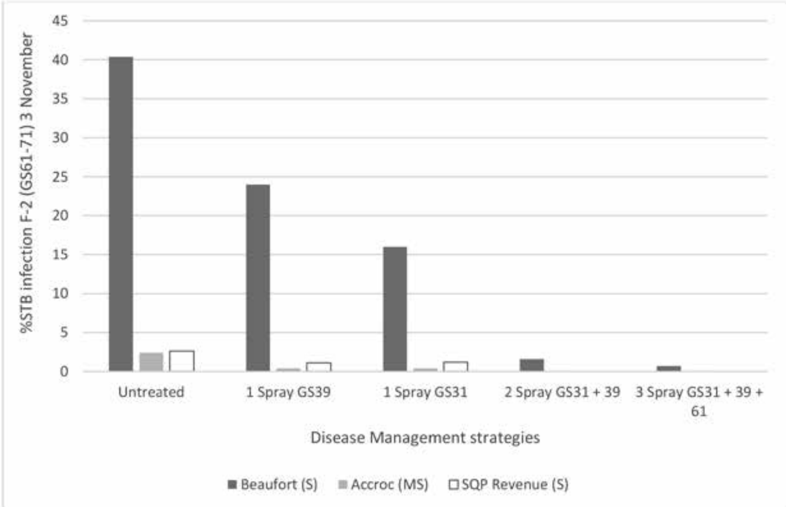


Figure 6: Influence of cultivar resistance and number of foliar fungicides on % STB infection on the lower crop canopy (Flag-2) assessed at flowering (GS61-71 3 November) – FAR Disease Management Centre, Hesse, Southern Victoria.

Based on 50 lesions tested from 10 samples from untreated areas of the trial the following STB mutations were found: 89% frequency CYP 51 Isoform 8 based (mutation Y416S), 69% CYP 51 Isoform 10 based (mutation Y137F) & 6% frequency CYP 51 Isoform 11 based (6 mutations including double deletion 459/460)

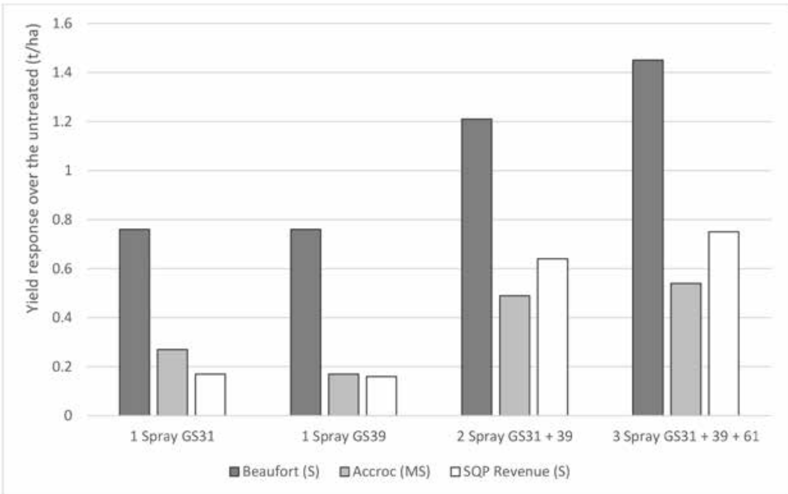


Figure 7: Influence of cultivar resistance and number of foliar fungicides on yield response (t/ha) in three cultivars (Beaufort, Accroc and SQP Revenue) of differing disease resistance – FAR Disease Management Centre, Hesse, Southern Victoria.

Based on 50 lesions tested from 10 samples from untreated areas of the trial the following STB mutations were found: 89% frequency CYP 51 Isoform 8 based (mutation Y416S), 69% CYP 51 Isoform 10 based (mutation Y137F) & 6% frequency CYP 51 Isoform 11 based (6 mutations including double deletion 459/460)

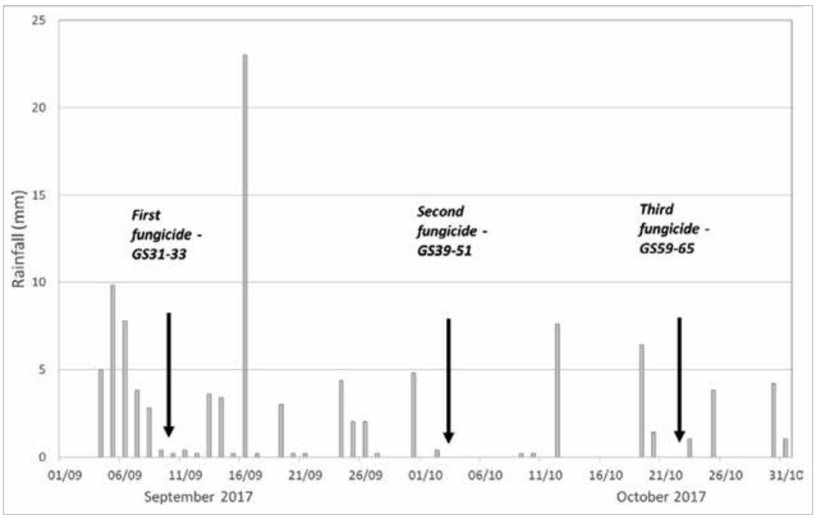


Figure 8: September & October rainfall in relation to fungicide application and development stage – FAR Disease Management Centre, Hesse, southern Victoria.

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