Fusarium crown rot seed fungicides: independent field evaluation 2018-2020

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Keywords

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GRDC code

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Take home messages

- Current fungicide seed treatments registered for the suppression of Fusarium crown rot (FCR) inconsistently reduce the extent of yield loss from FCR
- Syngenta® experimental (Tymirium™ technology) had consistent and stronger activity on limiting yield loss from FCR
- However, under high infection levels significant yield loss may still occur in drier seasons
- Fungicide seed treatments, including the Syngenta experimental, should not be considered standalone control options for FCR
- Seed treatments should be used as an additional tool within existing integrated disease management strategies for FCR.

Introduction

Fusarium crown rot (FCR), caused predominantly by the fungal pathogen *Fusarium pseudograminearum* (*Fp*), is a major constraint to winter cereal production across Australia. A range of integrated management strategies, including crop rotation, varietal selection, inter-row sowing, sowing time, stubble and fallow management are required to minimise losses. A number of fungicide seed treatments have been registered for the suppression of FCR in recent years with a further product from Syngenta likely to be available to Australian growers prior to sowing in 2023. Although chemical companies conduct their own widespread field evaluation across Australia, growers and their advisers value independent evaluation of the potential relative fit of these fungicide seed treatments within integrated management strategies for FCR.

What we did

A total of 11 replicated plot experiments (generally 2 x 10 m with minimum of 3 replicates) were conducted across NSW from 2018-2020 with one additional field experiment conducted in Victoria (Horsham) and two in WA (Merredin and Wongan Hills) in 2018 only (Table 1). The winter cereal crop and number of varieties differed between experiments with wheat (W), barley (B) and/or durum (D) evaluated in each experiment (Table 1).

Six fungicide seed treatments: Nil, Vibrance® (difenoconazole + metalaxyl-M + sedaxane at 360 mL/ 100 kg seed), Rancona® Dimension (ipconazole + metalaxyl at 320 mL/100 kg seed), EverGol®Energy (prothioconazole + metalaxyl + penflufen at 260 mL/100 kg seed) and Syngenta experimental (Tymirium™ technology based on cyclobutrifluram at 40 and/or 80 g active ingredient/100 kg seed). All fungicide seed treatments were applied in 1 to 3 kg batches using a small seed treating unit to ensure good even coverage of seed.

All field experiments used an inoculated vs uninoculated randomised complete block design with inoculated plots infected by *Fp* inoculum grown on sterilised wheat grain added at 2.0 g/m of row at sowing. This ensures high (>80%) FCR infection in inoculated plots with uninoculated plots only exposed to any background levels of *Fp* inoculum naturally present across a site. This design allows comparison between the yield effects of the various fungicide seed treatments in the presence and absence of FCR. Yield loss from this disease is measured as the difference between inoculated and uninoculated treatments.

What did we find?

Lower levels of in-crop rainfall between March and September generally lowered the yield potential at each site in each season, but also increased the extent of FCR yield loss. This was highlighted in the nil seed treatments where yield loss ranged from 11 to 48% in 2018, 14 to 20% in 2019 and 11 to 37% in 2020 (Table 1).

Table 1. Effect of various fungicide seed treatments on yield loss (%) associated with Fusarium crown rot infection in 14 replicated inoculated vs uninoculated field experiments – 2018 to 2020

Year	Location	Crop[A]	Rainfall[B] (mm)	Yield[C] (t/ha)	%Yield loss from Fusarium crown rot[D]					
					Nil	Vibrance	Rancona Dimension	EverGol Energy	Syngenta 40 gai[E]	Syngenta 80 gai[E]
2018	Merriwagga, NSW	2W	63	1.44	44	nd[F]	nd	32	25	18
	Mallowa, NSW	2W	73	1.73	48	nd	nd	nd	26	24
	Gilgandra, NSW	2W	93	2.14	42	35	27	28	16	9
	Merredin, WA	2W	182	2.66	35	nd	nd	nd	23	13
	Horsham, Vic	2W	185	2.56	21	nd	nd	nd	+2[I]	+5
	Wongan Hills, WA	2W	291	3.27	11	nd	nd	nd	1	0
2019	Gulargambone, NSW	W/B	141	3.12	20	2	5	9	-[G]	+2
	Narrabri, NSW	W/B	200[H]	4.01	14	10	9	7	-[G]	6
2020	Boomi, NSW	3W/D	202	4.91	37	nd	28	nd	24	18
	Gurley, NSW	W/B	234	6.50	13	nd	nd	nd	-	1
	Rowena, NSW	W/B	247	6.21	12	7	nd	4	-	2
	Trangie, NSW	3W/D	412	4.13	26	20	23	19	4	2
	Gilgandra, NSW	3W/D	420	4.07	12	6	7	7	3	0
	Armatree, NSW	3W/D	425	4.37	11	nd	nd	7	3	+1

[A] Winter crop type variety numbers where W = wheat variety, B = barley variety and D = durum variety.
[B] Rainfall in-crop from March to September at each site. Critical time for fungicide uptake off seed and expression of FCR.
[C] Yield in uninoculated treatment (average of varieties) with nil seed treatment.
[D] Average percentage yield loss from FCR for each seed treatment (averaged across varieties) compared with the uninoculated/nil seed treatment.
[E] gai = grams of active ingredient.
[F] nd = no difference, %yield loss from FCR with fungicide seed treatment not significantly different from the nil seed treatment. Values only presented when reduction in %yield loss from FCR significantly lower than the nil seed treatment.
[G] 40 gai treatment not included at these sites.
[H] Included two irrigations at GS30 and GS39 of 40 mm and 30 mm respectively due to drought conditions.
[I] Results with a plus in front of them show that the treatment yielded higher than the uninoculated nil treatment (i.e. the treatment reduced impact from both the added FCR inoculum as well as natural background levels of fusarium present at that site.)

Vibrance and Rancona Dimension significantly reduced the extent of yield loss from FCR in 6 of 14 experiments whilst EverGol Energy reduced FCR yield loss in 8 of 14 field trials (Table 1). However, the Syngenta experimental product significantly reduced yield loss from FCR in 10 of 10 trials at the 40 gai rate and 14 of 14 field experiments at the 80 gai rate (Table 1). The reduction in yield loss was also generally stronger with this product compared with the other fungicide seed treatments and better at the 80 gai than 40 gai rate (Table 1).

Significant yield loss (9 to 26%) still occurred with the Syngenta experimental treatment at generally drier sites which exacerbated yield loss from FCR (>35% in nil seed treatment). However, the 80 gai rate at these 'disease conducive sites', still at least halved the extent of yield loss compared with the nil seed treatment (Table 1). At wetter sites where yield loss from FCR was lower (<26%) the Syngenta experimental reduced the extent of yield loss to <6% with a yield increase at some sites due to reduced impact from background levels of FCR infection (Table 1). Moisture stress during grain filling is known to exacerbate yield loss from FCR and favour the growth of *Fp* within the base of infected plants. Dry soil conditions around seeding depth throughout the season is also likely to restrict the movement of fungicide actives off the seed coat into surrounding soil and subsequent uptake by root systems. This would reduce movement of the fungicides into the sub-crown internode, crown and tiller bases where FCR infection is concentrated. It is currently not clear whether reduced efficacy under drier conditions may be related to one or both of these factors.

What about durum?

Durum wheat is known to have increased susceptibility to FCR compared with many wheat and barley varieties. Consequently, the increased prevalence of FCR in farming systems with the adoption of conservation cropping practices, including retention of cereal stubble, has seen durum removed from rotations due to this increased disease risk. The durum variety DBA Lillaroiⓓ was compared with three bread wheat varieties at four sites in 2020 (Table 2).

Table 2. Effect of Syngenta experimental seed treatment at two rates on the extent of yield loss[A] (%) from Fusarium crown rot in three bread wheat (W) and one durum (D) variety at three sites in 2020

Variety	Boomi 2020			Trangie 2020			Gilgandra 2020			Armatree 2020		
	Nil[B]	Syngenta 40 gai	Syngenta 80 gai	Nil	Syngenta 40 gai	Syngenta 80 gai	Nil	Syngenta 40 gai	Syngenta 80 gai	Nil	Syngenta 40 gai	Syngenta 80 gai
Lancer (W)	29	23	20	30	10	8	13	2	0	9	4	+7[C]
Mitchⓓ (W)	39	18	11	13	+2	+5	9	2	1	5	0	0
Trojan (W)	34	22	18	20	4	2	12	1	0	14	2	2
Lillaroiⓓ (D)	48	32	24	45	11	6	16	5	+2	14	6	+2

[A] Average percentage yield loss from FCR for each seed treatment compared with the uninoculated/nil seed treatment for that variety.
[B] Nil = no seed treatment.
[C] Results with a plus in front of them show that the treatment yielded higher than the uninoculated nil treatment (i.e. the treatment reduced impact from both the added FCR inoculum as well as natural background levels of fusarium present at that site).

The extent of yield loss from FCR with nil seed treatment was generally higher in the durum variety (14 to 48%) compared with the three bread wheat varieties (5 to 39%). With the exception of the Boomi site, the wheat variety Mitchⓓ tended to have reduced yield loss from FCR compared with the other entries (Table 2). Yield loss from FCR was reduced with the Syngenta experimental in both the bread wheat and durum varieties (Table 2). Even in the higher loss site at Boomi in 2020, the 80 gai rate halved the extent of yield loss in the durum variety Lillaroiⓓ with better efficacy in the other three sites.

Conclusions

Current fungicide seed treatments registered for the suppression of FCR can inconsistently reduce the extent of yield loss from this disease. The Syngenta experimental (Tymirium technology) appears to have more consistent and stronger activity on limiting yield loss from FCR. However, under high infection levels, as created with artificial inoculation in these experiments, significant yield loss may still occur, particularly in drier seasons. Dry soil conditions around seeding depth throughout a season may reduce the uptake of fungicide actives applied to the seed coat. Drier seasons also exacerbate FCR expression which would place additional pressure on fungicide seed treatments. Consequently, fungicide seed treatments, including the Syngenta experimental, should not be considered standalone control options for FCR. Rather, they should be used as an additional tool within existing integrated disease management strategies for FCR.

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