Fusarium crown rot seed fungicides: independent field evaluation 2018-2021

Steven Simpfendorfer, NSW DPI Tamworth

Keywords

fungicide seed treatments, yield loss, wheat, barley, durum, disease

GRDC code

DAN00213: Grains Agronomy & Pathology Partnership (GAPP) - A strategic partnership between GRDC and NSW DPI (Project BLG208) and DAN00175: National crown rot epidemiology and management program.

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
- Victrato® 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 Victrato®, 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 Victrato® from Syngenta likely to be available to Australian growers prior to sowing in 2024. 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 15 replicated plot experiments (generally 2 x 10 m with minimum of 3 replicates) were conducted across NSW from 2018-2021 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 Victrato® (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. Note that not all six seed treatments were examined in 2020 and 2021.

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 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 (background levels) of FCR. Yield loss from this disease is measured as the difference between inoculated and uninoculated treatments.

What did we find?

Averaged across all cereal entries

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, 11 to 37% in 2020 and 9 to 11% in 2021 (Table 1).

Table 1. Effect of various fungicide seed treatments on yield loss (%) associated with Fusarium crown rot infection in 18 replicated inoculated vs uninoculated field experiments – 2018 to 2021

Year	Location	Crop[A]	Rainfall[B] (mm)	Yield[C] (t/ha)	%Yield loss from Fusarium crown rot[D]					
					Nil	Vibrance	Rancona Dimension	EverGol Energy	Victrato 40 gai[E]	Victrato 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	-[G]	1
	Rowena, NSW	W/B	247	6.21	12	7	nd	4	-[G]	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
2021	Boomi, NSW	3W/D	349	5.74	10	-[G]	-[G]	-[G]	2	+1
	Armatree, NSW	3W/D	404	6.67	11	-[G]	-[G]	-[G]	2	1
	Wongarbon, NSW	3W/D	424	5.68	9	-[G]	-[G]	-[G]	6	4
	Rowena, NSW	3W/D	454	6.80	11	-[G]	-[G]	-[G]	1	0

[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] All treatments 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 Victrato significantly reduced yield loss from FCR in 14 of 14 trials at the 40 gai rate and 18 of 18 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 Victrato at drier sites. These dry conditions increased the yield loss from FCR (>35% in nil seed treatment). However, the 80 gai rate at these disease conducive sites, at least halved the yield loss compared with the nil seed treatment (Table 1). Yield loss from FCR was lower at the wetter sites (<26%). Victrato® reduced yield loss to <6%, with increased yields at some sites due the effects of background levels of FCR infection being reduced (Table 1). Moisture stress during grain filling exacerbates yield loss from FCR and favours the growth of *Fp* within the base of infected plants. Dry soil conditions throughout the season at the seeding depth, is likely to restrict the movement of fungicide actives off the seed coat and into surrounding soil and 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 if 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. The increased prevalence of FCR in farming systems aided by the adoption of conservation cropping practices, including retention of cereal stubble, has seen durum removed from rotations due to this risk. The durum variety DBA Lillaroiᶲ was compared with three bread wheat varieties at four sites in 2020 (Table 1).

Table 2. Effect of Victrato 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]	Victrato 40 gai	Victrato 80 gai	Nil	Victrato 40 gai	Victrato 80 gai	Nil	Victrato 40 gai	Victrato 80 gai	Nil	Victrato 40 gai	Victrato 80 gai
Lancerᶲ (W)	29	23	20	30	10	8	13	2	0	9	4	+7[C]
Mitchᶲ (W)	39	18	11	13	+2	+5	9	2	1	5	0	0
Trojanᶲ (W)	34	22	18	20	4	2	12	1	0	14	2	2
Lillaroiᶲ (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%). The bread wheat variety Mitchᶲ tended to have reduced yield loss from FCR compared with the other entries, apart from the Boomi site (Table 2). Yield loss from FCR was reduced with Victrato 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 Lillaroiᶲ 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. Victrato® appears to have more consistent and stronger activity on limiting FCR yield loss. In the absence of fungicide seed treatments, average yield loss from FCR infection across the 18 sites over three seasons was 21.5%. The 80 gai rate of Victrato significantly reduced the level of yield loss from FCR down to an average of 4.9% across these 18 field experiments. Under high infection levels, as created with artificial inoculation in these experiments, significant yield loss may still occur (up to 24% measured), particularly in drier seasons.

Dry soil conditions around the seeding depth throughout a season may reduce the uptake of fungicides applied to the seed coat. Drier seasons also exacerbate FCR expression, which would place additional pressure on fungicide seed treatments. However, even under these conditions Victrato at the 80 gai rate still at least halved the level of yield loss from FCR.

Fungicide seed treatments, including Victrato, 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.

Acknowledgements

The research undertaken as part of this project is made possible by the significant contributions of growers and their advisers through their support of the GRDC. The author would also like to acknowledge the ongoing support for northern pathology capacity by NSW DPI. National trials conducted in 2018 in Victoria (Horsham) and Western Australia (Merredin and Wongan Hills) were in collaboration with Dr Grant Hollaway (Ag Vic) and Dr Daniel Huberli (DPIRD) with biometric support from Clayton Forknall (DAFQ). Technical support provided by Chrystal Fensbo, Robyn Shapland, Tim O'Brien, Finn Fensbo, Patrick Mortell and Jason McCulloch (all NSW DPI) is gratefully acknowledged. A number of field experiments were contracted through AMPS Research (Matt Gardner) or NSW DPI (Peter Matthews) which is also gratefully acknowledged.

Contact details

Steven Simpfendorfer
NSW DPI, 4 Marsden Park Rd, Tamworth, NSW 2340
Ph: 0439 581 672
Email: steven.simpfendorfer@dpi.nsw.gov.au
Twitter: @s_simpfendorfer or @NSWDPI_AGRONOMY

® Registered trademark
™ Trademark
Ⓟ Varieties displaying this symbol beside them are protected under the Plant Breeders Rights Act 1994.