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Fusarium crown rot seed fungicides: independent field evaluation, 2018–2020

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Key findings

- Current fungicide seed treatments registered for the suppression of Fusarium crown rot (FCR) inconsistently reduce the extent of yield loss from this disease.
- Victrato® had consistent and stronger activity than other seed treatments on limiting yield loss from FCR.
- Under high FCR infection levels significant yield loss may still occur with the use of Victrato® in drier seasons.
- Fungicide seed treatments, including Victrato®, should not be considered standalone control options for FCR but can 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 to suppress FCR in recent years with a further product, Victrato® from Syngenta, available to Australian growers before 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.

Evaluation parameters

- A total of 11 replicated plot experiments (generally 2 × 10 m with minimum of three replicates).
- Randomised complete block design.
- 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).
- Inoculated versus uninoculated treatments with inoculated plots infected by Fp inoculum grown on sterilised wheat grain (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. This allows for comparison between yield effects of the various fungicides when FCR is present or absent.
- Fungicide seed treatments were applied in 1 kg to 3 kg batches using a small seed treating unit to ensure good even coverage of seed.
- Yield loss from this disease is measured as the difference between inoculated and uninoculated treatments.

Locations

- Eleven sites: NSW from 2018–2020 (Table 1).
- Two sites: WA, Merredin and Wongan Hills, 2018.
- One site: Vic, Horsham, 2018 only (Table 1).

Treatments (6)

- 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)
- Victrato® (Tymirium® technology based on cyclobutrifluram at 40 g and/or 80 g active ingredient/100 kg seed).

Figure 1 Fusarium crown rot infection. Left hand plant affected, right hand plant unaffected.

Results

Averaged across all cereal entries

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

- Vibrance® and Rancona® Dimension significantly reduced the yield loss from FCR in six of 14 experiments.

- EverGol® Energy reduced FCR yield loss in eight of 14 field experiments (Table 1).
- Victrato® significantly reduced yield loss from FCR in 10 of 10 experiments at the 40 gai rate and 14 of 14 field experiments at the 80 gai rate. Yield loss reduction was also generally stronger with this product compared with the other fungicide seed treatments, and better at the 80 gai than 40 gai rate.
- Significant yield loss still occurred with Victrato® (9–26 %) at the drier sites. The 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.
- Yield losses from FCR were lower at the wetter sites (<26%). Victrato® reduced this yield loss to <6%, with increased yields at some sites due the effects from reduced background levels of FCR infection.
- Moisture stress during grain filling is known to exacerbate yield loss from FCR and favour Fp growth within the base of infected plants. Dry soil conditions throughout the season at the seeding depth is likely to have restricted the fungicide actives from moving off the seed coat and into surrounding soil. Consequently, uptake of the fungicide active by root systems would be restricted. This would reduce fungicide movement 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 could be related to one or both of these factors.

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

Year	Location	Crop[A]	Rainfall[B] (mm)	Yield[C] (t/ha)	%Yield loss from Fusarium crown rot[D]					
					Nil	Vibrance®	Rancona® Dimension	EverGol® Energy	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

[A] Winter crop type variety numbers where W = wheat variety, B = barley variety and D = durum variety.
[B] In-crop rainfall from March to September. 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 is significantly lower than the nil seed treatment.
[G] 40 gai treatment not included at these sites.
[H] 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 the effects from both the added FCR inoculum as well as natural background levels of fusarium present at that site.

Comparative effects on durum versus bread wheat

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

Table 2 Effect of Victrato® seed treatment at two rates on yield loss (%) from Fusarium crown rot in three bread wheat (W) and one durum (D) variety at three sites in 2020.

	Average yield loss from Fusarium crown rot (%)[AB]											
Site:	**Boomi 2020**			**Trangie 2020**			**Gilgandra 2020**			**Armatree 2020**		
Treatment:	**Nil[C]**	**Victrato®**		**Nil**	**Victrato®**		**Nil**	**Victrato®**		**Nil**	**Victrato®**	
Variety		**40 gai**	**80 gai**		**40 gai**	**80 gai**		**40 gai**	**80 gai**		**40 gai**	**80 gai**
Lancer (W)	29	23	20	30	10	8	13	2	0	9	4	+7
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] Results with a plus in front of them show that the treatment yielded higher than the uninoculated nil treatment (i.e. the treatment reduced affects from both the added FCR inoculum as well as natural background levels of Fusarium present at that site.
[C] Nil = no seed treatment.

FCR with nil seed treatment caused a generally higher yield loss in the durum (14–48%), compared with the three bread wheat varieties (5–39%).

The bread wheat Mitch⁽ᶦᵖ⁾ tended to have reduced yield loss from FCR compared with the other entries, apart from at the Boomi site (Table 2).

Yield loss from FCR was reduced with Victrato® in both the bread wheat and durum varieties. Even at the drier, higher, loss site at Boomi in 2020, the 80 gai rate halved the extent of yield loss in the durum variety Lillaroi⁽ᶦᵖ⁾, with better efficacy in the other three sites.

Conclusions

Current fungicide seed treatments registered for suppressing FCR can inconsistently reduce yield loss extent from this disease. Victrato® appears to have more consistent and stronger ability to limit FCR yield loss.

In the absence of fungicide seed treatments, average yield loss from FCR infection across the 14 sites over three seasons was 24.7%. The 80 gai rate of Victrato® significantly reduced yield loss from FCR to an average of 6.1% across the 14 field experiments. Under high infection levels as created with artificial inoculation in these experiments, there can be significant yield loss (up to 24% measured), particularly in drier seasons.

Dry soil conditions around seeding depth throughout a season might 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.

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