

Implications of sowing Fusarium infected wheat seed in 2023

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Take home messages

- Sowing wheat or durum seed with $\leq 5\%$ Fusarium grain infection had limited impact on yield even when no fungicide seed treatment was applied
- Sowing seed with 7.5% to 10% Fusarium grain infection had an average yield penalty of 13% (range 4% to 23%) with no seed treatment but was largely eliminated by the application of the seed treatment
- Sowing seed with $>10\%$ Fusarium grain infection had an average yield penalty of 27% (range 17% to 40%) with no seed treatment which was nearly halved to an average yield loss of 15% (range 9% to 27%) with the application of the seed treatment
- Implications on the incidence and severity of Fusarium crown rot introduced through Fusarium infected grain should also be considered.

Introduction

The prevalence of fusarium head blight (FHB) across large areas of eastern Australia in 2022 was unprecedented with implications for seed retained from infected crops (Simpfendorfer and Baxter 2023). Fusarium grain infection reduces germination and vigour of seed retained for sowing along with causing seedling blight (death) in plants arising from infected grain. The fungus replaces the contents of infected seed with its own mycelium, so while seed treatments can help reduce the level of seedling blight, they cannot restore the quality of heavily infected seed sources. Sowing Fusarium infected seed also introduces fusarium crown rot (FCR) into paddocks. Sourcing quality seed for sowing created issues in some regions in 2023.

Based on north American experience the general advice if retaining seed for sowing is:

- $<1\%$ Fusarium grain infection = no issues
- 1% to 5% Fusarium grain infection = consider using seed treatment (e.g. full rate Vibrance® or EverGol® Energy) to limit seedling blight, and slightly increase sowing rate
- $>5\%$ Fusarium grain infection = source cleaner seed if possible.

The opportunity was taken to test the effect of varying levels of Fusarium grain infection on yield and FCR incidence under Australian conditions using grower retained seed lots from 2022 across the northern grain region.

Fusarium grain infection levels in 2022

A 'free' seed testing service was offered to growers to support them in determining Fusarium grain infection levels. In total 1,934 seed lots from the 2022 harvest were tested consisting of 1,595 bread wheat, 191 durum and 148 barley samples (Table 1). The biggest issue with Fusarium grain infection levels was in durum wheat, which is very susceptible to FCR and FHB, with 82% of 2022 seed lots having greater than the recommended 5% level of Fusarium infection. Fusarium grain infection levels were still a widespread issue in bread wheat and barley seed retained from 2022 with 33% of bread wheat and 26% of barley seed lots having greater than the recommended 5% level of infection (Table 1).

Table 1. *Fusarium* spp. grain infection levels in bread wheat, durum wheat and barley seed lots harvested across eastern Australia in 2022.

Region	Bread wheat			Durum wheat			Barley		
	<5%	>5%	Max	<5%	>5%	Max	<5%	>5%	Max
SE NSW	163	27	16%				3	1	6%
SW NSW	149	57	43%	12	47	71%	12	4	9%
CE NSW	147	76	37%	0	2	30%	18	4	49%
CW NSW	257	169	43%	0	2	45%	20	12	19%
NE NSW	88	99	42%	16	87	69%	28	12	34%
NW NSW	62	39	28%	1	16	68%	13	4	13%
Sth Qld	118	25	26%	0	1	23%	10	1	7%
Victoria	71	37	33%	1	1	35%	6	0	5%
South Aus	9	0	2%	5	0	2%			
Tasmania	2	0	1%						

Values are the number of grower seed lots with less than or greater than 5% *Fusarium* grain infection. Max = maximum level of *Fusarium* grain infection (%) measured in each cereal crop type and region.

Levels of FHB infection and resulting *Fusarium* grain infection were prevalent across eastern Australia in 2022 but varied between regions. For example, in bread wheat the incidence of grain infection levels greater than 5% was most common in north-east NSW (53% of samples) followed by central-west NSW (40% of samples), north-west NSW (39% of samples), central-east NSW and Victoria (both 34% of samples) and south-west NSW (28% of samples). *Fusarium* grain infection levels in bread wheat greater than 5% were less prevalent in Qld (17% of samples) and south-east NSW (14% of samples) with the lowest level in South Australia and Tasmania (0% of samples; maximum 2% or 1% infection, respectively) from limited testing (9 and 2 samples, respectively) conducted from those states (Table 1).

What we did

Seven replicated small plot field experiments were conducted across the northern grain region in 2023 using locally sourced grower retained seed lots of a single variety. Seed lots (SL) were selected based on varying levels of *Fusarium* grain infection with SL1 lowest (0% to 1.7%), SL2 minor (3.3% to 5.0%), SL3 intermediate (7.5% to 10.0%) and SL4 highest (11.8% to 57.5%; Table 2). All sowing rates were adjusted to target 100 plants/m² based on seed size (1000 grain weight) and percentage germination. With each seed lot there were separate replicated plots sown comparing no seed treatment versus treatment with Vibrance (180 mL/100 kg seed) + Victrato® (400 mL/100 kg seed) (not currently registered for use within Australia). Field trials had a complete randomised block design with three replicates of each seed lot by seed treatment combination. Establishment, yield, grain quality and *Fusarium* crown rot incidence and severity were measured on all plots.

Table 2. *Fusarium* grain infection levels (%) in four local grower seed lots (SL) of different wheat or durum varieties tested at 7 locations in 2023. Note only three seed lots tested at Westmar.

Location	Variety	Seed lot			
		SL1	SL2	SL3	SL4
Westmar	LRPB Hellfire ^(b)	0.3%	5.0%	-	18.8%
Walgett	LRPB Hellfire ^(b)	1.7%	5.0%	9.5%	19.5%
Coonamble	LRPB Hellfire ^(b)	1.0%	4.0%	7.5%	14.5%
Nyngan	LRPB Lancer ^(b)	0.0%	4.0%	8.3%	29.0%
Wellington	Scepter ^(b)	0.5%	3.0%	7.5%	11.8%
Lake Cargelligo	Scepter ^(b)	0.5%	3.3%	9.5%	18.0%
Deniliquin	DBA Vittaroi ^(b)	1.0%	4.0%	10.0%	57.5%

What did we find?

Plant establishment

Average plant establishment did not achieve the target plant population of 100 plants/m² except for Scepter[®] SL4 at Wellington (103 plants/m²). Average plant populations established across the local seed lots at each site were highest at Westmar and Wellington (88 plants/m²), then Deniliquin (85 plants/m²), Nyngan (84 plants/m²), Coonamble (71 plants/m²), Lake Cargelligo (70 plants/m²) down to Walgett (66 plants/m²). The interaction between seed lot and seed treatment was only significant with Vittaroi[®] durum at Deniliquin. Seed lot 4 at this site had the highest Fusarium grain infection level (57.5%) of all tested which significantly reduced establishment in the absence of seed treatment (Table 3). However, in the presence of seed treatment this same seed lot had significantly higher establishment than the other three seed lots with lower Fusarium grain infection levels. This is potentially through the seed treatment reducing the level of seedling blight in this heavily infected seed lot. Except for this site, differences in plant establishment between treatments did not appear to have a major influence on yield outcomes which highlights the importance of adjusting sowing rates for germination and seed weight of individual seed lots.

Table 3. Effect of Vittaroi[®] seed lot (SL) and seed treatment on plant establishment (plants/m²) at Deniliquin in 2023.

Location	Minus seed treatment				Plus seed treatment			
	SL1	SL2	SL3	SL4	SL1	SL2	SL3	SL4
Deniliquin	81 b	93 b	78 b	55 c	83 b	91 b	85 b	114 a

Values followed by the same letter not significantly different at the 95% confidence level.

Yield

In the absence of seed treatment, the minor increase in Fusarium infection levels between SL1 (0% to 1.7%) and SL2 (3.3% to 5%) only reduced yield at Nyngan (11% yield loss; Table 4). A further increase in Fusarium infection level with SL3 (7.5 to 10.0%) reduced yield by between 4% (Wellington) to 23% (Nyngan) at 5 of 7 locations (except Coonamble where not significant and Westmar where no SL3 treatment) compared with the lowest levels in the SL1 treatment. The highest Fusarium infection levels in SL4 (11.8% to 57.5%) had an associated yield loss of between 17% (Westmar and Wellington) to 40% (Deniliquin) compared with the lowest Fusarium infection levels in SL1 in the absence of seed treatment (average 27% yield loss; Table 4).

Table 4. Yield (t/ha) of local grower seed lots of different wheat or durum varieties with varying levels of Fusarium grain infection at 7 locations in 2023 without and with fungicide seed treatment.

Location	Minus seed treatment				Plus seed treatment				Con
	SL1	SL2	SL3	SL4	SL1	SL2	SL3	SL4	
Westmar	2.94 a	3.03 a	-	2.45 c	2.97 a	3.05 a	-	2.65 b	96%
Walgett	1.75 a	1.73 a	1.48 b	1.26 c	1.76 a	1.72 a	1.74 a	1.50 b	90%
Coonamble	3.10 a	2.93 a	2.90 ab	2.23 c	3.04 a	3.09 a	2.96 a	2.72 b	99%
Nyngan	0.96 a	0.85 b	0.74 c	0.62 d	0.99 a	0.95 a	0.87 b	0.78 c	86%
Wellington	2.23 b	2.27 ab	2.13 c	1.85 d	2.34 a	2.28 ab	2.28 ab	2.07 c	82%
Lake Cargelligo	2.52 ab	2.56 ab	2.14 d	1.97 d	2.55 ab	2.61 a	2.40 bc	2.33 c	89%
Deniliquin	4.57 b	4.66 ab	4.16 c	2.73 e	4.70 ab	4.89 a	4.80 ab	3.45 d	97%

Values followed by the same letter not significantly different at the confidence (con) level at each location. Lettering only applies within individual locations.

When the seed treatment was applied, there was generally no yield difference between SL1, SL2 and SL3 treatments at each location (Table 4). Exceptions were at Nyngan where SL3 was 12% lower yielding than SL1 and 8% lower yielding than SL2, along with Lake Cargelligo where SL3 was 8% lower yielding than SL2 but equivalent to SL1. Application of the seed treatment reduced but did not eliminate the extent of yield loss between the lowest (SL1) and highest (SL4) Fusarium grain

infection levels which ranged from 9% (Lake Cargelligo) to 27% (Deniliquin) with an average across locations of 15% (Table 4).

Grain quality and pathology

Unfortunately, this data was not available at the time of writing this report. However, visual inspection of some sites during grain filling had a noticeable increase in the incidence of whiteheads in SL4 plots especially in the absence of seed treatment. Pathology assessments to determine the incidence and severity of FCR in each plot are currently being conducted.

Summary

Sowing wheat or durum seed with low (<5%) Fusarium grain infection had limited impact on yield when no seed treatment was used and no impact when the seed treatment was applied. Sowing seed with moderate (7.5% to 10%) Fusarium grain infection had an average yield penalty of 13% at 5 of 6 locations (not present in Westmar trial) when no seed treatment was used and no impact at 5 of 6 locations when the seed treatment was applied. Sowing seed with high (11.8% to 57.5%) Fusarium grain infection had an average yield penalty of 27% in the absence of seed treatment which was roughly half at 15% when the seed treatment was applied.

Based on only yield, this data broadly supports current north American recommendations around sowing cereal seed with varying levels of Fusarium grain infection. This data indicates that growers may still be able to consider sowing cereal seed with 5 to 10% Fusarium grain infection if the seed treatment is used without negatively impacting on yield. However, this does not consider the potential introduction of FCR into paddocks and subsequent inoculum issues for following cereal crops.

This was not a fungicide seed treatment study and only examined one option known to have stronger Fusarium activity that was used for experimental purposes with Victrato® not currently registered for use within Australia. This does not indicate what activity may be achieved with other registered fungicide seed treatments or a lower rate of this unregistered product which is anticipated for commercial release in 2024.

References

Simpfendorfer S and Baxter B (2023) [Fusarium head blight and white grain issues in 2022 wheat and durum crops, GRDC Update paper](#)

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