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Seed-borne *Fusarium* threatens crown rot control strategies – Tamworth 2011

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Introduction

There were several commercial wheat crops in northern NSW in 2011 that experienced high levels of crown rot even though they had come out of good rotations, such as canola and double-cropped chickpeas after sorghum. Seed-borne infection with *Fusarium* was suspected in these situations and was able to be traced back, in some cases, by culturing grain that growers had retained from their 2011 plantings. The planting seed had high levels of colonisation by *Fusarium* as a result of head blight (FHB) infection that occurred as a result of wet conditions during flowering and grain-fill in 2010.

FHB relates to the symptoms of head infection which appears as premature ripening of infected spikelets and white and/or pink grain. FHB in the northern region in 2010 was caused predominantly by *F. graminearum* and/or *F. pseudograminearum*. Wet weather during flowering and/or grain-fill is required for FHB infection and disease development.

One issue with grain infection by *Fusarium*, as a result of FHB in wet seasons, is if it is sown the next year it can lead to seedling death which reduces crop establishment. Seedling death (also called seedling blight) results from a severe infection of seedlings as they germinate with most dying before or shortly after they emerge (up to 5 leaf stage). This early infection by *Fusarium* introduced from the seed is effectively similar to a very severe early infection with crown rot. Hence, we were also concerned whether seed infected with *Fusarium* may also be introducing crown rot into surviving plants.

A replicated small plot field trial was conducted at Tamworth in 2011 to investigate the effect of grain infection with *Fusarium* on crop establishment and whether crown rot was introduced into surviving plants. The trial also examined the potential of five fungicide seed treatments to improve establishment and reduce any crown rot levels introduced into surviving plants when sowing seed infected by *Fusarium*.

Key findings

Sowing *Fusarium* infected seed significantly reduces crop establishment.

Sowing *Fusarium* infected seed can also introduce seed-borne crown rot into surviving plants which potentially diminishes any break crop benefits on inoculum levels.

The seed treatments examined in this study had limited activity on improving establishment and reducing seed-borne crown rot levels when sowing seed with high levels of *Fusarium* infection.

Growers should sow seed free of *Fusarium* or with as low a level as possible.

Site details

Location:	**Tamworth Agricultural Institute**
Sowing date:	**1st August 2011**
Fertiliser:	**50 kg/ha Granulock Supreme Z and 100 kg/ha of granular Urea at sowing**

Treatments

- Four grower seed lots of durum with 0 to 73% infection by *Fusarium* from 2010 harvest.
- Six seed treatments: Nil, Dividend® 260 mL, Dividend® 130 mL, Rancona C® 100 mL, Raxil Pro® 15 mL and Jockey 450® mL. All rates are per 100 kg of seed.
- Sown as 1 m plots with five rows at 38 cm spacing.
- Sowing rate adjusted based on 1000 grain weight of each seed lot to target 120 plants/m^2.
- Establishment measured at 5 leaf stage.
- Plots grown through to harvest and incidence of surviving plants infected with crown rot determined through visual assessments and confirmed by plating.

Results

Establishment

Untreated grain infected with *Fusarium* (nil treatment) had reduced emergence of between 53% down to 15% with the severely infected EGA Bellaroi$^{\Phi}$ seed lot (Table 1). None of the five seed treatments affected establishment in the Jandaroi$^{\Phi}$ seed lot which was free of *Fusarium* infection. Hence, establishment differences evident in the three *Fusarium* seed lots with some of the fungicide seed treatments appears related to reduced levels of seedling blight rather than improved germination and/or vigour.

Dividend® at the 260 mL/100 kg seed application rate was the only seed treatment to significantly improve establishment in all three seed lots infected with *Fusarium* over the untreated control (nil treatment, Table 1). Dividend®, at the 260 mL rate, increased establishment by 11% to 28% with the benefit lowest in the most heavily infected seed lot. However, even the best seed treatment in this trial could not improve establishment to even 80%. This was particularly evident in the heavily infected EGA Bellaroi$^{\Phi}$ seed lot. In this situation, Dividend® (260 mL) significantly improved establishment by 11% over the untreated seed. However, this still only raised establishment with this seed lot to 26%.

Table 1: *Effect of five fungicide seed treatments on establishment (%) of four durum seed lots ranging in levels of Fusarium infection.*

Seed treatment	Jandaroi$^{\Phi}$ 0% *Fusarium*	EGA Bellaroi$^{\Phi}$ 25% *Fp* only	Jandaroi$^{\Phi}$ 30% *Fp* + *Fg*	EGA Bellaroi$^{\Phi}$ 73% *Fp* + *Fg*
Nil	95.4 a	50.7 c	53.0 c	14.7 bc
Dividend® 260	93.2 a	78.7 a	69.0 a	25.7 a
Dividend® 130	94.8 a	54.3 a	62.7 ab	19.7 abc
Rancona C®	95.0 a	60.0 b	58.7 bc	20.3 ab
RaxilPro®	92.8 a	60.0 b	53.3 c	16.0 bc
Jockey®	90.1 a	54.0 c	59.7 bc	11.3 c

Establishment numbers followed by the same letter are not significantly different (P=0.05) within each seed lot. Variety, percentage of seed infected with *Fusarium* and species (*Fp* = *Fusarium pseudograminearum* and *Fg* = *F. graminearum*) are outlined in the column heading for each seed lot.

Crown rot at harvest

Sowing untreated seed infected with *Fusarium* resulted in 24 to 63% of surviving plants being infected with crown rot at harvest depending on the seed lot (data not shown). The uninfected Jandaroi$^{\Phi}$ seed lot only averaged 1% crown rot infection indicating that the trial was not compromised by background inoculum levels in the paddock. Averaged across the three *Fusarium* infected seed lots, Jockey® was the only seed treatment that did not reduce the incidence of crown rot in surviving plants compared to untreated seed (Nil treatment, Figure 1). However, the reduction in seed-borne crown rot levels was only modest with a maximum average reduction from 35% in untreated seed down to ~27% with Dividend® (260 mL), Rancona C® or Raxil Pro® (Figure 1). In the most heavily infected seed lot these same seed treatments reduced seed-borne crown rot levels at harvest from 63% down to between 43 to 48% (data not shown).

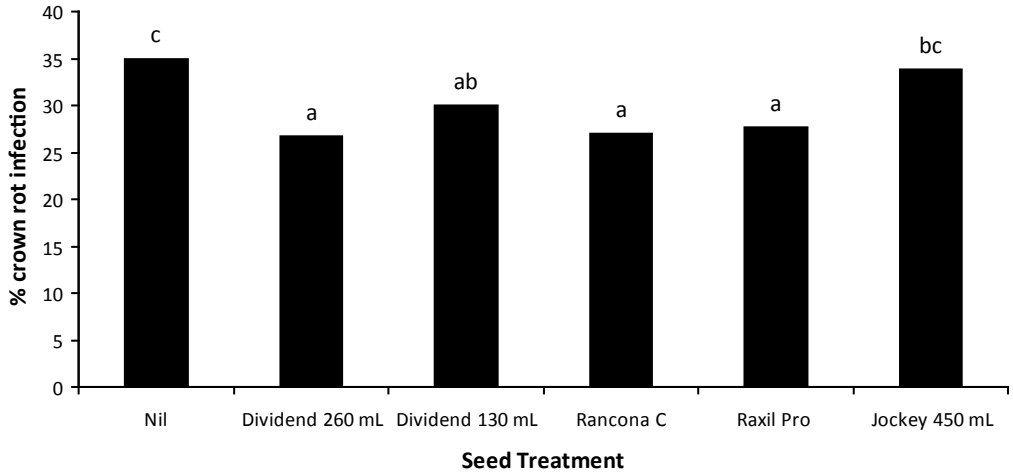

Figure 1: *Effect of five seed treatments on crown rot levels at harvest arising from sowing Fusarium infected seed. Data is average of three Fusarium infected seed lots. Bars with the same letter are not different at the 95% confidence level.*

Conclusions

Sowing seed infected with *Fusarium* significantly reduces crop establishment due to seedling blight. Seed treatments can improve emergence by 10 to 30% but this effect is insufficient if grain is heavily infected with *Fusarium*. In severely infected grain the seed becomes filled with mycelium of *Fusarium* which dramatically reduces germination and vigour. Even the most active seed treatments examined in this trial cannot restore such severely damaged grain to make it suitable for planting.

This study also demonstrated that sowing *Fusarium* infected grain can also introduce high levels (average 35%) of seed-borne crown rot infection into surviving plants. The seed treatments examined in this study had limited effect on reducing levels of seed-borne crown rot infection.

Grain infection with *Fusarium* only occurs as a result of FHB infection, which is favoured by wet conditions during flowering. Crown rot alone cannot directly result in grain infection, as the fungus does not develop up the entire stem and into heads within a season.

Ideally growers should plant wheat seed that is free of *Fusarium* infection by targeting crops which were not infected with FHB in the previous season. Grain infected with FHB is usually white and, if prolonged wet conditions occurred during grain-fill, infected grains will take on a pink appearance. However, it should be noted that if any white or pink grains are evident, then the levels of *Fusarium* infection can be significantly higher than what may be indicated by visual inspection. This is because FHB infections that occur later during grain-fill may not cause any visual discolouration of the seed.

Seed-borne crown rot affects yield in the current crop and introduces infected stubble back into the paddock. Sowing *Fusarium* infected seed, therefore, undoes any break-crop benefits that may have been obtained from growing non-host crops (such as chickpea, canola, faba bean, sorghum) within the rotation sequence.

No seed treatments are registered in Australia for the disinfection of grain infected with *Fusarium*. Even so, those treatments examined in the current study appear to have limited activity anyway.

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