Improving eyespot disease prediction and refining management strategies based on risk

RESEARCH

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Searching for answers

Location
Yeelanna
Rainfall
Av. Annual: 425 mm
Av. GSR: 325 mm
2017 Total: 360 mm
2017 GSR: 204 mm
Yield
Potential: 3.0 t/ha (B)
Actual: 2.94 t/ha
Paddock History
2017: Wheat
2016: Canola
2015: Wheat
Soil Type
Red chromosol
Plot Size
2 m x 10 m x 4 reps

Key messages

- **In a late break, low rainfall season at Yeelanna, under low-moderate disease levels, there was no yield response to fungicide application at any timing.**
- **Whilst variety choice did influence yield, this appeared to be unrelated to eyespot or any other disease, but rather related to phenology and season.**
- **Whilst some eyespot infection was recorded, there did not appear to be any effect of cultivar or fungicide application on disease incidence or severity.**
- **It is likely that total inoculum in the soil/stubble was reduced in all plots, due to the weather conditions alone and not influenced by either variety or fungicide treatments.**

Why do the trial?

Eyespot disease can have devastating effects on the yield of wheat under the right conditions. Growers on the lower Eyre Peninsula (LEP) are likely to have seen these effects in recent years, or at least heard about them. Yield losses in the order of 20-30% are common, resulting from both direct grain fill reduction as well as losses associated with harvesting difficulty.

Eyespot can be difficult to manage. Symptoms only appear long after infection has occurred and, by that point, fungicides are no longer effective. Thus, management decision-making is pre-emptive and based on risk. Management options include sowing cereals less often, choosing a more resistant cereal cultivar, sowing of eyespot-affected paddocks last in the normal sowing program, and application of a fungicide during early growth stages.

This research program is aimed at evaluating the benefit of various management strategies within cereal phases under varying eyespot inoculum levels and seasonal conditions, particularly in wheat-on-wheat situations, so that eyespot management remains flexible and fungicide use is limited to situations where a return is likely.

How was it done?

A trial was established at Yeelanna. The site was chosen based on a previous eyespot problem and the likelihood that the grower would plant consecutive cereal crops in 2017 and 2018, allowing a 2-year wheat-on-wheat trial to be established. The initial Predicta B soil test showed a low level of eyespot inoculum. Further testing of soil disease inoculum levels (eyespot only) was undertaken for every plot to identity variation across the trial site.

The trial was sown using a standard knife point/press wheel plot seeder, with two cultivars of varying susceptibility, Mace (S) and Trojan (MS) on 27 June, ahead of a forecast rain event on 3 July (30 mm). All seed was coated with a fungicide to assist in control of rusts. Herbicides and fertilisers used throughout the trial reflected district practice.

Plots received a fungicide treatment at either GS25 (25 August), GS31 (11 September) or GS 39 (3 October). There were also control plots for each variety, where no fungicide was applied. As yet, no fungicides are registered for the control of eyespot in wheat, however a fungicide registered for control of other diseases in wheat was used at maximum label rate.

Disease incidence and severity was calculated by visually inspecting plants from samples taken from 10 cm of row in eight locations across each plot on 16 November, with a 0-4 scoring scale for each plant used to calculate a disease index for that plot. The trial was harvested on 11 December and plot weights were recorded and grain samples retained for analysis.

Range	Row 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4	0.62	1.80	0	0	0	0	0.42	0	0	0	0	1.04	0	0	0.47	0
3	0	0.64	0	0	0.61	0.90	0	1.42	0	1.36	0	0	0	0	0	0
2	0	2.60	2.05	0	2.03	1.24	0	0	1.01	0	0	0	0	1.22	0	0
1	0	0	0	1.46	0.4	0	0	0	0	2.23	0	0	0.53	1.09	0	0.46

Figure 1. Starting inoculum at Yeelanna in 2017 (log10kDNA copies/g soil), where 0.3-1.5 is considered low risk, 1.5-3.1 moderate and >3.1 high.

What happened?

Starting disease inoculum at the trial site varied greatly between plots, ranging from 0 to 2.6 log10kDNA copies/g soil. Figure 1 shows the trial site layout and inoculum level.

Growing season rainfall was below average with just 204 mm from April to October. However, with the late break, the growing season at the trial site, measured from seeding to harvest, was just 161 days (23 weeks) compared to a common LEP growing season of 28 weeks.

All plots had at least some eyespot present, but incidence was generally low, ranging from 1–13% stem infection. Severity was extremely low, ranging across all plots from 0.01 to 0.18 (out of a possible 4). However, disease incidence and severity were not affected by either fungicide or variety, nor the starting inoculum present in the plot.

Yield was not affected by fungicide timing and no fungicide treatment was any higher yielding than the untreated control for either Mace or Trojan. Cultivar did significantly affect yield (P=0.0004), with Mace yielding 2.94 t/ha and Trojan 2.82 t/ha across all fungicide treatments. There was no relationship between starting inoculum and disease incidence or yield.

What does this mean?

For eyespot, risk is related to two factors; the inoculum level present in the paddock, since eyespot is predominantly rain-splashed from stubble already present in the paddock and, the weather conditions in any given season. Higher levels of inoculum in a paddock make infection more likely – this can now be tested as part of the Predicta B disease DNA soil test, but is also likely to be indicated by a recent eyespot problem in that paddock. Because of the disease's need for rain-splash to spread spores, as well as its slow growing nature, early sown crops which experience substantial or multiple rainfall events from early tillering to early stem elongation are likely to incur yield penalties if untreated where inoculum is present. Late-sown crops or crops which do not experience heavy and prolonged rainfall through this period, may not see yield effects, even though some infection may still occur (which would influence risk for the following year).

The starting inoculum levels, shown in Figure 1, highlight an important point. Eyespot inoculum was highly variable between plots at a trial scale. At a paddock scale this variability is also normally visible. The implications of this variability is that a PredictaB test conducted in part of a paddock may not represent the problem over the whole paddock. Likewise, a quick perimeter check of a paddock may not identify an eyespot problem throughout the paddock. Identifying the extent of inoculum presence is critical to making management decisions in following years and there is clearly the need to thoroughly assess the whole paddock based on the spatially-variable nature of this disease.

It is quite clear from this trial that the combination of low-moderate levels of starting inoculum and a late break/below average rainfall year is not conducive to eyespot disease development and does not justify fungicide application or the selection of a wheat cultivar of lower disease susceptibility. Whilst the low rainfall is likely to have directly reduced infection (fewer rain-splash events), it is also likely that the late break and low rainfall, which resulted in low crop biomass and thus low canopy humidity throughout peak spore release, reduced eyespot infection. Eyespot generally requires extended wet/humid conditions in early growth stages to successfully infect the host. Where there was infection, the severity scores of these infections were low. This is likely due to the short growing season, as eyespot is considered to be a slow-growing disease which generally needs a long growing season to have substantial yield impacts.

This trial highlights the cost-benefit of knowing the eyespot risk for each paddock, in each season, before making management decisions. Under the low-inoculum, late break conditions of 2017, choosing a variety of higher resistance status, Trojan, resulted in a yield reduction of 0.12 t/ha, compared with the less eyespot-resistant Mace. This equates to a loss of $30/ha (@ $250/t). Furthermore, application of a prophylactic fungicide would cost between $16.50 and $31/ha (depending on product and including contract spraying costs of $10/ha). Overall, management for eyespot in a low risk scenario could reduce profit by $46.50/ha.

Furthermore, the treatments did not appear to affect disease incidence and severity and, thus, may not have had any residual benefit on inoculum levels for the following year. This will be further tested ahead of the second cereal phase in this trial, however it appears that there would be little benefit of extensive management to successive wheat crops in a paddock where starting inoculum is low and seasonal conditions are unconducive to eyespot.

This trial will continue in 2018, with wheat plots sown directly over 2017 plots (i.e. wheat on wheat). Further assessment of disease inoculum will be undertaken in the established plots to determine whether 2017 treatments had any effects on inoculum build-up (or decline). In 2018, we plan to evaluate the effects of 2017 management decisions on both Trojan and Mace (possibly replaced with Scepter). A second trial site will also be established to restart the 2-year trial under different conditions.

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