Evaluating Fungicide Timing for Leaf Spot Disease Control in Wheat

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Abstract

Leaf spotting diseases commonly occur in the majority of spring wheat crops grown in Saskatchewan. Leaf spots are capable of causing losses in yield of up to 15%, depending on the cultivar of wheat grown as well as environmental factors. However, losses of 50% or greater have been documented during severe epidemics. Recently fusarium head blight (FHB) has also become a major concern for growers due to high yield and grade loss potential and mycotoxins in the grain. The optimal fungicide timing for leaf spot control is generally at the flag leaf stage, while optimal timing for FHB is during anthesis. Five different fungicide treatments were applied to cv. Carberry at 3 different timings: flag leaf stage, anthesis, and both flag leaf stage and anthesis. The objective of the experiment was to determine whether applying fungicide at anthesis timing would also provide adequate control of leaf spots relative to applying at flag leaf stage. Based on the data, it would appear that there was no difference with respect to leaf spot severity or yield for the two treatment timings. Applying fungicide at the anthesis stage, however, significantly increased thousand kernel weight (TKW) relative to the flag leaf stage treatment.

Introduction

Tan spot is capable of causing yield loss in wheat between 5-10% depending on management and environmental factors; however, losses as high as 50% have been recorded (Hosford et al., 1987). Increased prevalence of tan spot in western Canada may be due to changes in management practices from conventional tillage and stubble burning to conservation tillage, shorter rotations, and wheat on wheat plantings (De Wolf et al., 1998).

There are a variety of other leaf spot diseases that affect spring wheat, including those caused by the pathogen species that make up the septoria leaf spot complex, such as septoria leaf blotch as well as stagonospora blotch (Goodwin 2012). Yield loss due to septoria leaf blotch can be as high as 30-50% during severe epidemics, although is often times much lower (Eyal et al., 1987). Yield loss due to stagonospora blotch is also often much lower, accounting for a maximum level of 15%
during severe epidemics (King et al., 1983). Recently fusarium head blight (FHB) has also become a major concern for growers, as yield losses of up to 70% may occur, rapid grade reductions due to the presence of fusarium damaged kernels (FDK) and deoxynivenol (DON), which is highly toxic to both humans and livestock, may make the grain unsaleable.

Optimum application timing of fungicides to control tan spot and other leaf diseases of spring wheat is believed to be at GS39 or when the flag leaf is fully unfurled, whereas the timing for control of fusarium head blight is at GS60 or the beginning of anthesis (Wiersma and Motteberg 2005). The objective of the experiment was to determine whether applying fungicide at anthesis timing would also provide adequate control of leaf spots relative to applying at the flag leaf stage.

**Materials and methods**

The experiment was conducted at Saskatoon, Indian Head and Melfort in Saskatchewan as well as Lethbridge and Brooks in Alberta in 2013. The experiment was subsequently conducted in 2014 at Saskatoon and Melfort in Saskatchewan. Experiments were randomized complete block designs with four replicates. Each trial consisted of a $3 \times 5$ factorial design plus an unsprayed check. The fungicide treatments were Prosaro® (prothioconazole + tebuconazole), Folicur® (tebuconazole) and a biological fungicide, Serenade Optimum® ($Bacillus subtilis$). Prosaro and Folicur were applied at full rates as well as tank mixed with Serenade Optimum at three timings, flag leaf stage (GS39), anthesis (GS60) and at both GS39 and GS60. The CWRS wheat variety Carberry was chosen as it is moderately resistant to FHB, which would help alleviate confounding effects between leaf spots and FHB. Disease ratings were conducted on the check plots at each application date and prior to fungicide treatments. Leaf spotting diseases were rated using the Horsfall – Barratt scale (0-11) (Horsfall and Barratt 1945), and ratings were then converted to percent leaf area affected by the disease. The plots were also assessed using the McFadden scale to determine the level of severity over the whole plant (McFadden 1991). Harvest data included: plot yield (kg/ha) and thousand kernel weight (g).

All statistical analyses were performed using the Mixed Model procedure of SAS version 9.3 statistical software (SAS Institute Inc., Cary, NC), and treatment means separated with the Least Significance Difference (LSD) test ($P < 0.05$). The effects of treatments were considered fixed effects, and blocks within location*year were considered random effects. The DDFM = kenwardroger option was considered for approximating the degrees of freedom for means. Contrast statements were used to make comparisons among treatments of interest.

**Results**
There was no significant difference in leaf disease severity or yield between applying fungicide at anthesis stage and flag leaf stage (Figure 1-2), while both treatments significantly reduced disease and increased yield relative to the unsprayed check. However, there was a reduction in leaf disease severity and an increase in yield when fungicide was applied at both timings compared to either single application.

The biological fungicide *Bacillus subtilis* was shown to significantly decrease disease severity in comparison to the unsprayed check (Figure 3); however, upon closer inspection of the data, the biological fungicide was highly effective only at Lethbridge in 2013, while there were no significant differences observed at any of the other locations.

Thousand kernel weight (TKW) was significantly higher when fungicide was applied at anthesis compared to the flag leaf stage (Figure 4), however the increase in TKW did not result in higher yield for the anthesis versus flag leaf timing. All three fungicide timings increased TKW relative to the unsprayed check.

**Conclusion**
Based on the data from seven site-years it can be concluded that there was no significant difference with respect to leaf-spot control and between fungicide applications at the flag leaf versus the anthesis stage. It appears that applying fungicide at anthesis stage for controlling FHB will also result in adequate control of leaf spots with respect to yield impact. It should also be noted that disease levels were relatively low in 2013 and for the Alberta locations in 2014. However, should higher leaf-spot severity be observed in 2015 the data may show potentially more pronounced differences between the application timings.

References


