Fire & Iron: Tools for Disease Management?

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Abstract

Large volumes of crop residue are often managed using tillage or burning. This study examined the effect of these practices on diseases of barley [leaf spots, *Pyrenophora teres* Drechsler and *Cochliobolus sativus* (Ito & Kuribayashi)] and canola [blackleg, *Leptosphaeria maculans* (Desmaz.) Ces. & De Not.; sclerotinia stem rot, *Sclerotinia sclerotiorum* (Lib.) de Bary]. The trials were conducted at Birch Hills and Star City, SK for 5 years with treatments of: zero (ZT) and conventional (CT) tillage, and burning (B) or no burning (NB) of previous crop residue. At each site an experiment for barley and for canola was established and a 2-year rotation followed between these crops. In barley, leaf spot severity was slightly lower under ZT than CT at 3 of the 6 site-years (SY) where leaf spot symptoms occurred, and higher under the B treatment than NB at 1 SY, but no significant treatment difference was detected at the other SYs. ZT resulted in a higher seed yield than CT at 6 of 9 SYs, but there was little relationship between leaf spot severity and barley yield. Yield was higher in the NB than the B treatment at only 1 SY. At 2 SYs, yield was higher for the ZT-B treatment than the other treatment combinations. In canola, moderate sclerotinia stem rot incidence occurred at only 1 SY, and blackleg incidence did not show a consistent pattern with treatment. Canola yield was higher under ZT than CT at 3 SYs, but B had no consistent impact. We conclude that use of fire to manage the diseases of barley and canola assessed in this study was not effective. ZT sometimes increased the severity of leaf spots on barley but had little impact on blackleg of canola. The impacts of tillage and residue burning on diseases were generally inconsistent and the magnitude of the reduction in disease usually small. Crop yield was more frequently impacted by tillage system than residue burning.

Introduction

Residue of previous crops has often been managed by fire and tillage. However, the impact of crop residue management on crop diseases has not often been examined. Changes in tillage practices has resulted in more residue left on the soil surface, which may have an impact on seeding operations, fertility and plant pathogens. The objective of this study was to determine the impact that burning crop residue has on crop diseases of canola and barley under conventional and zero-tillage systems.
Experimental Method

Two experiments were established at each of Star City and Birch Hills, SK into which canola and barley were seeded into 4-treatment randomized complete block experiments with 6 replicates each. Treatments consisted zero-tillage (ZT) and conventional tillage (CT), with and without burning (B or NB) of crop residue the previous fall. A Conserva-pak drill with 23 cm (9 inch) row spacing was used to seed plots of 8 m x 20 m. A fertilizer blend (14-20-10-10) at a rate of 100 kg/ha and urea (46-0-0) applied at 130 kg/ha (60 kg/ha N) were side-banded at time of seeding. Tillage was performed using a Bourgault cultivator equipped with spikes in the fall, and shovels in the spring.

Barley was assessed for leaf spot disease severity as the percentage of the flag and penultimate leaves affected by disease symptoms during the soft dough stage of kernel development. Canola was assessed just prior to swathing for the percentage of plants in each plot with blackleg and sclerotinia stem rot symptoms. Barley and canola plots were swathed with a New Holland swather and harvested with a Massey 550 combine. Data were analysed using analysis of variance procedures.

Results

• For leaf spots of barley, burning had a significant effect on leaf spot severity only at Star City in 2004, where it appeared to increase severity (Table 1).
• Tillage had a significant impact on leaf spots at 3 of 6 sites (Star City 2000 and 2004, and Birch Hills 2004), although the difference in severity of leaf spots between the treatments was small (Table 1).
• Burning impacted yield at 3 site-years (Star City 2000, 2001 and 2004), but the results were dependent on tillage system at 2 site-years, and were not consistent between site-years. Yield of barley as impacted by tillage and burning was much more dependant on environmental conditions: ZT resulted in greater yields in dry seasons (2001 to 2003) than under ‘normal’ moisture (2000 and 2004) conditions (Table 1).
• There was an indication that sclerotinia stem rot may be greater when stubble of the previous crop is burnt (Star City and Birch Hills 2000), but significant sclerotinia (~25% incidence) appeared at only 1 site-year (Table 2).
• Tillage did not appear to impact sclerotinia stem rot infection in this study but the data was limited.
• Blackleg was affected by tillage system at Birch Hills in 2000, where incidence was less under ZT than CT (Table 2).
• Burning previous crop residue resulted in greater blackleg incidence than un-burnt treatments at Birch Hills in 2004, but less under ZT-B than ZT-NB at Birch Hills in 2001 (Table 2).
• ZT resulted in greater canola yields than CT at Star City in both 2000 and 2002 (Table 2).
• Burning increased canola yield at Star City in 2000, but reduced it at Birch Hills in 2004. Burning increased canola yield under ZT, (but not CT) at Birch Hills in 2000, but burning resulted in lower yield particularly on ZT at Birch Hills in 2001 (Table 2).
Conclusions

Despite the use of disease susceptible cultivars and a highly intensive rotation, neither large nor consistent effects of tillage system or residue burning were observed on the diseases of barley and canola observed in this study. Zero-tillage sometimes resulted in increased leaf spots of barley although the magnitude of the differences in leaf spot severity among treatments was not large. Similar to barley, there was little relationship between blackleg and sclerotinia incidence and canola yield as impacted by tillage system and residue burning. We conclude that fire was not an effective strategy to manage diseases of barley or canola in this study, regardless of tillage system and that greatest impact on crop yields was tillage system, as a result of the interaction with environment (moisture) rather than disease.

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