Field Crop Disease Management with Rotation, Tillage, and Fungicides

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Abstract

The impact of tillage, rotation, and fungicides on diseases and yield of wheat, barley, pea and canola were determined in an ongoing field study at Melfort in 1998 and 1999. A split-split plot design was used with conventional, minimum and zero tillage systems as main-plots, rotations (1 - canola, wheat, barley, barley; 2 - canola, barley, pea, wheat; and 3 - canola, pea, flax, barley) as sub-plots and fungicide treatments as sub-sub plots. The fungicides Tilt (propiconazole) for cereal foliar diseases, Quadris (azoxystrobin) for mycosphaerella blight of pea and blackleg of canola, and Ronilan (vinclozolin) for sclerotinia stem rot of canola were applied at recommended rates and crop development stages. Tillage system had little impact on diseases of any of the crops examined except common root rot of barley, which was less severe under reduced tillage. Barley foliar disease levels were greater and yields lower in rotation 1 than either rotations 2 or 3. This indicates the benefit of a more balanced rotation of broadleaf crops and cereals over the cereal based rotation containing 2 barley crops in four years. Rotation had little impact on diseases of other crops, all of which were grown only once in each four year rotation. Fungicides reduced blackleg of canola in both years and sclerotinia stem rot in 1998 but yield was only increased marginally in 1999. Canola diseases were not affected by tillage system or rotation. Fungicides had greater impact than tillage or rotation on diseases of wheat, barley and pea, reducing foliar disease severity and increasing yield in both 1998 and 1999. In summary, the results of this study demonstrate that fungicides had greater impact on crop diseases and yields than the tillage systems or rotations.

Background and Objectives

Reduced tillage systems have been suggested to contribute to increased problems with crop diseases due to the increased amount of residue left on the soil surface. This residue can harbor some types of plant pathogens, which produce inoculum resulting in infection of future crops. In recent years rotations that include more diverse crops of pulses and oilseeds have been adopted for a number of reasons. The inclusion of pulses and oilseed is expected to reduce the impact of cereal diseases on wheat and barley, however new challenges can be expected with disease control of pulses and oilseeds. Plant disease control can also be achieved with chemical pesticides. There are many foliar applied fungicides on the market that are effective against many of the major diseases in the Parkland. The objective of this study was to evaluate the effects of tillage systems and rotations on foliar diseases

of wheat, barley, canola, flax and pea and determine the benefit of foliar fungicides in disease control of these crops.

Experimental Method

This study was initiated in 1994 and the first cycle of 4 year rotations completed in 1997. This report summarizes results of the 1998 and 1999 crop years. The experiment is located at Melfort on a black silty clay loam soil and designed as a split-split plot of four replications with each phase of rotation occurring every year. Main plots were tillage systems (CT - conventional tillage: fall and spring tillage with harrow and packing of the seed bed; MT - minimum tillage: spring tillage with harrow and packing of the seed bed; ZT - zero tillage: no fall or pre-seeding tillage), sub-plots rotation (Rotation 1- canola, wheat, barley, barley; Rotation 2 – canola, barley, pea, wheat; Rotation 3 – canola, pea, flax, barley) and sub-sub-plots were fungicide treatments (treated or untreated). Tillage operations were conducted with a medium duty cultivator with 28 cm sweeps on 20 cm shank spacing. The rotations were selected for increasing numbers of broad leaf crops. Each sub plot was 15 m x 18 m.

The cultivars and seeding rates were AC Oxbow barley (108 Kg/ha), AC Barrie wheat (134 Kg/ha), Exceed canola (7 Kg/ha) with 7 Kg/ha of Counter 5G, Swing pea (164 Kg/ha), and Normandy flax (56 Kg/ha). Pea was inoculated with Soil Implant granulated peat at 5 Kg/ha. All crops were seeded with a 3.7 m pneumatic plot seeder and fertilizer was side-banded (2.5 cm to the side and 6.4 cm below the seed) at seeding. All treatments received 100 kg/ha of 14-20-10-10. Nitrogen rates were calculated by the target rate for each crop minus soil residual N. The target rates were 80 kg N/ha for barley and wheat, 90 kg N/ha for canola, and 60 kg N/ha for flax. Additional nitrogen was not added to pea.

Foliar fungicides were applied to sub-plots with a Hardy three-point hitch sprayer equipped with 8002 tee-jet flat fan nozzles. Tilt (propiconazole 125 g ai/ha) was applied to wheat and barley at flag leaf emergence. Quadris (azoxystrobin 175 g ai/ha) was applied to pea at first flower. Canola received Quadris (azoxystrobin 125 g ai/ha) at the 2-3 leaf stage for blackleg control and vinclozolin (500 g ai/ha) at 20-30% bloom for sclerotinia control. Diseases were assessed on all treatments of each crop except flax, which had few disease symptoms.

Results and Discussion

In 1998 weather was generally dry during seeding and crop establishment at 14 mm below average but 22 mm above average rainfall in late June and early July created conditions conducive to disease development (Table 1). By August precipitation was 46 mm below normal and temperatures were 2.7°C above normal causing disease development to decrease. In 1999 Melfort had near normal precipitation in May, 47 mm below normal in June but 29 mm above average in July. Temperatures were slightly below normal in May to 1.7°C below normal in July slowing spread of disease. The test was hit by a hail storm on August 5 resulting in yield loss in all crops.

Barley. Common root rot symptoms in barley were less severe under the reduced tillage systems than under conventional tillage although differences in yield were not detected in either year. Barley leaf spot disease (*Pyrenophora teres*) was reduced and yield was greater in the first crop of barley in rotation 1 than the second crop of barley (Figure 1). Yield of barley in rotation 3 was similar to rotation 2, but greater than in rotation 1 in both years. Propiconazole decreased foliar disease severity on barley in both years and increased yield by 865 kg/ha (19.5%) in 1998 and by 342 kg/ha (12.8%) in 1999.

Wheat. Wheat leaf spot diseases, tan spot (*Pyrenophora tritici-repentis*), and spot blotch (*Helminthosporium sativum*) were reduced with Tilt application in both years and yield increased by 608 Kg/ha (18.6%) in 1998 and by 254 Kg/ha (12.6%) in 1999 (Figure 2). Differences in foliar disease severity or yield of wheat due to rotation were not detected in either year, nor were differences due to tillage system in 1999. However in 1998 yields were greater under conventional tillage than minimal or zero tillage, but did not appear to be related to foliar or root disease infection.

Pea. Pea foliar disease incidence was not assessed in 1998 and in 1999 assessment was difficult due to hail damage. Pea yield was increased with Quadris application by 739 Kg/ha (31.5%) in 1998 and by 202 Kg/ha (9.6%) in 1999 (Figure 3) but was not affected by tillage system or rotation.

Canola. Incidence of blackleg (*Leptosphaeria maculans*) was decreased by Quadris application in both 1998 and 1999. Fungicides were not effective for increasing yield of canola (Table 2) in 1998 but there was a slight increase in 1999, likely from effective blackleg control. These treatments increased yield of canola by 168 Kg/ha (15.2%) only in 1999. Disease incidence and yield of canola were not affected by tillage treatment or rotation in either year of the study.

This study did not indicate an effect of tillage system on diseases of the crops examined under the four year rotations followed except for common root rot of barley, which was reduced under zero tillage. Rotation had little effect on disease levels of all crops except barley in the high cereal rotation where disease symptoms increased and yield decreased in comparison to rotations which had only a single year of barley in four years. Overall fungicide applications had the greatest impact on disease levels and were effective in the control of the major foliar pathogens of wheat, barley and pea.

Table 1. Monthly Precipitation and Mean Monthly Temperatures at Melfort in 1998 and 1999. Long Term Averages 1961 to 1991.

Month	Precipitation (mm)			Temperature (°C)		
	1998	1999	Long Term	1998	1999	Long Term
May	25.4	41.5	39.0	12.1	10.2	10.6
June	84.4	14.0	61.9	14.0	14.0	15.5
July	42.8	96.0	66.6	17.9	15.9	17.6
August	6.2	36.0	53.1	19.0	17.0	16.3

Table 2. Effect of Quadris Fungicide on Blackleg (BL) and Ronilan Fungicide on Sclerotinia Stem Rot (SSR) Incidence (%) and Yield (Kg/ha) of Canola at Melfort in 1998 and 1999.

Practice	1998			1999		
	BL	SSR	Yield	BL	SSR	Yield
Control	11.3	15.0	1784	55.1	12.7	1078
Quadris+ Ronilan	4.3	1.6	1852	47.5	11.8	1242
LSD(0.05)	3.0 *	3.3 *	70	4.7 *	2.1	74 *

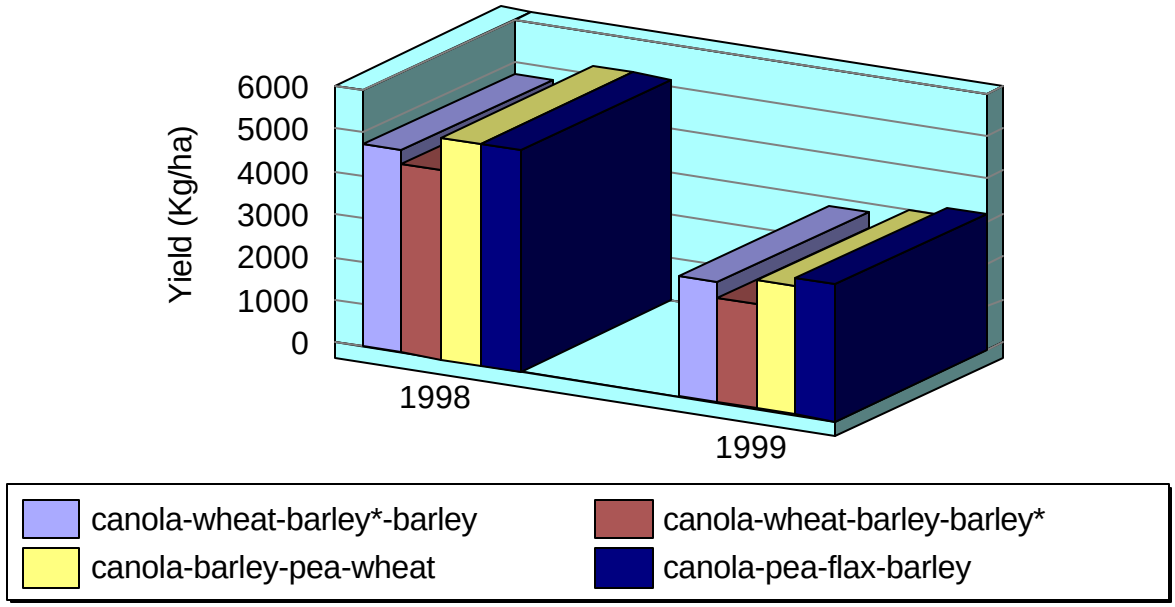

Figure 1. Effect of rotation on yield of AC Oxbow barley at Melfort in 1998 and 1999.

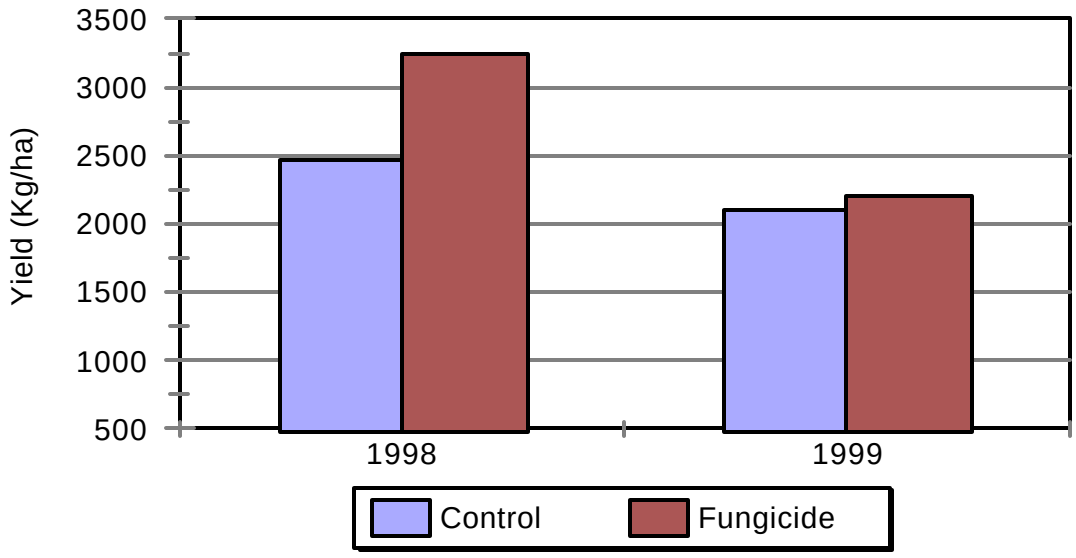

Figure 2.Effect of Tilt fungicide on yield of AC Barrie wheat in at Melfort in 1998 and 1999.

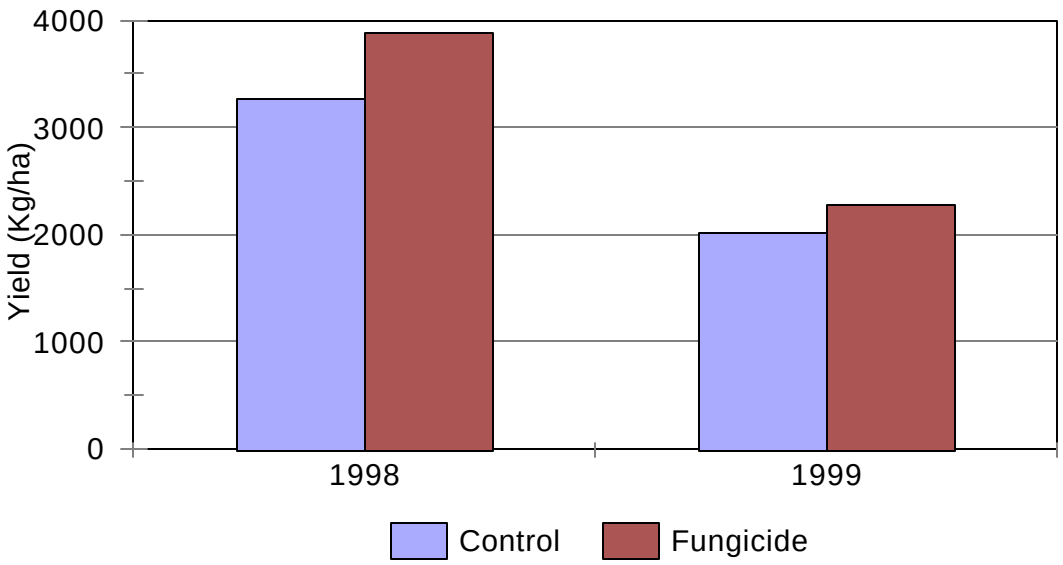

Figure 3. Effect of Quadris fungicide on yield of Swing pea at Melfort in 1998 and 1999.