Impact of Preceding Crops on Incidence and Severity of Disease in Canola

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INTRODUCTION

Higher prices for alternative crops, rotation benefits, and severe wheat disease problems have encouraged many northern plains producers to turn to alternative broadleaf crops. For example, canola acres have increased from 18,000 acres in 1991 to 1.35 million acres in 2010 in North Dakota. Current recommendations are to plant a broadleaf crop like canola or sunflower no more than once every four years to avoid buildup of disease inoculum. However, producers want rotations involving more profitable broadleaf crops to be shortened. Some producers have planted a broadleaf crop for two consecutive years on the same field in an attempt to increase overall profit potential. Additional information on the impact of crop rotation on disease will help producers optimize their limited resources.

The objectives of this research were to 1) document the influence of crop rotation on incidence and severity of sclerotinia (*Sclerotinia sclerotiorum*), blackleg (*Leptosphaeria maculans*), and alternaria black spot (*Alternaria brassicae*) in canola; 2) determine the impact of the previous crop on disease levels in canola; 3) and determine if fungicide applications can be avoided by altering crop sequence.

MATERIALS AND METHODS

Eighteen treatments consisting of six crop rotations were established in 2000 *(Table 1*). 2010 marked the 11th year of the 12-year study. The rotations consist of canola, wheat, barley, and flax with canola preceded by flax, wheat, or canola. Every crop of the rotation is grown each year to help explain the effect of individual years. There are six canola, five wheat, four barley, and two flax treatments with four replications each year. Individual plots are 30 by 180 feet with a 30-foot border around each plot.

Figure 1. Petal test used to estimate SSR risk.

Figure 2. Steadman test used to estimate SSR risk.

Table 1. Crop rotations and treatments.

Rotation	Trt	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	1	Canola	Canola	Barley	Wheat	Canola	Canola	Barley	Wheat	Canola	Canola	Barley
	2	Canola	Barley	Wheat	Canola	Canola	Barley	Wheat	Canola	Canola	Barley	Wheat
	3	Barley	Wheat	Canola	Canola	Barley	Wheat	Canola	Canola	Barley	Wheat	Canola
	4	Wheat	Canola	Canola	Barley	Wheat	Canola	Canola	Barley	Wheat	Canola	Canola
2	5	Canola	Wheat	Canola	Wheat	Canola	Wheat	Canola	Wheat	Canola	Wheat	Canola
	6	Wheat	Canola	Wheat	Canola	Wheat	Canola	Wheat	Canola	Wheat	Canola	Wheat
3	7	Flax	Canola	Barley	Wheat	Flax	Canola	Barley	Wheat	Flax	Canola	Barley
	8	Canola	Barley	Wheat	Flax	Canola	Barley	Wheat	Flax	Canola	Barley	Wheat
	9	Barley	Wheat	Flax	Canola	Barley	Wheat	Flax	Canola	Barley	Wheat	Flax
	10	Wheat	Flax	Canola	Barley	Wheat	Flax	Canola	Barley	Wheat	Flax	Canola
4	11	Flax	Wheat	Canola	Wheat	Flax	Wheat	Canola	Wheat	Flax	Wheat	Canola
	12	Wheat	Canola	Wheat	Flax	Wheat	Canola	Wheat	Flax	Wheat	Canola	Wheat
	13	Canola	Wheat	Flax	Wheat	Canola	Wheat	Flax	Wheat	Canola	Wheat	Flax
	14	Wheat	Flax	Wheat	Canola	Wheat	Flax	Wheat	Canola	Wheat	Flax	Wheat
5	15	Canola	Barley	Wheat	Canola	Barley	Wheat	Canola	Barley	Barley	Canola	Barley
	16	Barley	Wheat	Canola	Barley	Wheat	Canola	Barley	Wheat	Wheat	Barley	Wheat
	17	Wheat	Canola	Barley	Wheat	Canola	Barley	Wheat	Canola	Canola	Wheat	Canola
6	18	Canola	Canola	Canola	Canola	Canola	Canola	Canola	Canola	Canola	Canola	Canola

One-half of each canola plot is treated with a fungicide at approximately 20% bloom. Ronilan® at 12 fl oz is applied with Teejet Twinjet TJ60-8002VS nozzles at 45 psi delivering 20 gpa (*Figure 3*). The other half of the plot remains untreated.

Figure 3. Fungicide applied to one-half of plot for SSR control.

Two methods of sampling are used to evaluate each canola subplot for sclerotinia stem rot (SSR) disease risk at 20% bloom and 1 week later (*Table 2*). Petals are collected from four areas in each subplot (Morrall and Thomson 1991). Four petals from each sample are plated on a semi-selective media for a total of 16 petals per subplot (Figure 1). The second method (lower canopy test) involves placing a culture plate of SM semi-selective media (Steadman et al. 1994) on the ground in four places in the subplot (Figure 2). The culture plates are left uncovered in the plot for 2.5 hours. Culture plates from petal and lower canopy tests are incubated in the dark at room temperature for 3-4 days (*Figures 4 & 5*).

Late-season SSR and blackleg incidence and severity are determined by evaluating standing plants adjacent to canola swaths (*Table 2*). A total of 100 plants per subplot are evaluated (10 plants in 10 locations). Disease severity is rated on a scale of 0 to 5, 0 being no disease and 5 being total girdling of stem resulting in plant death.

Early-season blackleg incidence in the vegetative stage is also determined at about the 4-leaf stage. Approximately 100 leaves per subplot are evaluated for blackleg symptoms (10 leaves in 10 locations).

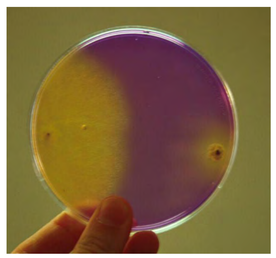

Figure 4. S. sclerotiorum on petal test .

Figure 5. S. sclerotiorum on Steadman test.

ACKNOWLEDGMENTS

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RESULTS AND DISCUSSION

Sclerotinia. In general, petal testing from 2000 to 2010 indicated low to moderate risk for SSR (*Figure 6*). In 2001, early petal and lower canopy testing showed the highest incidence over the course of the study. In June 2001, there was almost three inches of rain before the first risk tests were conducted. However, very little rainfall occurred between or after the two testing dates, which helps explain why the early tests were higher than the later tests. In 2005, conditions seemed ideal for disease proliferation. We received over 10 inches of rainfall during June, which helped create an environment conducive to ascospore production. However, even with these wet conditions, SSR was very low in late-season evaluations. In 2009 and 2010, we received less than three inches of rain during flowering. The individual rainfall events were one to three weeks apart, thus prolonged, wet conditions necessary for SSR infection never materialized. Both years showed very low SSR incidence for early petal and lower canopy testing as well as the late season evaluation.

In most years of the study, dry conditions have prevailed before and during flowering inhibiting ascospore production and disease proliferation. In all years, SSR disease incidence has been less than 26% (data not shown) with no significant correlation to rotation or fungicide treatment. Our observations indicate that SSR disease risk is more likely dependent on environmental conditions than on rotation**.**

Blackleg. *Vegetative evaluation:* Blackleg lesions were visible in the vegetative stage in 2005, 2007 and 2008. Early-season rainfall was plentiful in those years. However, 2006, 2009 and 2010 were fairly dry. In 2005, blackleg incidence in the vegetative stage was highest in canola every other year (82%) and continuous canola (62%), while rotations with canola once in four years were 32 and 42%.

Late-season evaluation: In 2001 to 2003, blackleg incidence was higher in rotations that included canola more frequently (every other year, second year canola, and continuous canola). In 2004 and 2005, blackleg incidence was generally similar across rotations. In 2006, blackleg incidence was higher in second-year canola and continuous canola compared to rotations where a crop other than canola was grown for at least one year. In 2007, incidence was the highest in all rotations to date likely due to13 inches of rain falling from early May to mid-June. Canola every three years had the highest incidence in 2008, while continuous canola was highest in 2009 and 2010 (*Fig 7*).

Although blackleg incidence was higher in some rotations in certain years, blackleg severity was generally low and similar across rotations (*Fig. 8*). Since 2002, blackleg severity generally has been increasing in all rotations, but still has remained relatively low. To date, there has been no obvious correlation between blackleg severity and crop rotation.

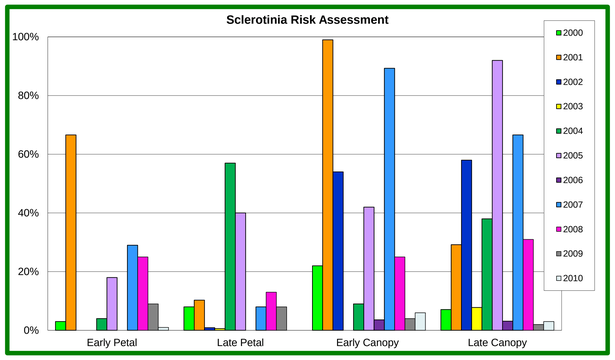

Figure 6. Sclerotinia risk assessment

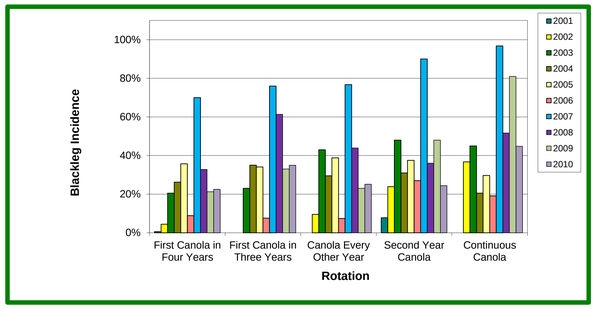

Figure 7. Late-season blackleg disease incidence

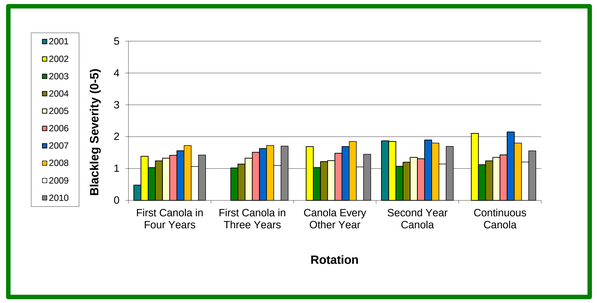

Figure 8. Blackleg plant severity

Table 2. Canola variety and critical dates for 2000 to 2010.

Year	Variety	BL Rating	Seed	Swath	Harvest	SSR Risk Test	BL/SSR Evaluation
2000	2573	R	29-Apr	8-Aug	17-Aug	29-Jun / 2-Jul	9-Aug
2001	3455	R	30-Apr	3-Aug	7-Aug	27-Jun / 3-Jul	6-Aug
2002	2663	R	2-May	29-Jul	5-Aug	27-Jun / 2-Jul	8-Aug
2003	2061	MR	19-May	6-Aug	15-Aug	3-Jul / 10-Jul	18-Aug
2004	4870	R	23-Apr	3-Aug	16-Aug	2-Jul / 9-Jul	16-Aug
2005	910	R	5-May	26-Jul	1-Aug	24-Jun/ 1-Jul	8-Aug
2006	5550	R	6-May	3-Aug	8-Aug	29-Jun / 7-Jul	26-Jul
2007	7145	R	10-May	31-Jul	8-Aug	29-Jun / 6-Jul	2-Aug
2008	8440	R	9-May	NA	21-Aug	4-Jul / 12-Jul	27-Aug
2009	DKL3 0-42	R	8-May	18-Aug	25-Aug	30-Jun / 8-Jul	25-Aug
2010	8440	R	12-May	NA	24-Aug	29-Jun / 6-Jul	24-Aug

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