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

Progress Report

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Research Objectives

1. Document the influence of crop rotation on the incidence and severity of sclerotinia, blackleg, and alternaria black spot in canola.
2. Determine the impact of the previous crop on disease levels in canola.
3. Determine if fungicide applications can be eliminated or rates reduced by altering the sequence of crops in the rotation.

Research Procedures

Crop Rotation

Eighteen treatments consisting of six crop rotations involving canola, spring wheat, barley and flax were established at Minot, ND in 2000 (Table 1). This year (2006) was the seventh of the rotation sequence. Every crop included in the rotation must be grown each year in order to explain the effect of individual years. Each year there are four replications of the various treatments; 7 canola, 5 wheat, 4 barley, and 2 flax. The plots were 30 by 180 feet with a 30 foot border surrounding each plot. One-half of the plot is untreated while the other half is treated with a fungicide to help protect canola from sclerotinia stem rot (SSR). Canola varieties selected were rated "MR" or "R" for blackleg resistance (Table 2). Varieties alternated between Liberty Link and Roundup Ready.

Table 1. Crop rotations and treatments.

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

Table 2. Canola variety and critical dates for 2000 to 2006.

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-April	3-Aug	16-Aug	2-Jul / 9-Jul	16-Aug
2005	910	R	5-May	26-July	1-Aug	24-June / 1-July	8-Aug
2006	5550	R	6-May	3-Aug	8-Aug	29-June / 7-July	26-July

Disease Sampling

All canola plots (both the untreated and fungicide-treated halves) were sampled for the presence of sclerotinia spores and disease, and for blackleg incidence and severity.

Sclerotinia

Sclerotina ascospore counts: Sampling for ascospores was done within the canopy of each canola subplot using two different methods.

Lower canopy testing: The first test was conducted at 20% bloom and the second was conducted one week later. Petri plates with Steadman's semi-selective media (Steadman *et al.* 1994) were placed on the soil surface at four different locations in each canola subplot. The lids were removed and the plates were left exposed underneath the canopy for 2.5 hours. After exposure, the plates were covered and placed in the dark at room temperature (70-75ºF) for 3 days.

Petal testing: Canola petals were also tested for the presence of ascospores. This test was also done at 20% bloom and then again one week later. Petals were collected from four different locations within each subplot. At each location, four main racemes were clipped and placed into a ziplock baggy. From these four flowering stems, four petals were randomly chosen and placed on a Petri plate with Steadman's semi-selective media. The plates were then placed in the dark at room temperature for 3 days.

After the three day incubation period all plates were assessed to determine Sclerotinia disease risk. The scale used was 0 to 45% incidence being low risk, 45 to 90% incidence considered moderate risk, and 90 to 100% considered high risk for SSR (Morrall and Thomson, 1991).

Sclerotinia Incidence and Severity: Ten standing canola stems were evaluated for SSR incidence and severity at ten random locations for a sample size of 100 plants per subplot. Sclerotinia was identified by bleached white stems that were spongy or shredded. Sclerotinia incidence (percent of infected plants) and severity on a scale of 0 to 5 (0 being healthy, 5 being dead) was recorded.

Blackleg

Canola was evaluated for blackleg incidence and severity two times during the growing season. The first was a leaf evaluation for blackleg incidence and the second was a stem evaluation to determine incidence and severity.

Starting in 2005, ten plants were evaluated in ten random locations in each canola subplot for the presence or absence of blackleg lesions. This evaluation was done early in the growing season when plants were still in the vegetative stage (4-leaf to bolting).

The second evaluation was conducted when canola was in the swath (2000 – 2006). Standing canola adjacent to the swath was clipped off at soil level so the crown of the plant could be assessed for blackleg presence and severity. Blackleg severity was expressed on a 0 to 5 scale, 0 being no disease and 5 being completely girdled and dead. Incidence, the number of infected plants out of 100, was also determined for each subplot.

Results and Discussion

Sclerotinia

Sclerotinia ascospore levels in 2006 indicated very low risk, based on results from petal and lower canopy testing (Fig 1). Early and late lower canopy tests were below 5% and no petal tests indicated ascospore presence. SSR disease levels were too low to detect any differences between rotations.

In general, petal testing from 2000 to 2005 indicated low to moderate disease risk. 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 in the month of June, which helped create an environment conducive to ascospore production. Most of the rain fell in early or late June. Nearly five inches of rain fell between the early and late tests, which resulted in higher ascospore levels detected in the late test compared to the early test. However, even with these wet conditions, SSR was very low in late-season evaluations.

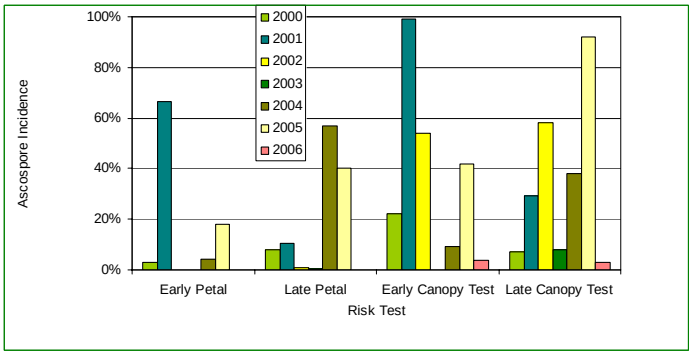

Fig 1. Sclerotinia risk assessment

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 7% (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

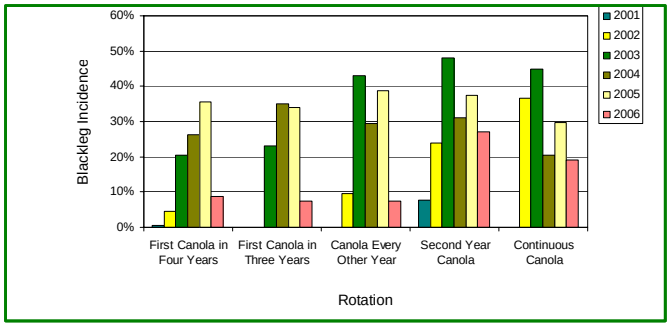

Fig 2. Late-season blackleg disease incidence

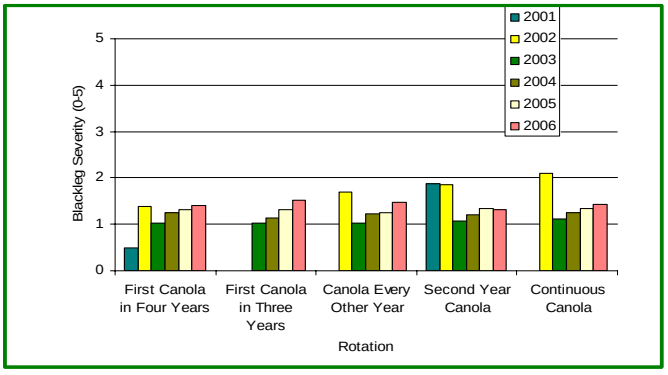

Fig 3. Blackleg plant severity

Vegetative evaluation: Blackleg lesions were visible in the vegetative stage in 2005, but not 2006. Early-season rainfall was plentiful in 2005, while 2006 was very 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 most 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 (Fig 2). Although blackleg incidence was incidence

higher in some rotations in certain years, blackleg severity was generally low and similar across rotations. Since 2002, blackleg severity has been steadily increasing in all rotations, but still has remained relatively low (Fig 3). To date, there has been no obvious correlation between blackleg severity and crop rotation.

Future Research

This study will be continued for five more years when each rotation will have completed at least three cycles. There have been no patents or publications from this study.

Outreach Opportunities

Markle, D. M. and B. M. Jenks. 2004. Impact of Preceding Crops on Incidence and Severity of Disease in Canola. North Dakota Oilseed Council Meeting. February. Minot, North Dakota.

Markle, D. M. and B. M. Jenks. 2006. Impact of Preceding Crops on Incidence and Severity of Disease in Canola. NCGA Canola Forum. January. Minot, North Dakota.

Markle, D. M. and B. M. Jenks. 2006. Impact of Preceding Crops on Incidence and Severity of Disease in Canola. Board of Visitors Annual Meeting. January. Minot, North Dakota.

Markle, D. M. and B. M. Jenks. 2006. Impact of Preceding Crops on Incidence and Severity of Disease in Canola. American Society of Agronomy Annual Meeting. November 13-16. Indianapolis, Indiana.

Literature Cited

Morrall, R. A. and J.R. Thompson. 1991. Petal test manual for Sclerotinia in canola. University of Saskatchewan, Saskatoon, SK 25pp.

Steadman, J.R., J. Marcinkowska and S. Rutledge. 1994. A semi-selective medium for isolation of *Sclerotinia sclerotiorum.* Can. J. Plant Pathology 16: 68-70.