Validation of a Sclerotinia Disease-Warning Model for Canola in North Dakota

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Abstract

A survey was conducted to estimate Sclerotinia stem rot (SSR) prevalence and incidence as a mean of validating information generated by a disease-warning model in 60 canola fields during August 2004. The model estimates the probability of apothecia production as measure of risk of SSR development. Surveyed fields were chosen arbitrarily for their proximity to North Dakota Agriculture Weather Network stations located in Bottineau, Cavalier, Renville, Rolette, Towner, and Ward counties. At each field, a total of 100 plants in 10 stations were scouted for SSR. Results of the survey revealed 100% prevalence; however, the proportion of infected plants in each field (incidence) within locations ranged from 1 to 58%. Irrespective of the location at the time of survey, mean SSR incidence (6%) was significantly lower in fields that were still flowering compared to fields that were closer to maturity (22%). SSR incidence higher than 35% were observed only in fields located in counties where the model predicted at least 9 continuous days of moderate to high risk warnings starting just before and during flowering. The only exception was Ward County, were the highest field incidence was 24% and the average was 6%. Rolette County had the shortest warning duration (three days at moderate risk) and the second lowest SSR mean incidence (14%).

Introduction

Sclerotinia stem rot (SSR) caused by *Sclerotinia sclerotiorum* (SS) (L.) de Bary is a serious and damaging disease that affects canola causing severe economic losses to growers. In 2003, North Dakota planted approximately 388,000 ha of canola with an estimated production of 67,680 metric ton. SSR is greatly regulated by variations in weather conditions. A Sclerotinia risk map has been developed and is in use for the prairie provinces of Canada. The model generates three maps; 1) growth stage of the crop based on estimates of 50% planting; 2) estimates of soil moisture content; and 3) risk of apothecia formation reported as low, moderate or high risk. Results of a field survey conducted in August 2004 to validate the risk model under North Dakota conditions are presented here.

Materials and Methods

Disease survey. Ten fields selected arbitrarily from six counties (Bottineau, Cavalier, Renville, Rolette, Towner, and Ward) across the canola growing regions were inspected around middle of August for SSR incidence. A total of 60 fields were inspected during the course of the survey. In each field, 10 stops were made in a zigzag pattern with at least 10 m interval between each stop. At each stop, 100 plants were evaluated for SSR incidence and are reported in percentage.

Risk map. The model generated maps with estimates of growth stages, soil moisture content, and risk of apothecia formation during the growing season as decision making tools for growers. The risk categories are divided into probabilities of low, moderate, and high for SSR development. The growth stages were generated based on estimates of 50% planting. Predictions of soil moisture content were based on initial soil moisture content at planting time and precipitation data obtained from North Dakota Agriculture Weather Network (NDAWN). A sample risk map is shown in Figure 1.

Table 1. Sclerotinia stem rot (SSR) incidence within fields across locations in 2004

Location	Field	Growth Stage[a]	SSR Incidence (%)	Location	Field	Growth Stage	SSR Incidence (%)
Towner	1	M	42	Rolette	1	M	32
	2	M	55		2	Y	
	3	M	12		3	M	30
	4	Y	3		4	M	14
	5	M	20		5	M	22
	6	M	8		6	M	17
	7	M	19		7	VY	2
	8	Y	3		8	VY	2
	9	M	21		9	VY	1
	10	M	8		10	Y	9
Cavalier	1	M	56	Renville	1	M	37
	2	Y	11		2	M	49
	3	M	24		3	Y	8
	4	M	44		4	M	23
	5	Y	13		5	Y	<1
	6	M	31		6	Y	11
	7	Y	9		7	Y	9
	8	VY	1		8	M	11
	9	VY	<1		9	M	11
	10	Y	2		10	M	9
Bottineau	1	M	34	Ward	1	M	19
	2	M	58		2	M	24
	3	M	15		3	M	<1
	4	Y	2		4	M	3
	5	M	13		5	M	4
	6	Y	4		6	M	<1
	7	M	5		7	M	<1
	8	Y	2		8	M	<1
	9	M	13		9	M	1
	10	Y	<1		10	M	1

[a] Growth stages: M=maturity; Y=close to maturity/pod setting, VY=start to flowering.

Table 2: Description of Sclerotinia stem rot (SSR) risk periods before and during flowering across locations

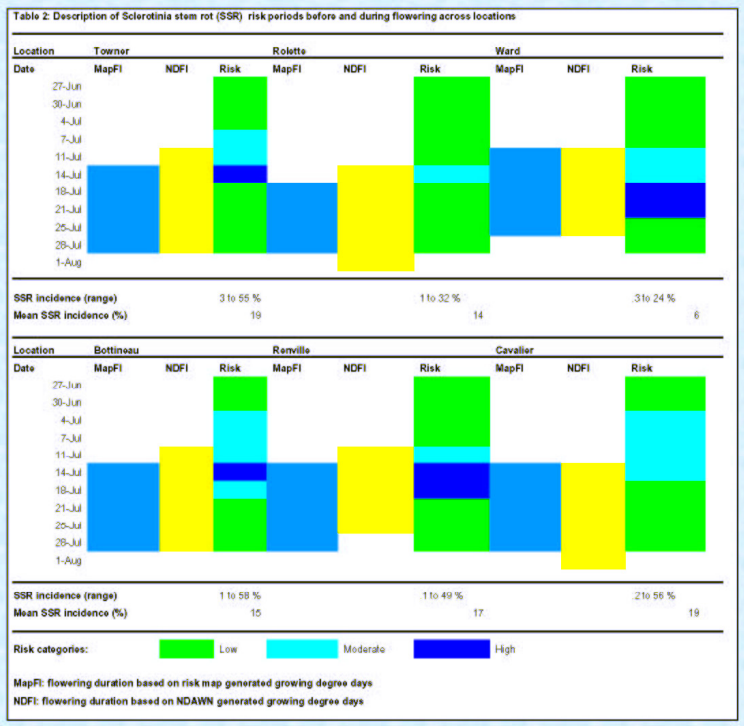

Table 3. Description of mean air and soil temperatures, and precipitation 10 days before and during flowering for different locations

	Mean Temperature (C)		Precipitation (mm)			Frequency of fields with SSR [a] Incidence (%)			
Location	Air	Soil	Total	BFL [b]	DFL [b]	>0-10	>10-20	>20-30	>30
Bottineau	18.7	16.4	62.3	53.1	9.2	50	30	0	20
Cavalier	18.6	20.5	45.2	35.8	9.4	50	20	10	20
Renville	19	17.1	80	66.8	13.2	40	50	10	0
Rolette	18.3	18.3	35.8	30.5	5.1	56	22	22	0
Towner	19.2	18.3	39.9	36.8	3.1	40	50	0	10
Ward	18.4	17	61.7	24.1	37.6	80	10	10	0

[a] SSR= sclerotinia stem rot.
[b] BFL= before flowering and DFL= during flowering.

Results

The unusually cold weather during the growing season delayed normal development of the crop and prolonged flowering further than what was estimated by the growth stage model. The flowering period was predicted to start in mid July and end by late July; however, by the time of survey (mid August), up to 60% of the fields surveyed were still flowering in some locations. All of the fields inspected had SSR. Mean SSR incidence ranged from 6 to 19 % across locations. However, the range of SSR incidence across fields within each location was much wider and ranged from 1 to > 50%. In most locations except Ward, earlier planted fields had greater SSR incidence than later planted fields. Locations with at least nine consecutive days of moderate to high risk were the only ones with fields where SSR incidence was higher than 35% (Tables 1 and 2). Economical yield losses due to SSR have been observed when incidences are greater than this level. Air and soil temperatures were near optimum for SSR development during flowering. Total precipitation 10 days before flowering ranged from 36 to 80 mm except for Ward were only 24 mm was recorded (Table 3).

Short Falls:

1. Exact planting dates for each of the fields inspected are not known. This deficiency was reflected by the variability in flowering as noticed during the survey.
2. Risk map does not relate growing degree days and optimum soil moisture content for apothecia formation.
3. Pre and post-infection (especially) weather conditions are not evaluated by the risk map.
4. Information about cultural practices (such as fungicide application, etc) in each field is unknown.
5. Availability of inoculum density is not known.

Improvements Needed:

1. Gather information on exact planting date, plant emergence date (better than planting date), and cultural practices.
2. Pre- and post-flowering weather conditions, especially rainfall and temperature for SSR development is needed.
3. Probably a more site (location)-specific risk maps may provide better risk advisory for SSR in canola.

Acknowledgements

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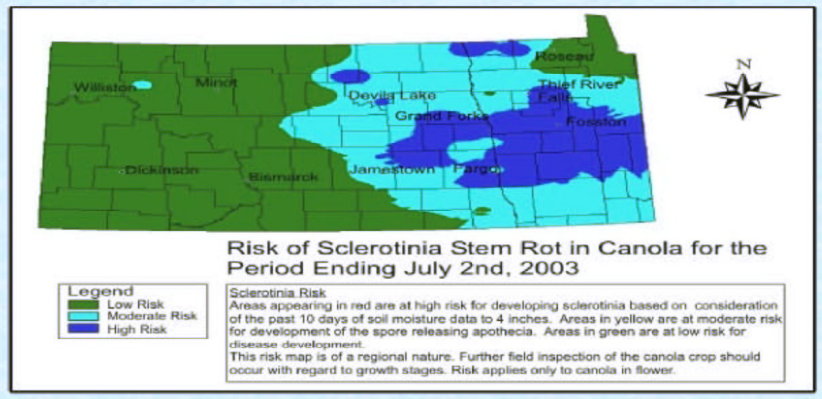

Figure 1. A generated sample of risk map.