

MANAGING CERCOSPORA LEAF SPOT IN SUGARBEET USING THE CERCOSPORA LEAF SPOT PREDICTION MODEL

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INTRODUCTION

Cercospora leaf spot, caused by the fungus *Cercospora beticola* Sacc. is the most serious leaf disease of sugarbeet (*Beta vulgaris* L.) in the production areas of North Dakota and Minnesota. Sugarbeet growers in North Dakota and Minnesota lost about \$113 M in 1998 because of Cercospora leaf spot. Cercospora leaf spot control using fungicides during the 1999, and 2000 sugarbeet-growing season was effective but costly. In 2000, Southern Minnesota Beet Sugar Cooperative growers averaged four fungicide sprays at an estimated cost of \$66.40/acre. This research was conducted to determine whether the cost of controlling Cercospora leaf spot could be reduced without adversely affecting sugar yield and quality.

OBJECTIVES

Evaluate fungicide applications based on the leaf spot prediction model (based on the factory district advisory, and the use of Hobo's within research plots to calculate DIVs above 87% RH) to determine the most effective and economical method for controlling Cercospora leaf spot in sugarbeet.

MATERIALS AND METHODS

Research was conducted at Breckenridge, MN, and St. Thomas, ND. 'HH Agate' sugarbeet seeds susceptible to Cercospora leaf spot and 'Crystal 222' sugarbeet seeds tolerant to Cercospora leaf spot were planted into plots 11 feet in width (6 22-inch wide rows) and 30 feet in length. Seeds were placed 1.25 inches deep and 3 inches apart in rows that were 22 inches wide. Counter was applied at 11.9 lb/acre at planting to control sugarbeet root maggot. The experiment was arranged in a randomized complete block design with four replications. Plots were thinned manually to 150 beets per 100 foot of row on 6 June. The cultural practices and application dates for each location are in [Table 1](#). Treatments were applied directly to the 4-inner rows of the 6-row plots with a boom sprayer operating at 100 psi and delivering 20 gallons spray solution per acre. There were also untreated check plots. Fertilization was done according to standard recommendation for sugarbeet. Plots were kept weed free using micro-rates of herbicides recommended for sugarbeet, hand-pulling, and cultivation.

The middle two rows of each 6-rows plot were harvested. Yield was determined, and quality analysis performed by American Crystal Sugar Company Quality Tare Laboratory, East Grand Forks, Minnesota. Data was analyzed for differences by analysis of variance and LSD using Agriculture Research Manager, version 6.0.

The treatments for Breckenridge were as follows:

- (1) Untreated check.
- (2) 14 d interval calendar spray with the first application at row closure and continuing until conditions are unfavorable for the disease in late August.
- (3) First application at row closure followed by a second application 21 d after. One more application possible in August will be based on the factory district Cercospora advisory indicating the possibility of infection being 'high'.
- (4) First application when first symptoms (0.01% infection) are present in the factory district followed by a second application 14 d after. Subsequent applications of at least 14d intervals will be based on the factory district Cercospora advisory indicating the possibility of infection being 'medium'.
- (5) First application when first symptoms (0.01% infection) are present in the factory district. Subsequent applications of at least 14 d intervals will be based on DIVs for two consecutive days totaling seven or more when the RH is above 90% (using Hobo's) in the presence of disease.
- (6) First application when first symptoms (0.01% infection) are present in the factory district. Subsequent applications of at least 14 d intervals will be based on DIVs for two consecutive days totaling seven or more when the RH is above 87% (using Hobo's) in the presence of disease.
- (7) After row closure, first, and subsequent applications of at least 14 d intervals when DIVs for two consecutive days totaling seven or more when the RH is above 87% (using Hobo's).
- (8) After row closure, first, and subsequent applications of at least 14 d intervals when DIVs for two consecutive days totaling seven or more when the RH is above 90% (using Hobo's).
- (9) First application when symptoms are present in plots followed by a second application 14 d after. There may be a third application based on DIVs for two consecutive days totaling seven or more when the RH is above 87% (using Hobo's) in the presence of disease.
- (10) First application when symptoms are present in plots followed by a second application 14 d after. There may be a third application based on the factory district Cercospora advisory being 'high' in the presence of disease.

The treatments for St. Thomas were as follows:

- (1) Untreated check.
- (2) First application when symptoms are present in plots followed by a second application 14 d after. There may be a third application based on the factory district Cercospora advisory being 'high' in the presence of disease.
- (3) First application when symptoms are present in plots. Subsequent applications of at least 14 d intervals when DIVs for two consecutive days totaling seven or more when the RH is above 90% (using Hobo's) in the presence of disease.
- (4) First application when symptoms are present in plots. Subsequent applications of at least 14 d intervals when DIVs for two consecutive days totaling seven or more when the RH is above 87% (using Hobo's) in the presence of disease.
- (5) First and subsequent applications of at least 14 d intervals based on DIVs for two consecutive days totaling seven or more when the RH is above 87% (using Hobo's).

PS: As a result of late planting, row closure (about July 16) was also later than normal. The first treatment was applied at Breckenridge on July 25 and at St. Thomas on August 3.

RESULTS AND DISCUSSION:

The effect of the treatments for Cercospora leaf spot control using the Cercospora leaf spot prediction model for Breckenridge and St. Thomas are shown in [Tables 2 and 3](#), respectively. The cost per fungicide application was estimated at \$18.25 per acre.

Breckenridge:

Cercospora leaf spot severity was low during the season with the untreated check plots having a KWS Cercospora leaf spot rating of 3.4 at harvest. There was no significant difference in recoverable sugar per acre between the untreated and treated susceptible Agate or between untreated and treated tolerant Crystal 222. It was not economical to apply fungicides in most of the treatments in the low disease conditions that prevailed.

St. Thomas:

Cercospora leaf spot rating was highest (5.5) for the untreated susceptible Agate. There was a significantly lower recoverable sugar per acre between the untreated and treated susceptible Agate. There was no significant difference in recoverable sugar per acre between the untreated and treated tolerant Crystal 222. It was economical to apply fungicides to the susceptible Agate. One fungicide application, based on spraying only when symptoms were present and the possibility of infection was high was as effective but more economical than two fungicide applications (where the second application was applied 14 d after the first, irrespective of disease or environmental conditions). It was not always economical to apply fungicides to the tolerant Crystal 222.

D. Comments

There was no difference in the Daily infection values calculated at $RH > 87\%$ and at $RH > 90\%$.

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Table 1. Cultural Practices And Application Date Information For Cercospora Prediction Model Trials At Breckenridge and St. Thomas In 2001

	Breckenridge	St. Thomas
Planting Date	May 11	May 10
Previous Crop	Wheat	Wheat
Variety	HM Agate	HM Agate
	Crystal 222	Crystal 222
Weed Control	Betamix –micro-rate	Betamix –micro-rate
	Betanex – m/rate	Betanex – m/rate
	Upbeet – m/rate	Upbeet – m/rate
	Stinger – m/rate	Stinger – m/rate
	Poast – m/rate	Poast – m/rate
	MSO – micro-rate	MSO – micro-rate
	Hand labor	Hand labor
	Cultivation	Cultivation
Insecticide	Counter	Counter
Plant Population at Thinning	35,000 plant/A	35,000 plant/A
Spray Application	Breckenridge	St. Thomas
1 st	July 24	August 3
2 nd	August 7	August 17
3 rd	August 14	
4 th	August 20	
5 th	September 5	
DIV > 6	Breckenridge	St. Thomas
	July 16 - 7	July 16 - 8
	July 17 - 11	July 17 - 10
	July 20 - 10	July 18, 19 - 8
	July 23 - 10	July 20, 21 - 7
	July 24 - 8	July 22 - 8
	July 27 - 7	July 27 - 8
	July 28 - 9	July 28 - 10
	July 29 - 8	July 29, 30 - 8
	July 30 - 11	July 31 - 10
	July 31 - 14	August 1 - 7
	August 1 - 10	August 4 - 11
	August 4 - 9	
	August 5 - 9	
Fungicides Applied/A	Eminent 13 fl oz	Eminent 13 fl oz
	BAS 500 9 fl oz	BAS 500 9 fl oz
Spray Volume (gpa)	20	20
Spray Pressure (psi)	100	100
Harvest Date	September 19	September 24

Table 2. Cercospora leaf spot control using the Prediction Model at Breckenridge, 2001.

Treatment	App. Date	Recoverable Sucrose (lb/A)	Recoverable Sucrose (lb/T)	Root Yield (T/A)	Sucrose Content (%)	LTM ** (%)	Returns \$
HH Agate - Susceptible							
Untreated Check		6021	316	19.2	17.2	1.4	623
App 1 - 4, 14 d interval	7/24	6618	310	21.5	16.9	1.3	603
	8/7, 8/20, 9/05						
App 1 - row closure; App 2 - 21 d after	7/24, 8/14	6365	315	20.4	17.2	1.4	623
App 1 - 0.01% disease; App 2 - 14 d after	7/24, 8/7	6559	304	21.8	16.5	1.3	617
App 1 - 0.01% disease; DICV>6, RH >87%	7/24	6834	321	21.5	17.4	1.3	703
App 1 - 0.01% disease; DICV>6, RH >90%	7/24	6164	300	20.9	16.4	1.4	595
App 1 - row closure; DICV>7, RH >87%	7/24	6231	288	21.6	15.8	1.4	561
App 1 - row closure; DICV>7, RH >90%	7/24	6315	300	21.0	16.4	1.4	598
App 1 - 0.01% disease; App 2 - 14 d after; App 3 - DICV>6, RH>87%	7/24, 8/14	5992	318	19.0	17.3	1.4	652
App 1 - 0.01% disease; App 2 - 14 d after; App 3 - Factory - DICV>6 in presence of disease	7/24, 8/14	6563	319	20.8	17.2	1.3	588
Crystal 222- Tolerant							
Untreated Check		6162	319	19.5	17.3	1.4	650
App 1 - 4, 14 d interval	7/24	6532	317	20.8	17.1	1.3	607
	8/7, 8/20, 9/05						
App 1 - row closure; App 2 - 21 d after	7/24, 8/14	6274	321	19.7	17.4	1.3	624
App 1 - 0.01% disease; App 2 - 14 d after	7/24, 8/7	5566	295	19.1	16.0	1.3	500
App 1 - 0.01% disease; DICV>6, RH >87%	7/24	6461	303	21.6	16.5	1.4	624
App 1 - 0.01% disease; DICV>6, RH >90%	7/24	6712	313	21.6	16.9	1.3	692
App 1 - row closure; DICV>7, RH >87%	7/24	5931	314	18.9	17.0	1.3	592
App 1 - row closure; DICV>7, RH >90%	7/24	6253	305	20.7	16.6	1.3	610
App 1 - 0.01% disease; App 2 - 14 d after; App 3 - DICV>6, RH>87%	7/24, 8/14	5947	312	19.2	16.9	1.3	646
App 1 - 0.01% disease; App 2 - 14 d after; App 3 - Factory - DICV>6 in presence of disease	7/24, 8/14	6311	329	19.4	17.8	1.3	575
LSD (P=0.05)		996.4	23.7	4.3	1.2	0.2	
CV%		11.2	5.4	14.8	4.9	8.4	

*Cercospora leaf spot measured on KWS scale 1-9 (no leaf spot – dead outer leaves, inner leaves severely damaged, regrowth of new leaves)

**LTM: Sugar loss to molasses

Table 3: Cercospora leaf spot control using the Prediction Model at St. Thomas, 2001.

Treatment	App. Date	Recoverable Sucrose (lb/A)	Recoverable (lb/T)	Root Yield (T/A)	Sucrose Content (%)	LTM ** (%)	Ret-Urns \$
HH Agate - Susceptible							
Untreated Check		6464	294	22.2	16.6	1.9	623
App 1 - 0.01% disease; App 2 - 14 d after	8/3	6995	295	23.7	16.6	1.9	634
	8/17						
App 1 - 0.01% disease; DICV>6, RH >90%	8/3	7296	318	23.2	17.6	1.7	750
App 1 - 0.01% disease; DICV>6, RH >87%	8/3	7392	320	23.3	17.6	1.6	763
App DICV>7, RH> 87%	8/3	7136	311	23.3	17.4	1.8	719
Crystal 222 - Tolerant							
Untreated Check	8/3,	6691	304	22.4	17.0	1.7	675
	8/17						
App 1 - 0.01% disease; App 2 - 14 d after	8/3	6990	309	22.9	17.0	1.5	710
App 1 - 0.01% disease; DICV>6, RH >90%	8/3	6969	321	22.1	17.6	1.5	728
App 1 - 0.01% disease; DICV>6, RH >87%	8/3	6783	287	24.0	16.2	1.9	615
App DICV>7, RH> 87%	8/3	6935	302	23.2	16.8	1.7	672
LSD (P=0.05)		512.2	24.6	1.8	1.0	0.2	
CV%		5.0	5.5	5.4	4.1	10.6	

*Cercospora leaf spot measured on KWS scale 1-9 (no leaf spot – dead outer leaves, inner leaves severely damaged, regrowth of new leaves)

**LTM: Sugar loss to molasses