OPTIMIZING CERCOSPORA LEAF SPOT MANAGEMENT IN DIFFERENT REGIONS OF NORTH DAKOTA AND MINNESOTA

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INTRODUCTION

Cercospora leaf spot (CLS), caused by the fungus *Cercospora beticola*, remains the most devastating foliar disease of sugarbeet in Minnesota and North Dakota despite the regular and widespread use of chemical controls and tolerant varieties. Although asymptomatic CLS infections are often detected prior to sugarbeet row closure (Wyatt 2025), the combination of row closure, moisture as rainfall or humidity, and temperature create prime conditions for symptom development and disease epidemics from July through September. Given the 300-mile north-south spread of sugarbeet grown in MN and ND, environmental conditions vary considerably. During the 2024 season, 74% of sugarbeet growers in the southern Red River Valley (RRV) and in southern Minnesota applied four or more fungicide applications to CR+ sugarbeet (Branch et al. 2025). In contrast, only 32% of growers in the northern RRV applied four or more fungicide applications to control CLR. When the northernmost growers are considered alone, only 3% applied 4 or more fungicide application in 2024 (Branch et al. 2025). Clearly, the need for chemical control varies on a north-south axis.

The purpose of this project was to evaluate several fungicide programs, differing in application frequency and timing, across multiple locations ranging from south-central Minnesota to northeastern North Dakota. Both CR+ and non-CR+ sugarbeet varieties were used, despite no difference in best management practices or cooperative recommendations for CLS control between the categories. A second year of this experiment is planned for the 2026 season, and results in this report may be considered preliminary.

Project objectives:

- Evaluate the relative performance of CLS fungicide programs applied to CR+ and non-CR+ varieties at multiple locations, targeting unique environments in the sugarbeet-growing regions of ND and MN.
- Evaluate the effect of each treatment on sugarbeet yield and sucrose content within each location to fine-tune recommendations.

METHODS AND MATERIALS

Field Trials

Locations in 2025 for this project were Renville, MN; Foxhome, MN; Prosper, ND, and St. Thomas, ND. At each location, two adjacent trials were planted. One was planted with a CR+ variety, Beta 7231 or Beta 8018 (St. Thomas location only) that had a 2-year-average 2.9 CLS rating (Brantner et al. 2025). At all four locations, a non-CR+ variety, Crystal 912, was planted, with a 2-year average CLS rating of 5.0 (Brantner et al. 2025). Standard seed treatments were used. Since a direct comparison of CR+ and non-CR+ sugarbeet varieties was not an objective of this project, plots were laid out in a randomized complete block design with four replications, with a separate trial for each variety. Each plot consisted of six 30-foot-long rows with 22-inch spacing. Planting dates for each location are provided in Table 1. Fungicide programs (treatments) were intended to mirror actual grower practices as much as possible while still providing comparative information between locations. No CLS inoculum was applied to these trials. Treatment information is provided in Table 2. The Renville location included an extra application (G or H) in order to follow local practices. The Prosper location did not have a G or H timing application due to late planting. The B timing was approximately row closure at each location. Fungicide programs were similar among the programs, and is outlined in Table 3. All fungicides were applied to the center four rows of each plot, using either a

bike sprayer at 17 gallons per acre (gpa) or tractor-mounted sprayer applying 17 gpa (20 gpa for the Renville location). CLS severity was rated from mid-July to the end of the season using the scale developed by Jones and Windels (1991). The center two rows of each plot were rated. Area under disease progress curve (AUDPC) was calculated from CLS severity and allowed for comparison disease severity between plots (Simko and Piepho 2012). Log transformation was conducted prior in order to meet model assumptions. Plots were harvested on in mid-September through early October (Table 1) using a custom 2-row plot harvester. The center two rows were harvested and used for yield calculations. Approximately 25 lbs of roots were arbitrarily selected and delivered to the American Crystal Sugar Company Quality Tare Laboratory, East Grand Forks, MN, and analyzed for sugar quality. The effect of treatment on AUDPS (following log transformations), root yield, and recoverable sugar per acre (RSA) was evaluated using a generalized linear mixed model. A Fishers protected least significant different test was used for mean separation at the $\alpha = 0.05$ level (Steel et al. 1997) in R version 4.2.3 (R Core Team 2023).

Table 1. Planting dates, seasonal rainfall totals, and Cercospora Risk DIVs (Daily Infection Value) for each month and the total season. DIV values were obtained from the North Dakota Agricultural Weather Network (NDAWN).

Location	Planting Date	Harvest Date	Approximate Rainfall (in.) (May 1st – September 30th)	Cercospora Risk (monthly cumulative DIVs[1])				Total cumulative DIVs
				June	July	August	September	
Renville, MN	April 26th	September 16th	26.0	26	77	80	35	218
Foxhome, MN	April 25th	September 22nd	18.8	20	69	69	31	189
Prosper, ND	May 27th	September 15th	13.0	20	46	56	16	138
St. Thomas, ND	May 7th	October 2nd	10.1	6	37	31	17	91

[1]DIV = Daily Infection Value, per the Sugarbeet Cercospora Risk Model utilized by the North Dakota Agricultural Weather Network.

Table 2. Treatment list and application timing of treatments for sugarbeet field trials conducted at four locations in eastern North Dakota and western and southern Minnesota in 2026.

Treatment	Program Start Date	Application Interval	Number of Applications	Application Dates[1]
1	Mid-June	10-14 days	6	A B C D E F[2]
2	Late June	10-14 days	5	B C D E F[2]
3	Late June	10-14 days then 21-28 days ("Extended")	4	B C E G[3]
4	Early July	10-14 days then 21-28 days ("Extended")	4	C D F H[4]
5	Early July	3-spray	3	C E G[5]
6 (Nontreated control)	-	-	0	-

[1]Application dates at Renville: A = June 21st, B = July 9th, C = July 16th, D = August 1st, E = August 11th, F = August 21st, G = August 29th, H = September 8th. Application dates at Foxhome: A = June 19th, B = July 1st, C = July 14th, D = July 25th, E = August 13th, F = August 28th, G = September 10th. Application dates at Prosper: A = June 27th, B = July 2nd, C = July 17th, D = July 31st, E = August 12th, F = August 26th. Application dates at St. Thomas: A = June 17th, B = June 27th, C = July 10th, D = July 24th, E = August 5th, F = August 19th, G = September 9th.

[2]The Renville location incorporated an additional G (or H) application to match regional practices for treatments 1 and 2.

[3]B C E F at Prosper

[4]C D F G at Foxhome and St. Thomas, C D F (G spray was omitted) at Prosper

[5]C E F at Prosper

Table 3. Fungicide programs used for a multi-location experiment conducted to evaluate Cercospora leaf spot control in sugarbeet in 2026 in Minnesota and North Dakota. The Renville site incorporated additional G and H applications due to local practices.

Treatment	Product @ Rate
1	A[1] = Proline @ 5.7 fl oz/A + Koverall @ 2 lbs/A B = Super Tin @ 8 fl oz/A + Topsin @ 20 fl oz/A C = Headline SC @ 12 fl oz/A + Koverall @ 12 fl oz/A D = Super Tin @ 8 fl oz/A + Koverall @ 2 lbs/A E = Inspire XT @ 7 fl oz/A + Koverall @ 2 lbs/A F = Super Tin @ 8 fl oz/A + Koverall @ 2 lbs/A G = Badge SC @ 2 pt/A + Koverall @ 2 lbs/A
2	B = Proline @ 5.7 fl oz/A + Koverall @ 2 lbs/A C = Super Tin @ 8 fl oz/A + Topsin @ 20 fl oz/A D = Headline SC @ 12 fl oz/A + Koverall @ 12 fl oz/A E = Super Tin @ 8 fl oz/A + Koverall @ 2 lbs/A F = Inspire XT @ 7 fl oz/A + Koverall @ 2 lbs/A G = Super Tin @ 8 fl oz/A + Koverall @ 2 lbs/A H = Badge SC @ 2 pt/A + Koverall @ 2 lbs/A
3	B= Proline @ 5.7 fl oz/A + Koverall @ 2 lbs/A C = Super Tin @ 8 fl oz/A + Topsin @ 20 fl oz/A E = Headline SC @ 12 fl oz/A + Koverall @ 12 fl oz/A G = Inspire XT @ 7 fl oz/A + Koverall @ 2 lbs/A
4	C = Proline @ 5.7 fl oz/A + Koverall @ 2 lbs/A D = Super Tin @ 8 fl oz/A + Topsin @ 20 fl oz/A F = Headline SC @ 12 fl oz/A + Koverall @ 12 fl oz/A E = Inspire XT @ 7 fl oz/A + Koverall @ 2 lbs/A
5	C = Proline @ 5.7 fl oz/A + Koverall @ 2 lbs/A E = Super Tin @ 8 fl oz/A + Topsin @ 20 fl oz/A G = Headline SC @ 12 fl oz/A + Koverall @ 12 fl oz/A
6 (Nontreated control)	-

[1]Application dates at Renville: A = June 21st, B = July 9th, C = July 16th, D = August 1st, E = August 11th, F = August 21st, G = August 29th, H = September 8th. Application dates at Foxhome: A = June 19th, B = July 1st, C = July 14th, D = July 25th, E = August 13th, F = August 28th, G = September 10th. Application dates at Prosper: A = June 27th, B = July 2nd, C = July 17th, D = July 31st, E = August 12th, F = August 26th. Application dates at St. Thomas: A = June 17th, B = June 27th, C = July 10th, D = July 24th, E = August 5th, F = August 19th, G = September 9th. The St. Thomas location incorporated the QoI fungicide, Headline, last to match regional practices.

RESULTS AND DISCUSSION

During the 2025 growing season, local environmental variability was observed through differences in rainfall, temperature, and humidty. Generally, there was a trend of increased rainfall and Cercospora DIVs in the two southern RRV locations, Renville and Foxhome. The St. Thomas location experienced both the least rainfall (10.1 inches) and the fewest cumulative DIVs for the season, 58% and 52% fewer cumulative DIVs than Renville and Foxhome, respectively (Table 1). Environmental conditions at Prosper were similar to the St. Thomas conditions, with 13.0 inches of rainfall during the growing season and 138 cumulative DIVs. Although none of the trials in this project were inoculated with *C. beticola* directly, the Renville and Foxhome trials were nearby inoculated CLS experiments and were located nearby commercial sugarbeet fields. Compared to the Prosper and St. Thomas sites, Renville and Foxhome were judged to be “high-risk” for CLS symptom development due to both environmental history and CLS epidemics in the region, historically. Indeed, in 2025 the average CLS rating (both CR+ and non-CR+ varieties, combined) was 3.7 at Prosper and 3.8 at St. Thomas, but 5.3 and 5.7 for Renville and Foxhome, respectively. These values include both the best- and least-performing treatments, indicating similar patterns in treatment effect but different background levels of disease development. Although trends in CLS severity were similar between both CR+ and non-CR varieties, separate analysis was required to meet statistical assumptions.

At both of Renville and Foxhome locations, the mid-June program start was less effective at reducing CLS severity than the late-June start (Tables 4 and 5). However, this was only a significant effect at the Renville location, and there was no statistically significant different in RSA between these treatments at any location. Based on this single year of data, there is no evidence to support fungicide applications earlier than the final 10 days of June. In the

locations were CLS pressure was relatively low (Prosper and St. Thomas), the effect of treatment on yield and RSA not significant, with the exception of the non-CR+ variety at Prosper. Notably, treatments that began at row closure (late June) were all statistically similar in terms of disease control, yield, and RSA even with the extended interval in treatment 3 (Table 4 and 5). Future experiments may evaluate whether one or two late June or early July fungicide applications may provide enough control to offer flexibility of timing subsequent applications, at least in the northern RRV under normal to below-normal rainfall.

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Table 4. Effect of fungicide program start date and interval on Cercospora leaf spot disease severity (area under the disease progress curve, AUDPC), yield, and recoverable sugar per acre (RSA) in trials conducted at four locations in Minnesota and North Dakota in 2025.

Location / Variety	Treatment, Program start date/ Intervals[1]	CLS Severity log(AUDPC)[2]	Yield (tons/A)	RSA[3] (lbs)
Renville/ CR+	1) Mid-June / Standard	5.1 b[4]	27.2 a	7,170 a
	2) Late June / Standard	4.9 a	26.9 a	7,169 a
	3) Late June / Extended	5.3 c	25.4 a	6,578 ab
	4) Early July / Extended	5.2 bc	25.6 a	6,547 ab
	5) 3-spray	5.3 c	24.0 ab	6,131 b
	6) Nontreated control	5.8 d	20.8 b	4,802 c
	P =	< 0.001	0.004	< 0.001
Foxhome/ CR+	1) Mid-June / Standard	3.0 a	32.4 abc	9,037
	2) Late June / Standard	2.9 a	34.5 a	9,472
	3) Late June / Extended	3.8 b	32.9 abc	8,761
	4) Early July / Extended	3.7 b	33.7 ab	9,469
	5) 3-spray	3.7 b	31.5 bc	8,767
	6) Nontreated control	4.6 c	30.9 c	8,603
	P =	< 0.001	0.015	NS[5]
Prosper/ CR+	1) Mid-June / Standard	3.1 a	28.6	8,609
	2) Late June / Standard	3.6 b	28.1	8,657
	3) Late June / Extended	3.5 ab	28.9	9,014
	4) Early July / Extended	3.6 b	29.1	9,149
	5) 3-spray	3.8 b	28.7	8,894
	6) Nontreated control	4.5 c	26.1	8,263
	P =	< 0.001	NS	NS
St. Thomas/ CR+	1) Mid-June / Standard	3.4 a	41.8	12,932
	2) Late June / Standard	3.7 ab	41.5	12,878
	3) Late June / Extended	4.0 b	39.6	11,997
	4) Early July / Extended	3.7 ab	41.7	12,488
	5) 3-spray	4.1 b	41.0	12,321
	6) Nontreated control	4.7 c	37.8	11,367
	P =	< 0.001	NS	NS

[1]Standard = 10-14 days; Extended = 10-14 days, then 21-28 days
[2]Area Under the Disease Progress Curve. AUDPC values were log transformed prior to mixed-model statistical analysis.
[3]Recoverable Sugar per Acre
[4]Means in the same column that share a letter are not significantly different ($\alpha = 0.05$).
[5]Not Significant

Table 5. Effect of fungicide program start date and interval on Cercospora leaf spot disease severity (area under the disease progress curve, AUDPC), yield, and recoverable sugar per acre (RSA) in trials conducted at four locations in Minnesota and North Dakota in 2025 on non-CR+ sugarbeet.

Location / Variety	Treatment, Program start date/ Intervals[1]	CLS Severity log(AUDPC)[2]	Yield (tons/A)	RSA[3] (lbs)
Renville/ non-CR+	1) Mid-June / Standard	5.2 b[4]	24.3 a	5,767 a
	2) Late June / Standard	5.0 a	23.6 a	5,994 a
	3) Late June / Extended	5.4 c	23.7 a	5,354 ab
	4) Early July / Extended	5.5 d	20.2 ab	4,726 b
	5) 3-spray	5.6 d	23.0 a	5,173 ab
	6) Nontreated control	5.8 e	17.1 b	3,387 c
	P =	< 0.001	0.004	< 0.001
Foxhome/ non-CR+	1) Mid-June / Standard	5.6 a	30.4	7,361
	2) Late June / Standard	5.5 a	29.6	6,960
	3) Late June / Extended	5.8 b	27.7	6,155
	4) Early July / Extended	5.8 b	27.4	6,120
	5) 3-spray	5.8 b	29.8	6,656
	6) Nontreated control	6.1 c	24.7	5,069
	P =	< 0.001	NS[5]	NS
Prosper/ non-CR+	1) Mid-June / Standard	3.0 a	32.4 abc	9, 037
	2) Late June / Standard	2.9 a	34.5 a	9,472
	3) Late June / Extended	3.8 b	32.9 abc	8,761
	4) Early July / Extended	3.7 b	33.7 ab	9,469
	5) 3-spray	3.7 b	31.5 bc	8,797
	6) Nontreated control	4.6 c	30.9 c	8,604
	P =	< 0.001	0.015	NS
St. Thomas/ non-CR+	1) Mid-June / Standard	3.1 a	36.1	11,545
	2) Late June / Standard	3.4 a	34.3	11,072
	3) Late June / Extended	3.4 a	38.9	12,681
	4) Early July / Extended	3.6 a	39.4	13,108
	5) 3-spray	3.5 a	36.9	11,923
	6) Nontreated control	4.7 b	34.8	10,855
	P =	< 0.001	NS	NS

[1]Standard = 10-14 days; Extended = 10-14 days, then 21-28 days

[2]Area Under the Disease Progress Curve. AUDPC values were log transformed prior to mixed-model statistical analysis.

[3]Recoverable Sugar per Acre

[4]Means in the same column that share a letter are not significantly different ($\alpha = 0.05$).

[5]Not significant

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