

Cercospora Leaf Spot Fungicide Screening Trials

David Mettler¹ and Mark Bloomquist²

¹Research Agronomist, ²Research Director, SMBSC, Renville, MN

Introduction: Cercospora Leaf Spot (CLS) is the most destructive foliar disease to impact sugar beet production in the SMBSC growing area. Without effective new fungicides, controlling the disease has become more difficult. Without a new “silver bullet”, the key to controlling CLS will be utilizing best management practices that include an appropriately timed fungicide program that utilizes multiple modes of action.

Objective: High levels of cercospora inoculum and a favorable environment for the development of CLS have been major contributors in causing losses to profitability in sugar beet production in recent years. Due to the high levels of disease pressure, an effective fungicide program is necessary to grow a profitable crop. Trials need to be conducted to test the efficacy of individual fungicides and season long fungicide programs.

Materials and Methods: Separate trials were conducted as randomized complete block with four replications at the same site near Clara City, MN. These trials evaluated fungicides in a program setting, but also for individual efficacy. These trials will be referred to as, the Program and Fungicide Screening trials, respectively. This site was planted on April 27th using Crystal 018 with 3gpa of 6-24-6 starter fertilizer applied in-furrow. Dual Magnum was applied preemergence and as a layby application with Roundup Powermax to keep the site weed free. The site was inoculated with 1.67 lbs/acre of pulverized leaves from the previous year that were infected with CLS. The inoculum was spread evenly across the site with a Gandy Orbit-Air applicator on July 6th. Six fungicide applications were made in the Fungicide Screening Trial and in the Program Trial beginning July 9th and continuing on a ten to twelve-day spray interval. Applications were made using a custom-made tractor sprayer traveling 3.6mph with a spray volume of 20gpa and 60psi, utilizing XR11002 spray nozzles. Each plot consisted of six rows that were 40ft in length. The sprayer used CO₂ as a propellant and was designed to apply the treatment to the center four rows, leaving rows one and six untreated. Plots were rated for foliar damage using the KWS (Kleinwanzlebener Saatzucht) scale with one being disease free and nine being completely necrotic. The center two rows of each six row plot were harvested on September 25th using a six row defoliator and a two row research lifter. The beets harvested from the center two rows were weighed on the lifter and a sample of those beets were used for a quality analysis at the tare lab. The data was analyzed for significance using SAS version 9.4. The analysis for the Program Trial only utilized reps 2 through 4 due to water damage to rep 1 which caused stand loss and inconsistent disease and yield in that rep.

Program Trial Results: Few significant differences were found in the yield and quality parameters of the Program Trial (Table 1). The untreated check had significantly lower yield and quality parameters compared to all of the other treatments. The remainder of the treatments were fairly similar with regard to yield and had yield and quality parameters comparable to the cooperative average. More significant differences were observed in the visual foliar ratings (Table 2). The untreated check had a much higher rating throughout the season than all of the other treatments. The Standard Program with no tank-mix partners had a significantly higher rating than all other treatments with the exception of the untreated check. In general, the Standard Programs, which included two copper tank-mix applications, had a slightly higher rating than the EBDC Programs, which contained no copper products. There were not many differences in the Program Trial between treatments that included different adjuvants.

Treatment	Percent	Tons	Percent	Extractable	Extractable	Percent
	Sugar	PerAcre	Extractable	Sugar per	Sugar per	
	Sugar	PerAcre	Sugar	Ton (lbs.)	Acre (lbs.)	Purity
Check	15.2 a	21.0 a	12.6 a	251.0 a	4953.0 a	89.8 a
Standard Program	17.1 bcd	28.0 b	14.5 cd	289.0 cde	8128.3 bcd	90.7 cd
Standard Inverse Program	16.6 b	29.1 bc	13.8 b	277.3 bc	8082.3 bcd	90.1 ab
No Tank-Mix Program	16.4 b	27.1 b	13.8 b	275.0 b	7448.0 b	90.3 abc
Standard Inverse w/ Lucento	17.0 bcd	28.6 bc	14.4 bc	289.0 cde	8259.0 bcde	91.1 de
Standard Inverse w/ Provysol	17.1 bcd	26.4 b	14.5 cd	289.3 cde	7635.7 bc	90.9 de
EBDC Program No Adj.	17.3 cd	32.3 c	14.7 cd	294.3 de	9491.3 e	90.9 de
EBDC Program w/ Masterlock	17.4 cd	29.0 bc	14.8 cd	295.7 de	8607.7 bcde	91.1 de
EBDC Program w/ Masterlock & Transfix	17.3 cd	27.4 b	14.7 cd	293.0 de	8023.7 bcd	91.0 de
EBDC Program w/ Reguard & Diligence	17.4 cd	30.0 bc	14.8 cd	295.0 de	8882.0 cde	90.9 de
EBDC Program w/ Reguard, Diligence, & Ndemand	17.7 d	30.4 bc	15.1 d	301.5 e	9040.0 de	91.3 e
EBDC Program w/ Justified & Cohere	16.9 bc	28.0 b	14.3 bc	285.3 bcd	8021.0 bcd	90.6 bcd
EBDC Program w/ Cerium Elite	17.4 cd	32.3 c	14.8 cd	295.7 de	9545.0 e	90.7 cd
EBDC Program w/ Liberate	17.4 cd	26.5 b	14.7 cd	294.3 de	7792.7 bcd	90.8 cde
Standard Inverse Program w/ Early Topguard	17.4 cd	27.3 b	14.7 cd	295.0 de	8045.7 bcd	90.8 cde
Standard Inverse Program w/ Early Manzate	17.1 bcd	29.9 bc	14.5 cd	290.0 cde	8639.3 bcde	90.6 bcd
Mean	17.1	28.3	14.4	288.5	8198.0	90.7
CV%	2.5	8.6	2.8	2.8	10.1	0.4
Pr>F	0.0006	0.0012	0.0004	0.0003	0.0025	0.0131
lsd (0.05)	0.70	4.00	0.68	13.39	1362.5	0.59

Table 1: Yield parameter results for the Program Trial. Values with different letters are significantly different. Table 5 contains a full description of each treatment.

Treatment	29-Jul	7-Aug	17-Aug	26-Aug	4-Sep	14-Sep	23-Sep
Check	3.5 a	5.8 a	6.8 a	9.0 a	9.0 a	9.0 a	9.0 a
Standard Program	1.3 c	2.5 c	2.7 c	4.5 c	5.8 c	6.1 c	6.7 c
Standard Inverse Program	1.3 c	2.2 cd	2.4 cde	4.3 cd	5.2 cd	5.6 def	6.3 cdefgh
No Tank-Mix Program	1.8 b	3.2 b	4.0 b	6.3 b	7.3 b	7.9 b	8.4 b
Standard Inverse w/ Lucento	1.3 c	2.1 d	2.5 cde	4.1 cde	5.1 d	5.9 cd	6.6 cd
Standard Inverse w/ Provysol	1.2 c	2.1 cd	2.5 cde	4.2 cde	5.1 d	5.7 de	6.5 cde
EBDC Program No Adj.	1.4 bc	2.1 d	2.2 cde	3.7 defg	4.6 defg	5.4 efgh	6.1 efghi
EBDC Program w/ Masterlock	1.2 c	2.1 cd	2.6 cd	3.7 defg	4.6 def	5.5 def	6.2 defgh
EBDC Program w/ Masterlock & Transfix	1.3 c	2.2 cd	2.5 cde	3.7 defg	4.8 de	5.4 efg	6.4 cdef
EBDC Program w/ Reguard & Diligence	1.3 c	2.0 d	2.3 cde	3.5 fg	4.4 efg	4.9 i	5.8 ghi
EBDC Program w/ Reguard, Diligence, & Ndemand	1.3 c	1.8 d	2.0 e	3.2 g	4.1 fg	5.0 hi	5.6 i
EBDC Program w/ Justified & Cohere	1.2 c	2.1 cd	2.3 cde	3.6 efg	4.7 def	5.1 ghi	5.9 fghi
EBDC Program w/ Cerium Elite	1.1 c	1.8 d	2.1 de	3.2 g	3.9 g	5.0 hi	5.8 hi
EBDC Program w/ Liberate	1.2 c	2.1 d	2.2 cde	3.9 def	4.8 de	5.3 efgh	6.4 cdef
Standard Inverse Program w/ Early Topguard	1.1 c	1.9 d	2.4 cde	3.9 def	4.8 de	5.5 def	6.4 cdef
Standard Inverse Program w/ Early Manzate	1.2 c	1.9 d	2.1 de	3.7 defg	4.7 def	5.3 fghi	6.3 cdefg
Mean	1.4	2.4	2.7	4.3	5.2	5.8	6.5
CV%	19.4	10.2	11.5	8.5	7.4	4.0	4.8
Pr>F	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
lsd (0.05)	0.40	0.40	0.52	0.61	0.64	0.38	0.52

Table 2: Foliar ratings for the Program Trial using the KWS rating system with 1 being disease free and 9 being completely necrotic. Ratings with different letters are significantly different. Table 5 contains a full description of each treatment.

Fungicide Screening Trial Results: Several significant differences were found in the yield and quality parameters of the Fungicide Screening Trial (Table 3). The untreated check had substantially lower yield and quality parameters than any of the other treatments. The treatments with only one mode-of-action or Proline with a copper product treatment had either significantly or numerically lower extractable sugar per acre (ESA) than almost all other treatments with two modes-of-action. Manzate Prostick and Proline applied as a tank-mix treatment had significantly higher ESA than either product applied alone. The difference in the foliar ratings correlated well with the differences seen in the yield parameters (Table 4). The untreated check had the highest foliar rating followed by treatments with only one mode-of-action and the Proline with a copper product treatments. Most of the other treatments with two modes-of-action were very similar with the exception of the Proline + Manzate Prostick tank mix having a significantly lower rating.

Conclusion: The results of the Program Trial and the Fungicide Screening trial indicate that a CLS fungicide program that uses multiple modes of action in a single application will have superior performance over a program that applies only a single mode of action. The results of the Program Trial indicate no clear benefit to using an adjuvant with CLS fungicide applications in terms of disease control or ESA. The use of copper or SDHI products did not appear to add any significant benefit to disease control. These results would indicate that EBDC products are the most effective class of fungicides currently available to control CLS in sugar beets and that Proline is the most effective triazole product. These results are consistent with trials conducted 2019.

Treatment	Percent Sugar	Tons PerAcre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
Check	14.8 a	23.5 a	12.3 a	245.3 a	5761.9 a	89.8 NS
Manzate Prostick	17.0 bc	31.7 bcdef	14.4 bcd	287.9 bcd	9127.4 cdef	90.8 NS
Proline	17.1 bc	30.8 bcd	14.4 bcd	287.3 bcd	8828.6 bc	90.4 NS
Manzate Prostick & Proline	17.4 d	33.7 fg	14.8 e	296.1 e	9964.4 g	90.9 NS
Manzate Prostick & Lucento	17.3 cd	33.4 efg	14.7 de	294.5 de	9823.9 fg	91.0 NS
Manzate Prostick & Topguard	17.3 cd	34.2 g	14.7 de	293.9 de	10035.1 g	90.8 NS
Manzate Prostick and Eminent VP	17.3 cd	32.6 cdefg	14.7 de	294.1 de	9588.0 defg	91.2 NS
Manzate Prostick and Inspire XT	17.5 d	32.8 defg	14.8 e	295.3 e	9690.0 efg	90.6 NS
Manzate Prostick and Tin	17.0 bc	33.3 efg	14.4 bcd	287.4 bcd	9667.2 defg	90.6 NS
Proline & Badge SC	16.8 b	29.4 b	14.2 b	283.5 b	8341.8 b	90.5 NS
Proline & Champ 2 Flowable	17.0 bc	31.1 bcde	14.4 bcd	287.5 bcd	8934.6 bcd	90.7 NS
Proline & Agrilife Copper	17.0 bc	30.4 bc	14.4 bcd	287.7 bcd	8757.4 bc	90.7 NS
Manzate Prostick & Provysol (5oz)	17.0 bc	31.7 bcdef	14.3 bc	286.3 bc	9069.3 bcde	90.4 NS
Manzate Prostick & Provysol (4oz)	17.1 bcd	33.2 efg	14.5 bcde	289.5 bcde	9620.0 defg	90.6 NS
Manzate Prostick & Enable 2F	17.2 cd	33.1 defg	14.6 cde	292.3 cde	9670.0 defg	90.8 NS
Proline & Oxidate 5.0	17.3 cd	32.2 cdefg	14.7 cde	293.7 de	9447.5 cdefg	91.1 NS
Manzate Prostick & Eminent VP (6.5oz) + Topguard (7oz)	17.3 cd	33.8 fg	14.6 cde	291.7 cde	9847.7 fg	90.5 NS
Manzate Prostick & Eminent VP (25oz)	17.2 cd	33.0 defg	14.5 bcde	290.7 bcde	9589.3 defg	90.5 NS
Mean	17.0	31.9	14.4	288.1	9202.7	90.7
CV%	1.5	5.2	1.8	1.8	5.7	0.5
P<>F	<.0001	<.0001	<.0001	<.0001	<.0001	0.1323
lsd (0.05)	0.36	2.32	0.37	7.37	745.4	NS

Table 3: Yield parameter results for the Fungicide Screening Trial. Values with different letters are significantly different.

Treatment	29-Jul	7-Aug	17-Aug	26-Aug	4-Sep	14-Sep	23-Sep
Check	4.8 a	6.2 a	7.3 a	9.0 a	9.0 a	9.0 a	9.0 a
Manzate Prostick	1.8 b	3.2 b	3.6 c	5.9 b	6.6 b	7.1 b	7.9 b
Proline	1.3 d	2.5 de	3.2 cd	5.5 b	6.4 b	7.2 b	7.9 b
Manzate Prostick & Proline	1.2 d	1.6 h	1.9 h	2.5 h	3.3 j	3.6 g	4.4 g
Manzate Prostick & Lucento	1.2 d	2.0 fgh	2.3 efg	4.2 ef	5.2 ghi	6.2 ef	6.8 f
Manzate Prostick & Topguard	1.3 d	2.1 efg	2.5 efg	4.5 de	5.4 fgh	6.5 de	7.2 de
Manzate Prostick and Eminent VP	1.4 cd	2.3 ef	2.7 e	4.8 d	5.9 cde	6.7 cd	7.4 cd
Manzate Prostick and Inspire XT	1.2 d	1.9 gh	2.1 fgh	4.0 gf	5.0 hi	6.0 f	6.7 f
Manzate Prostick and Tin	1.7 bc	2.8 cd	2.7 e	4.9 d	5.6 efg	6.5 de	7.0 ef
Proline & Badge SC	1.9 b	3.1 bc	4.1 b	5.5 b	6.4 b	7.1 b	7.9 b
Proline & Champ 2 Flowable	1.9 b	3.3 b	4.0 b	5.4 bc	6.2 bcd	7.0 bc	7.8 b
Proline & Agrilife Copper	1.9 b	3.3 b	4.1 b	5.8 b	6.4 bc	7.2 b	7.9 b
Manzate Prostick & Provysol (5oz)	1.3 d	2.3 efg	2.5 efg	4.6 de	5.4 efgt	6.4 e	6.9 ef
Manzate Prostick & Provysol (4oz)	1.3 d	2.0 fgh	2.6 e	4.6 de	5.5 efg	6.3 ef	6.9 ef
Manzate Prostick & Enable 2F	1.3 d	2.4 ef	2.5 ef	4.9 cd	5.7 efg	6.5 de	7.0 ef
Proline & Oxidate 5.0	1.2 d	2.0 fgh	2.8 de	4.6 de	5.7 edf	6.5 de	7.5 c
Manzate Prostick & Eminent VP (6.5oz) + Topguard (7oz)	1.2 d	2.0 fg	2.4 efg	4.3 ef	5.4 fghi	6.3 ef	7.0 ef
Manzate Prostick & Eminent VP (25oz)	1.2 d	1.9 gh	2.1 gh	3.5 gf	4.9 i	6.0 f	6.7 f
Mean	1.6	2.6	3.1	4.9	5.8	6.6	7.2
CV%	12.5	10.8	9.8	7.3	6.3	3.3	3.0
Pr>F	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
lsd (0.05)	0.30	0.40	0.43	0.51	0.52	0.30	0.30

Table 4: Foliar ratings for the Fungicide Screening Trial using the KWS rating system with 1 being disease free and 9 being completely necrotic. Ratings with different letters are significantly different.

Program Trial		Rate/Acre	Application Code
1) Check	Untreated	n/a	ABCDEF
2) Standard Program	SuperTin	8 oz	ACE
	Masterlock	6.4 oz	ABCDEF
	Inspire XT	7 oz	B
	Badge SC	32 oz	CF
	Manzate Prostick	2 lbs	ABDE
	Proline	5.7 oz	F
	Eminent VP	13 oz	D
3) Standard Inverse Program	Inspire XT	7 oz	A
	Badge SC	32 oz	CF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Manzate Prostick	2 lbs	ABDE
	Proline	5.7 oz	E
	Masterlock	6.4 oz	ABCDEF
4) Standard No Tank-Mix Program	SuperTin	8 oz	ACE
	Inspire XT	7 oz	B
	Eminent VP	13 oz	D
	Proline	5.7 oz	F
	Masterlock	6.4 oz	ABCDEF
5) Standard Inverse Program w/ Lucento	Lucento	5.5 oz	A
	Badge SC	32 oz	CF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Manzate Prostick	2 lbs	ABDE
	Proline	5.7 oz	E
	Masterlock	6.4 oz	ABCDEF
6) Standard Inverse Program w/ Provysol	Provysol	5 oz	A
	Badge SC	32 oz	CF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Manzate Prostick	2 lbs	ABDE
	Proline	5.7 oz	E
	Masterlock	6.4 oz	ABCDEF
7) EBDC Program	Inspire XT	7 oz	A
	Manzate Prostick	2 lbs	ABCDEF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Induce	0.125 %	E
	Proline	5.7 oz	E
8) EBDC Program w/ Masterlock	Inspire XT	7 oz	A
	Manzate Prostick	2 lbs	ABCDEF
	Masterlock	6.4 oz	ABCDEF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Proline	5.7 oz	E
9) EBDC Program w/ Masterlock and Transfix	Inspire XT	7 oz	A
	Manzate Prostick	2 lbs	ABCDEF
	Masterlock	6.4 oz	ABCDEF
	Transfix	4 oz	ABCDEF
	SuperTin	8 oz	BDF
	Proline	5.7 oz	E

Table 5: Program Trial treatment list. The application code indicates when the product was applied in the six spray program treatments.

Program Trial Continued		Rate/Acre	Application Code
10) EBDC Program w/ Reguard and Diligence	Inspire XT	7 oz	A
	Manzate Prostick	2 lbs	ABCDEF
	Reguard	12 oz	ABCDEF
	Diligence	1.5 oz	ABCDEF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Proline	5.7 oz	E
11) EBDC Program w/ Reguard, Diligence, and Ndemand	Inspire XT	7 oz	A
	Manzate Prostick	2 lbs	ABCDEF
	Reguard	12 oz	ABCDEF
	Diligence	1.5 oz	ABCDEF
	N-Demand	1 gal	ACE
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
12) EBDC Program w/ Justified and Cohere	Inspire XT	7 oz	A
	Manzate Prostick	2 lbs	ABCDEF
	Justified	3 oz	ABCDEF
	Cohere	0.125 %	ABCDEF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Proline	5.7 oz	E
13) EBDC Program w/ Cerium Elite	Inspire XT	7 oz	A
	Manzate Prostick	2 lbs	ABCDEF
	Cerium Elite	6.4 oz	ABCDEF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Proline	5.7 oz	E
14) EBDC Program w/ Liberate	Inspire XT	7 oz	A
	Manzate Prostick	2 lbs	ABCDEF
	Liberate	12.8 oz	ABCDEF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Proline	5.7 oz	E
15) Standard Inverse Program w/ Early Topguard	Inspire XT	7 oz	A
	Badge SC	32 oz	CF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Manzate Prostick	2 lbs	ABDE
	Proline	5.7 oz	E
	Masterlock	6.4 oz	0ABCDEF
	Topguard	14 oz	0
16) Standard Inverse Program w/ Early Manzate Prostick	Inspire XT	7 oz	A
	Badge SC	32 oz	CF
	SuperTin	8 oz	BDF
	Eminent VP	13 oz	C
	Manzate Prostick	2 lbs	0ABDE
	Proline	5.7 oz	E
	Masterlock	6.4 oz	0ABCDEF