CERCOSPORA LEAF SPOT CONTROL IN EASTERN NORTH DAKOTA AND MINNESOTA IN 2002

Mohamed Khan[1], Larry Smith[2], Mark Bredehoeft[3], and Steve Roehl[4]

[1]Extension Sugarbeet Specialist, North Dakota State University / University of Minnesota
[2]Head, Northwest Research and Outreach Center, Crookston, University of Minnesota
[3]Senior Research Agronomist, Southern Minnesota Beet Sugar Coop., Renville, Minnesota
[4]Research Agronomist, Southern Minnesota Beet Sugar Coop., Renville, Minnesota

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. This disease may cause reductions in tonnage and sucrose, and increase impurities. Losses as high as 30 percent in recoverable sucrose are fairly common under moderate disease conditions. Roots of diseased plants do not store in piles as well as roots of healthy plants. Limited tolerance to the triphenyl tin hydroxide (TPTH) fungicides was identified in the southern Red River Valley and southern Minnesota in 1994. This tolerance has increased in incidence and severity in the Red River Valley and southern Minnesota. Benzimidazole resistance is present in all production areas of North Dakota and Minnesota.

OBJECTIVES:

The research objectives of these trials were to evaluate the efficacy of labeled and experimental fungicides at controlling Cercospora leaf spot. These fungicides were applied alone, in tank mixes, or alternated at various application intervals not only to evaluate control, but also to evaluate management strategies to prevent or slowdown the buildup of tolerance or resistance to the fungicides. All 2002 test sites had known TPTH tolerance and benzimidazole resistance.

PROCEDURES:

Research was conducted at Crookston, Breckenridge, and Willmar, Minnesota. The cultural practices and application dates for each location are in **Table 1**. At all locations, plots were 11 feet wide (6-22 inches rows) and 35 feet long. The middle four rows received the fungicide applications. The middle two rows of each plot were harvested for yield and quality determinations. The Breckenridge and Crookston analysis were completed at the American Crystal Sugar Company Quality Tare Laboratory, East Grand Forks, MN. Southern Minnesota samples were analyzed at the Southern Minnesota Beet Sugar Cooperative Laboratory, Renville, MN. The experiments were all arranged in a randomized complete block design with four replications. Cercospora leaf spot severity was rated on the KWS scale of 1 to 9. One indicates there was no disease, a rating of 3 indicates the early stages of economic loss level, and a rating of 9 indicates that the plants assessed had only new leaf growth, all earlier leaves being dead, and severe economic loss.

All sites were planted in April-May but there was a prolonged cold spring. Crookston and Willmar sites were inoculated with *Cercospora beticola* inoculum provided by Art Quinn, Betaseed, Shakopee. At Crookston and Willmar, disease severity was moderate to high, and at Breckenridge disease severity was low.
The fungicides tested in 2002 are listed in **Table 2**. The application interval for each treatment at each site is indicated in the tables for the respective sites.

RESULTS AND DISCUSSION:

The effect of the treatments for Cercospora leaf spot control for the test sites are shown in Tables 3, 4, and 5. The payment system for Crookston and Breckenridge was calculated using ACSC rates. A Section 18 label was granted for Eminent 125 SL on sugarbeet for the 2002 cropping season. **Another Section 18 label for Eminent 125 SL on sugarbeet in North Dakota and Minnesota will be requested for the 2003 cropping season**. Registration status of all other experimental fungicides for the 2003 cropping season is not known at this time.

Crookston:

Cercospora leaf spot severity was high, particularly during September, with the untreated check having a KWS Cercospora leaf spot rating ranging from 7.63-8.25 (**Table 3**).

All fungicide treatments resulted in significantly lowered Cercospora leaf spot rating, significantly higher recoverable sucrose per acre, and significantly higher yield than the untreated check. The most effective treatments were Eminent followed 21 d after by a mixture of Topsin + TPTH followed 14 d after with Headline; Eminent followed 21 d after with Headline followed 14 d after with TPTH; and an Eminent/TPTH/Headline/TPTH 14 d alternation program.

Breckenridge:

Cercospora leaf spot was first observed in mid-August and disease severity was low during the season with the untreated check plots having a KWS Cercospora leaf spot rating of 5.1 six days before harvest (**Table 4**).

All fungicide treatments resulted in significantly lower Cercospora leaf spot rating, and significantly higher recoverable sucrose per acre than the untreated check. The most effective treatments were Headline in alternation with TPTH; Eminent in alternation with TPTH and Headline; and Headline in alternation with Eminent.

Willmar:

Cercospora leaf spot severity was high with the untreated check plots having a KWS Cercospora leaf spot rating of 7.92 at harvest (**Table 5**)

All fungicide treatments, except the experimental HM 0125 in alternation with Headline, and Eminent applied at 21 d intervals in alternation with TPTH, resulted in significantly higher recoverable sugar per acre than the untreated check. All fungicide treatments, except Eminent applied at 21 d intervals in alternation with TPTH, resulted in significantly lower Cercospora leaf spot rating than the untreated check. The most effective treatments were Eminent in alternation with Headline; Eminent in alternation with TPTH; Eminent in alternation with Gem; Gem in alternation with TPTH; and Headline in alternation with TPTH – all applied at 14 d intervals. No phytotoxicity was observed.

SUMMARY AND CONCLUSIONS

At Willmar, under high Cercospora leaf spot disease pressure, four applications of two different classes of fungicides in an alternation program provided good disease control and resulted in high recoverable sucrose per acre.

At Crookston, under high Cercospora leaf spot disease pressure, and at Breckenridge, under low disease pressure, using two, three, or four different classes of fungicides in an alternation program, provided effective Cercospora leaf spot control and resulted in high recoverable sucrose per acre.

A. Fungicide with Section 18 Label

1. The availability of Eminent (a Section 18 was granted for 2002 and a request will be submitted to the EPA for another section 18 label for the 2003 growing season) will enhance the ability of growers to control Cercospora leaf spot and better manage fungicide resistance. Alternating Eminent with other classes of fungicides provides better disease control and delays the development of fungicide resistance.

B. Other Comments

1. The first fungicide application should be made when conditions first favor the disease or at disease onset. If the first application is late, control will be difficult all season.

2. Use the recommended rate of fungicides to control Cercospora leaf spot – do not cut rates!

3. The 5.0 oz/A TPTH rate should be used with an application interval of 10-14 days at southern Minnesota and 14 days in the Red River Valley.

4. Use Headline or Eminent as your first fungicide application. Do not use the fungicide or a fungicide from the same class of chemistry used in the last fungicide application in 2002 as the first fungicide

application in 2003.

5. In the southern Minnesota, Minn-Dak, and Moorhead factory districts, the use of Headline or Gem, Eminent, and TPTH in an alternation program will effectively control Cercospora leaf spot.

6. In Hillsboro, East Grand Forks, Crookston, and Drayton factory districts, the use of Headline or Gem, Eminent, TPTH, or a tank-mix of Topsin and Penncozeb, in an alternation program will effectively control Cercospora leaf spot.

7. Only one application of a benzimidazole fungicide (Topsin M) in combination with a protectant fungicide (Penncozeb or TPTH) should be used in the Hillsboro, East Grand Forks, Crookston, and Drayton factory districts.

8. Please note that Headline and Gem, both strobilurins, received full (Section 3) registration and can be used for controlling Cercospora leaf spot on sugarbeet.

9. Never use the same fungicide or fungicides from the same class 'back-to-back'.

10. Alternate, alternate, alternate! Alternate different chemistry fungicides.

The following shows the fungicides and their class of chemistry:

Strobilurins	**Sterol Inhibitors**	**Ethylenebisdithiocarbamates (EBDC)**
Quadris	Eminent	Penncozeb
Gem		
Headline		

Benzimidazole	**Triphenyltin Hydroxide (TPTH)**
Topsin M	SuperTin
Thiophanate Methyl 85 WDG	AgriTin

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Table 1. Cultural Practices And Application Date Information For Cercospora Leaf Spot Trials In 2002

	Crookston	**Breckenridge**	**Gluek**
Planting Date	May 4	April 30	May 13
Previous Crop	Wheat	Wheat	Corn
Variety	HM Agate	HM Agate	Beta 4705
Weed Control	Betamix –micro-rate	Betamix –micro-rate	Betamix –micro-rate
	Betanex – m/rate	Betanex – m/rate	Betanex – m/rate
	Upbeet – m/rate	Upbeet – m/rate	Upbeet – m/rate
	Stinger – m/rate	Stinger – m/rate	Stinger – m/rate
	Poast – m/rate	Poast – m/rate	Poast – m/rate
	MSO – micro-rate	MSO – micro-rate	Oil – micro-rate
	Hand labor	Hand labor	Hand labor
	Cultivation	Cultivation	Cultivation
Insecticide	Counter, Asana XL	Counter	None

Plant Population at Thinning	35,000 plant/A	35,000 plant/A	35,000 plant/A
Spray Application			
	Crookston	**Breckenridge**	**Gluek**
1st	July 26	July 25	July 15
2nd	August 9	August 8	July 31
3rd	August 16	August 15	August 5
4th	August 22	August 23	August 14
5th	August 30	August 29	August 28
6th	September 7	September 9	
Spray Volume (gpa)	20	20	20
Spray Pressure (psi)	100	100	120
Harvest Date	October 2	September 23	October 15

Table 2. Fungicides tested in 2002.

Fungicides	Status
Penncozeb	Registered
Topsin M	Registered
Super Tin, Agritin, Triphenyltin hydroxide (TPTH)	Registered
Quadris	Registered
Headline	Registered
Eminent	Section 18 granted for 2002
Gem	Registered

Table 3. Cercospora leaf spot control at Crookston in 2002 with registered and experimental fungicides.

Treatment, Rate of Product or ai/a or ha	Appl. Interval (d)	CLS * KWS	Recoverable Sucrose		Root Yield (T/A)	Sucrose (%)	LTM** (%)	$/T	Gross $/A
			Lb/A	Lb/T					
Eminent 13 oz/Topsin 0.375 lb+ TPTH 3.75 oz/Headline 9 oz	21/14/21	3.13	8205	311.0	26.4	16.83	1.28	37.23	982
Eminent 13 oz/Headline 9 oz/TPTH 5 oz	21/14/14	3.38	8073	307.0	26.3	16.65	1.30	36.31	955
Eminent 13 oz/TPTH 5 oz/Headline 9 oz/ TPTH 5 oz	14	3.13	7943	307.5	25.8	16.67	1.30	36.43	940
Eminent 13 oz/Headline 9 oz	14	3.00	7938	303.5	26.2	16.53	1.35	35.51	928
Headline 9 oz/TPTH 5 oz/Eminent 13 oz / TPTH 5 oz	14	2.63	7932	301.5	26.3	16.40	1.33	35.05	922
Headline 9 oz/ TPTH 5 oz	14	3.13	7828	300.5	26.1	16.40	1.38	34.82	907
Headline 9 oz/Eminent 13 oz/TPTH 5 oz	14/21/14	4.00	7818	306.5	25.5	16.60	1.28	36.20	924
Eminent 13 oz/Topsin M 0.5 lb + Penncozeb 2.0 lb/Headline 9 oz	21/14/21	3.75	7815	311.5	25.1	16.93	1.35	37.34	937
Headline 9 oz/Eminent 13 oz/Headline 9 oz	21	2.88	7806	303.5	25.7	16.55	1.38	35.51	913
Headline 9 oz/TPTH 5 oz/Eminent 13 oz/Headline 9 oz	14	2.50	7781	301.5	25.8	16.38	1.30	35.05	904
Eminent 13 oz/TPTH 5 oz	14	3.75	7722	313.0	24.7	16.93	1.28	37.69	930
Headline + Poast + COC 9 oz + 1 pint + 1% v/v/TPTH 5 oz/Eminent 13oz/ Headline 9 oz	14	2.63	7666	304.5	25.1	16.43	1.20	35.74	902
Eminent 13 oz/Headline 9 oz/Eminent 13 oz	21	3.38	7641	306.0	25.0	16.58	1.28	36.08	900
Eminent 13 oz/Headline 9 oz (2 apps only)	21	4.50	7607	304.5	25.0	16.55	1.33	35.74	892
Gem 7 oz/TPTH 5 oz	14	3.50	7584	306.5	24.8	16.58	1.25	36.20	895
Quadris (8-leaf) 12 oz/Eminent 13 oz/TPTH 5 oz/Headline 9 oz/Eminent 13 oz	14	2.75	7551	299.0	25.2	16.25	1.30	34.48	871
Eminent 13 oz + Poast 1 pt + COC 1% v/v/TPTH 5 oz/Headline 9 oz/Eminent 13 oz	14	2.63	7545	298.0	25.3	16.25	1.35	34.25	867

Eminent 13 oz/Gem 7.0 oz	14	3.63	7533	307.5	24.5	16.68	1.30	36.43	892
Headline 9 oz/Eminent 13 oz	14	2.63	7518	299.5	25.1	16.43	1.45	34.59	869
Eminent 13 oz/TPTH 5 oz/Eminent 13 oz	21/14/21	3.50	7502	312.5	24.0	16.90	1.28	37.57	903
Eminent 13 oz/TPTH 5 oz/Headline 9 oz/ Eminent 13 oz	14	2.63	7433	293.5	25.3	16.03	1.35	33.22	841
HM0125 1.5 lb/Headline 9 oz	14	4.88	6756	284.5	23.7	15.78	1.55	31.16	740
Check 1	----	7.63	5416	282.5	19.2	15.70	1.58	30.70	589
Check 2	----	8.13	5394	280.0	19.2	15.55	1.55	30.13	581
Check 3	----	8.25	5143	283.0	18.2	15.55	1.40	30.82	561
Statistical Sign		**	**	**	**	**	**	**	**
LSD (P=.05)		0.69	590	15.5	1.4	0.71	0.17	3.56	103
CV		12.12	5.77	3.69	4.22	3.09	9.12	7.28	8.63

*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 4. Cercospora leaf spot control at Breckenridge in 2002 with registered fungicides.

Treatment and Rate/A	App. Inter-val	CLS*	Recoverable Sugar		Net T/A	Sucrose Content	LTM**	$/T	Gross $/A
			RSA	RST					
	d	KWS	lb	lb	t	%	%		
Headline 2.09 EC 9 fl oz (App 1,3) / TPTH 80 WP 5 oz (App 2,4)	14	1.3	7461	273	27.6	15.4	1.77	27.28	753
Eminent 125 SL 13 fl oz (App 1) / TPTH 80 WP 5 oz (App 2,4) / Headline 2.09 EC 9 fl oz (App 3)	14	1.3	7447	267	28.2	15.2	1.92	25.88	731
Headline 2.09 EC 9 fl oz (App 1,3) / Eminent 125 SL 13 fl oz (App 2,4)	14	1.1	7341	273	27.3	15.5	1.90	27.12	738
Headline 2.09 EC 9 fl oz (App 1,4) / TPTH 80 WP 5 oz (App 2) / Eminent 125 SL 13 fl oz (App 3)	14	1.1	7319	273	27.1	15.6	1.95	27.14	738
Eminent 125 SL 13 fl oz (App 1,3) / TPTH 80 WP 5 oz (App 2,4)	14	1.4	7237	270	27.1	15.3	1.90	26.53	721
Eminent 125 SL 13 fl oz (App 1,3) /Gem 7 oz (App 2,4)	14	1.2	7228	274	26.7	15.6	1.95	27.40	732
Eminent 125 SL 13 fl oz (App 1,3) / TPTH 80 WP 5 oz (App 2)	21, 14	1.5	7158	267	27.1	15.2	1.90	25.87	704
Eminent 125 SL 13 fl oz (App 1,4) / TPTH 80 WP 5 oz (App 2) / Headline 2.09 EC 9 fl oz (App 3)	14	1.2	7098	267	26.8	15.1	1.80	26.01	698
Headline 2.09 EC 9 fl oz (App 1) / TPTH 80 WP 5 oz (App 2,4) / Eminent 125 SL 13 fl oz (App 3)	14	1.3	7087	268	26.7	15.3	1.95	26.09	699
Eminent 125 SL 13 fl oz (App 1) / Topsin M 70 WSB 0.5 lb a.i + Penncozeb 75 DF 2 lb (App 2) / Headline 2.09 EC 9 fl oz (App 3)	21, 14, 21	1.2	7081	266	26.9	15.0	1.70	25.61	691
Eminent 125 SL 13 fl oz (App 1) / Topsin 70 WSB 0.375 lb + TPTH 80 WP 3.75 oz (App 2) / Headline 2.09 EC 9 fl oz (App 3)	21, 14, 21	1.2	7065	267	26.7	15.3	1.95	25.99	696
Eminent 125 SL 13 fl oz (App 1,3) / Headline 2.09 EC 9 fl oz (App 2)	21	1.4	6998	265	26.7	15.2	1.93	25.51	681
Eminent 125 SL 13 fl oz (App 1,3) / Headline 2.09 EC 9 fl oz (App 2,4)	14	1.1	6946	273	25.6	15.3	1.65	27.31	701
Eminent 125 SL 13 fl oz (App 1) / Headline 2.09 EC 9 fl oz (App 2) / TPTH 80 WP 5 oz (App 3)	21, 14	1.2	6906	267	26.2	15.3	2.02	25.82	676
Headline 2.09 EC 9 fl oz (App 1) / Eminent 125 SL 13 fl oz (App 2) / TPTH 80 WP 5 oz (App 3)	14, 21	1.2	6897	262	26.6	15.0	1.90	24.87	662
Headline 2.09 EC 9 fl oz (App 1,3) / Eminent 125 SL 13 fl oz (App 2)	21	1.5	6841	266	25.9	15.1	1.80	25.71	669
Eminent 125 SL 13 fl oz (App 1) / Headline 2.09 EC 9 fl oz (App 2)	21	1.3	6766	261	26.3	15.0	2.03	24.48	642
Gem 7 oz (App 1,3) / TPTH 80 WP 5 oz (App 2,4)	14	1.2	6692	265	25.5	15.2	1.92	25.54	653
Untreated Check		5.1	5915	261	23.0	15.1	2.05	24.49	564
LSD (P=.05)		0.5	693	19.3	2.1	0.8	0.27	4.25	118
CV		22.3	7.14	5.18	5.8	3.8	10.4	11.7	12.3

*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 5. Cercospora leaf spot control at Willmar in 2002 with registered fungicides.

	Application Interval	Recoverable Sucrose		Yield	Sucrose Content	LTM**	CLS*

Treatment and Rate/A		RSA	RST				
	d	Lb	t	t/a	%	%	KWS
Eminent 125 SL 13 fl oz (App 1,3) / Headline 2.09 EC 9 fl oz (App 2,4)	14	7288.67	317.17	22.99	16.93	1.08	4.25
Eminent 125 SL 13 fl oz (App 1,3) /Gem 7 oz (App 2,4)	14	7277.00	306.00	23.75	16.42	1.12	4.08
Gem 7 oz (App 1,3) / TPTH 80 WP 5 oz (App 2,4)	14	6788.83	312.50	21.63	16.73	1.10	4.42
Headline 2.09 EC 9 fl oz (App 1,3) / TPTH 80 WP 5 oz (App 2,4)	14	6590.83	317.67	20.74	16.96	1.08	5.08
Eminent 125 SL 13 fl oz (App 1,3) / TPTH 80 WP 5 oz (App 2,4)	14	6575.67	303.17	21.63	16.29	1.14	4.25
Headline 2.09 EC 9 fl oz (App 1,3) / TPTH 80 WP 5 oz (App 2,4)	14	6567.67	310.33	21.29	16.62	1.10	4.33
Headline 2.09 EC 9 fl oz (App 1,3) / Eminent 125 SL 13 fl oz (App 2,4)	14	6566.50	301.17	21.79	16.19	1.14	4.00
Eminent 125 SL 13 fl oz (App 1,3) / TPTH 80 WP 3.75 oz (App 2,4)	14	6453.67	298.50	21.66	16.08	1.15	4.92
Eminent 125 SL 13 fl oz (App 1,3) / Headline 2.09 EC 9 fl oz (App 2,4)	21	6375.33	293.67	21.75	15.85	1.17	4.92
Eminent 125 SL 13 fl oz (App 1,4) / Headline 2.09 EC 9 fl oz (App 2) / TPTH 80 WP 5 oz (App 3)	14	6364.83	301.50	21.13	16.21	1.14	4.00
Headline 2.09 EC 9 fl oz + Agro 1005 1% v/v (App 1-4)	14	6309.00	306.50	20.38	16.44	1.12	3.75
Eminent 125 SL 9 fl oz (App 1,3) / TPTH 80 WP 3.75 oz (App 3) / Eminent 125 SL 13 fl oz	14	6155.50	297.17	20.63	16.01	1.16	5.50
Headline 2.09 EC 9 fl oz (App 1,3) / Eminent 125 SL 13 fl oz (App 2,4)	21	6060.50	303.33	19.96	16.31	1.13	4.17
Eminent 125 SL 13 fl oz (App 1,4) / Topsin 70 WSB 0.375 lb + TPTH 80 WP 3.75 oz (App 2) / Headline 2.09 EC 9 fl oz (App 3)	21, 14, 21	5955.17	293.83	20.23	15.85	1.17	6.33
Eminent 125 SL 13 fl oz (App 1,3) / TPTH 80 WP 5 oz (App 2,4)	21, 14	5542.67	301.50	18.35	16.22	1.14	6.92
Untreated check		4510.33	290.67	15.53	15.71	1.18	7.92
LSD (P=.05)		1210.6	19.61	3.63	0.91	0.07	1.00
CV		16.98	5.67	15.45	4.89	5.71	17.55

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

[2]LTM: Sugar loss to molasses