CERCOSPORA LEAF SPOT CONTROL IN EASTERN NORTH DAKOTA AND MINNESOTA IN 2004

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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 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.

PROCEDURES:

Research was conducted at Crookston, Foxhome, and Renville, 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 30 or 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. Foxhome 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 killed, and severe economic loss.

All sites were affected by Cercospora leaf spot, but disease severity was moderate to high depending on location.
The fungicides tested in 2004 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 effects of the treatments for Cercospora leaf spot control for the test sites are shown in Tables 3, 4, and 5.

Crookston, Foxhome, and Renville:
Cercospora leaf spot severity was moderate at Crookston with the untreated check plots having a KWS Cercospora leaf spot rating of 6.6 at harvest **(Table 3)**. All fungicide treatments resulted in significantly better disease control (lower leaf spot rating), significantly higher recoverable sugar per acre and ton, significantly higher root yield and higher return per acre compared to the untreated check.
Cercospora leaf spot severity was moderate at Foxhome with the untreated check plots having a KWS Cercospora leaf spot rating of 6.6 at harvest **(Table 4)**. All fungicide treatments resulted in significantly better disease control (lower leaf spot rating) and higher recoverable sugar, root yield and return per acre compared to the untreated check.
Cercospora leaf spot severity was moderate to high at Renville I and II (**Table 5 & 6**), with the untreated check plots having a KWS Cercospora leaf spot rating at harvest of 6.4 and 8.5, respectively. All fungicide treatments resulted in significantly better disease control (lower leaf spot rating) and significantly higher recoverable sugar, root yield and return per acre compared to the untreated check.

SUMMARY AND CONCLUSIONS

The increase in recoverable sucrose yield and sucrose percent in the trials listed cannot be explained solely on the basis of Cercospora leaf spot. At Crookston, a visual vigor rating of the trial using a scale of 1 (least vigor) – 10 (most vigor) had the highest correlation with recoverable sucrose per acre. The difference observed in vigor cannot be explained at this time.

Other Comments [Please note that Eminent can only be used for the 2005 crop if it is granted registration by the EPA]

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 rates of fungicides to control Cercospora leaf spot.

3. Use a strobilurin (Headline or Gem) or a triazole (Eminent) as your first fungicide application.

4. The 5.0 oz/A TPTH rate should be used with an application interval of 14 days in all factory districts in Minnesota and North Dakota.

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, and a tank-mix of Topsin and TPTH or 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. Never use the same fungicide or fungicides from the same class of chemistry or same mode of action 'back-to-back'.

9. Use high volumes of water – 20 gpa for ground-rigs and 5-7 gpa for aerial application – with fungicides for effective disease control.

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

The following shows the registered and experimental fungicide and their class of chemistry:

Strobilurins	**Sterol Inhibitors**	**Ethylenebisdithiocarbamate (EBDC)**
Headline	Eminent	Penncozeb
Gem		

Benzimidazole	**Triphenyltin Hydroxide (TPTH)**
Topsin M	SuperTin
	AgriTin

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Table 1. Cultural practices and application date information for Cercospora leaf spot trials in 2004.

	Crookston	Foxhome	Renville I	Renville II
Planting Date	April 27	April 26	April 23	April 27
Previous Crop	Wheat	Field Corn	Field Corn	Field Corn
Variety	VDH 66561	Beta 3800	ACH 826	ACH 826
Weed Control	Betamix – micro-rate Betanex – m/rate Upbeet – m/rate Stinger – m/rate Select – m/rate MSO – m/rate	Betamix – micro-rate Betanex – m/rate Upbeet – m/rate Stinger – m/rate Select – m/rate MSO – m/rate	One app. of Nortron 7pt/A broadcast PPI One app. of Betanex 1 pt/A + Stinger 1.5 oz/A One app. of Progress 1 pt/A + Stinger 1.5 oz/A	One app. of Nortron 7 pt/A broadcast PPI One app. of Betanex 1 pt/A + Stinger 1.5 oz/A One app. of Progress 1 pt/A + Stinger 1.5 oz/A
	Hand labor Cultivation	Hand labor Cultivation	Hand labor Cultivation	Hand labor Cultivation
Insecticide	Counter	Counter	None	None
Plant Population at Thinning	35,640 plants/A	35,640 plants/A	35,640 plants/A	35,640 plants/A
Spray Application	**Crookston**	**Foxhome**	**Renville I**	**Renville II**
1st	July 26	July 27	July 20	July 22
2nd	August 11	August 10	August 03	August 05
3rd	August 16	August 19	August 10	August 12
4th	August 23	August 23	August 17	August 19
5th	August 30	August 30	August 24	August 26
6th	September 08	September 08	August 31	September 2
Spray Volume (gpa)	19	20	20	20
Spray Pressure (psi)	100	100	120	120
Harvest Date	October 12	October 04	September 26	October 21

Table 2. Fungicides tested in 2004.

Fungicides	**Status**
Penncozeb 75 DF	Registered
Topsin M 45 WP	Registered
Topsin 4.5 F	Registered
Triphenyltin hydroxide (TPTH) 80 WP	Registered
Headline 2.09 EC	Registered
Eminent 125 SL	Section 18 granted for 2004
Gem 25 WG	Registered

Table 3. Cercospora leaf spot control at Crookston in 2004 with registered and experimental fungicides.

Treatment and rate/A	App. interval (days)	CLS*	Recoverable Sucrose (lb/A)	Recoverable Sucrose (lb/T)	Root yield (t/A)	Sucrose content (%)	LTM** (%)	Return ($/A)***
Gem 25 WG 7 oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	21/14/21	1.8	8628	350	24.7	18.40	0.93	1078
TPTH 80 WP 5 oz (App 1,4)/ Eminent 125 SL 13 fl oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	14	2.4	8560	340	25.2	18.10	1.10	1047
TPTH 80 WP 5 oz (App 1,4)/ Headline 2.09 EC 9 fl oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	14	2.9	8560	350	24.5	18.55	1.05	1072
TPTH 80 WP 5 oz (App 1)/ Eminent 125 SL 13 fl oz (App 2)/ Gem 25 WG 7 oz (App 3)/ Topsin 4.5 F 7.6 fl oz + TPTH 80 WP 3.75 oz (App 4)	14	1.9	8534	350	24.4	18.53	1.05	1067
Gem 25 WG 7 oz (App 1)/ Topsin 4.5 F 7.6 fl oz + TPTH 80 WP 3.75 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	21/14/21	1.6	8491	342	24.9	18.13	1.05	1043
Eminent 125 SL 13 fl oz (App 1)/ Topsin 4.5 F 7.6 fl oz + TPTH 80 WP 3.75 oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	21/14/21	2.0	8480	350	24.3	18.45	0.98	1059
Eminent 125 SL 13 fl oz (App 1)/ Topsin 4.5 F 10 fl oz + TPTH 80 WP 5 oz (App 2)/ Headline 2.09 EC 9 fl oz (App3)	21/14/21	1.8	8442	347	24.4	18.35	1.03	1048
Gem 25 WG 7 oz (App 1)/ Topsin 4.5 F 7.6 fl oz + TPTH 80 WP 3.75 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)/ TPTH 80 WP 5 oz (App 4)	14	1.8	8417	350	24.1	18.48	0.98	1054
Headline 2.09 EC 9 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	21/14/21	1.5	8415	348	24.2	18.35	0.98	1048
TPTH 80 WP 5 oz (App 1)/ Eminent 125 SL 13 fl oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	14/21/21	1.9	8414	344	24.5	18.18	1.00	1038
Eminent 125 SL 13 fl oz (App 1)/ Topsin 4.5 F 7.6 fl oz + TPTH 80 WP 3.75 oz (App 2)/ Gem 25 WG 7 oz (App 3)/ TPTH 80 WP 5 oz (App 4)	14	2.0	8363	346	24.2	18.33	1.03	1038
Eminent 125 SL 13 fl oz (App 1)/ Topsin 4.5 F 10 fl oz + Penncozeb 75 DF 2.0 lb (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	21/14/21	1.8	8348	348	24.1	18.38	0.98	1045
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	21/14/21	2.1	8263	350	23.6	18.38	0.90	1033
Eminent 125 SL 13 fl oz (App 1)/ Topsin 4.5 F 7.6 fl oz + TPTH 80 WP 3.75 oz (App 2)/ Gem 25 WG 7 oz (App 3)	21/14/21	1.9	8116	345	23.5	18.23	0.98	1005
Headline 2.09 EC 9 fl oz (App 1)/ Eminent 125 SL 13 fl oz (App 2)/ TPTH 80 WP 5 oz (App 3)	21/14/21	1.9	7991	348	23.0	18.38	0.98	996
TPTH 80 WP 5 oz (App 1)/ Headline 2.09 EC 9 fl oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	14/21/21	2.3	7941	349	22.8	18.55	1.10	992
Eminent 125 SL 13 fl oz (App 1,3)/ Headline 2.09 EC 9 fl oz (App 2)	21/14/21	1.9	7885	342	23.1	18.13	1.03	969
Eminent 125 SL 13 fl oz (App 1,3)/ Gem 25 WG 7 oz (App 2)	21/14/21	1.9	7838	340	23.0	18.08	1.08	960
Check	—	6.6	6121	324	18.9	17.38	1.20	719
LSD (P= 0.05)		0.7	589	14	1.4	----	0.15	

*Cercospora leaf spot measured on KWS scale 1-9 (1= no leaf spot 9 = dead outer leaves, inner leaves severely damaged, regrowth of new leaves). Rated October 11.

**LTM: Sugar loss to molasses.

***: Based on American Crystal Sugar Company payment system.

Table 4. Cercospora leaf spot control at Foxhome in 2004 with registered and experimental fungicides.

Treatment and rate/A	App. Interval (days)	CLS*	Recoverable Sucrose (lb/A)	Recoverable Sucrose (lb/T)	Root Yield (t/A)	Sucrose Content (%)	SLM** (%)	Return ($/A) ***
Eminent 125 SL 13 fl oz (App 1,3)/ Headline 2.09 EC 9 fl oz (App 2)……	21/14/ 14	1.4	8915	302	29.7	15.99	0.92	1070
Headline 2.09 EC 9 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3).....	14	1.3	8881	301	29.7	15.92	0.87	1066
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	14	1.4	8555	292	29.5	15.47	0.85	1027
Headline 2.09 EC 9 fl oz (App 1)/ Eminent 125 SL 13 fl oz (App 2,4)/ TPTH 80 WP 5 oz (App 3).....	14	1.4	8490	306	28.1	16.14	0.86	1019
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	1.4	8404	294	28.7	15.68	0.95	1008
TPTH 80 WP 5 oz (App 1,4)/ Eminent 125 SL 13 fl oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)…	14	1.4	8275	284	29.4	15.31	1.13	993
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 3.75 oz + Topsin 4.5 F 7.6 fl oz (App 2)/ Gem 25 WG 7 oz (App 3)……	14	1.4	8155	297	27.7	15.72	0.90	979
Gem 25 WG 7 oz (App 1)/ TPTH 80 WP 3.75 oz + Topsin 4.5 F 7.6 fl oz (App 2)/ Eminent 125 SL 13 fl oz (App 3).....	21/14/ 14	1.4	8147	283	29.2	15.14	0.97	978
Gem 25 WG 7 oz (App 1)/ TPTH 80 WP 3.75 oz + Topsin 4.5 F 7.6 fl oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)……	14	1.4	8122	277	29.1	14.98	1.10	975
Gem 25 WG 7 oz (App 1)/ TPTH 80 WP 3.75 oz + Topsin 4.5 F 7.6 fl oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)/ TPTH 80 WP 5 oz (App 4)……...	14	1.4	8121	290	28.2	15.49	0.98	975
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	1.4	8118	269	30.5	14.79	1.36	974
Eminent 125 SL 13 fl oz (App 1)/ Topsin 4.5 F 7.6 fl oz + Penncozeb 75 DF 2.0 lb (App 2)/ Headline 2.09 EC 9 fl oz (App 3)……..…….....	21/14/ 14	1.4	8012	288	28.2	15.33	0.92	961
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	21/14/ 14	1.5	7998	295	27.0	15.71	0.92	960
Headline 2.09 EC 9 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3).....	21/14/ 14	1.4	7967	291	27.7	15.51	0.95	956
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	1.4	7927	277	29.0	14.89	1.02	951
Eminent 125 SL 13 fl oz (App 1)/ Topsin 4.5 F 7.6 fl oz + TPTH 80 WP 3.75 oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	21/14/ 14	1.4	7895	288	27.8	15.43	1.02	947
Untreated Check……		6.6	6933	299	23.3	15.84	0.90	832
LSD (P= 0.05)……		0.3	1085	25	3.8	1.07	0.27	130

*Cercospora leaf spot measured on KWS scale 1-9 (1 = no leaf spot; 9 = dead outer leaves, inner leaves severely damaged, regrowth of new leaves). Rated October 04.

**SLM: Sugar loss to molasses.

*** Payment based on Minn-Dak payments system.

Table 5. Cercospora leaf spot control at Renville I in 2004 with registered and experimental fungicides.

Treatment and rate/A	App. Interval (days)	CLS*	Recoverable Sucrose (lb/A)	Recoverable Sucrose (lb/Ton)	Root Yield (t/A)	Sucrose content (%)	Return ($/A)**
Gem 25 WG 7 oz (App 1)/ Eminent 125 SL 13 fl oz (App 2,4)/ TPTH 80 WP 5 oz (App 3).....	14	1.9	6301	281	22.4	16.68	1015
TPTH 80 WP 5 oz (App 1)/ Eminent 125 SL 13 fl oz (App 2)/ Gem 25 WG 7 oz (App 3).....	14	2.4	6234	280	22.2	16.64	1006
Gem 25 WG 7 oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	14	2.4	6156	277	22.2	16.47	988
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Gem 25 WG 7 oz (App 3).....	14	2.7	6118	293	20.9	16.80	957
Headline 2.09 EC 9 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3).....	14	4.1	5992	295	20.3	17.24	969
Gem 25 WG 7 oz (App 1)/ Eminent 125 SL 13 fl oz (App 2)/ TPTH 80 WP 5 oz (App 3).....	14	2.6	5972	283	21.1	16.69	954
TPTH 80 WP 5 oz (App 1,4)/ Eminent 125 SL 13 fl oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	14	3.1	5854	280	20.9	16.50	928
Eminent 125 SL 13 fl oz (App 1)/ Topsin M 45 WP 0.5 lb + TPTH 80 WP 3.75 oz (App 2)/ Gem 25 WG 7 oz (App 3).....	14	3.0	5849	277	21.1	16.54	944
Gem 25 WG 7 oz (App 1)/ Eminent 125 SL 13 fl oz (App 2).....	14	3.1	5829	278	21.0	16.49	932
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Gem 25 WG 9 oz (App 3).....	21/14/21	5.1	5018	270	18.6	16.25	808
Headline 2.09 EC 9 fl oz (App 1)/ Eminent 125 SL 13 fl oz (App 2,4)/ TPTH 80 WP 5 oz (App 3)	14	2.9	4906	278	17.6	16.63	795
Check.....		6.4	3379	257	13.1	15.53	529
LSD (P=0.05).....		1.0	905	22	2.7	1.04	160

*Cercospora leaf spot measured on KWS scale 1-9 (1 = no leaf spot; 9 = dead outer leaves, inner leaves severely damaged, regrowth of new leaves). Rated September 25.

** Based on Southern Minnesota Beet Sugar Cooperative payment sytem.

Table 6. Cercospora leaf spot control at Renville II in 2004 with registered and experimental fungicides.

Treatment and rate/A	App. Interval (days)	CLS*	Recoverable Sucrose (lb/A)	Recoverable Sucrose (lb/Ton)	Root Yield (t/A)	Sucrose content (%)	Return ($/A)**
Gem 25 WG 7oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	14	4.1	5712	305	20.0	17.89	1007
Gem 25 WG 7oz (App1)/ Eminent 125 SL 13 fl oz (App 2)	14	4.8	5510	293	18.8	17.64	930
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Gem 25 WG 7 oz (App 3)	21/14/21	3.6	5331	306	19.1	18.00	973
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Gem 25 WG 7 oz (App 3)	14	3.8	5313	304	17.5	17.91	883
Gem 25 WG 7 oz (App 1)/ Eminent 125 SL 13 fl oz (App 2,4)/ TPTH 80 WP 5 oz (App 3)	14	3.1	5247	299	19.1	17.43	929
Headline 2.09 EC 9 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	14	4.5	4836	297	17.9	17.80	894
Check		8.5	3352	282	11.9	16.99	553
LSD (P=0.05)		1.1	1291	20	2.6	0.82	221

*Cercospora leaf spot measured on KWS scale 1-9 (1 = no leaf spot; 9 = dead outer leaves, inner leaves severely damaged, regrowth of new leaves). October 21

** Based on Southern Minnesota Beet Sugar Cooperative payment sytem.