

CERCOSPORA LEAF SPOT CONTROL IN EASTERN NORTH DAKOTA AND MINNESOTA IN 2003

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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. All 2003 test sites had known TPTH tolerance and benzimidazole resistance.

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 have only new leaf growth, all earlier leaves being dead, 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 2003 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 6.5 at harvest ([Table 3](#)). Cercospora leaf spot severity was high at Foxhome ([Table 4](#)) and Renville ([Table 5](#)), with the untreated check plots having a KWS Cercospora leaf spot rating at harvest of 8.1 and 7.0, respectively. All fungicide treatments resulted in significantly lower leaf spot rating (effective disease control) and significantly higher recoverable sugar per acre compared to an untreated check at all three research locations.

SUMMARY

The increase in recoverable sucrose yield and sucrose percent in the three 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 2004 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 experimental and registered fungicides and their class of chemistry:

Strobilurins	Sterol Inhibitors	Ethylenebisdithiocarbamate (EBDC)
Headline	Eminent	Penncozeb
Gem	JAU 6476	
USF 2004		

Quadris
JAU 6476

Benzimidazole
Topsin M

Triphenyltin Hydroxide (TPTH)
SuperTin
AgriTin

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Table 1. Cultural Practices And Application Date Information For Cercospora Leaf Spot Trials In 2003

	Crookston	Foxhome	Renville
Planting Date	April 26	May 13	April 25
Previous Crop	Wheat	Wheat	Corn
Variety	Seedex Titan	HH Agate	Beta 4811
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	Select – 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	Counter	None
Plant Population at Thinning	35,000 plant/A	35,000 plant/A	35,000 plant/A
Spray Application	Crookston	Foxhome	Renville
1st	July 23	July 23	July 16
2nd	August 6	August 5	July 30
3rd	August 15	August 12	August 6
4th	August 20	August 18	August 13
5th	August 27	August 27	August 20
6th	September 4	September 2	August 27
Spray Volume (gpa)	20	20	20
Spray Pressure (psi)	100	100	120
Harvest Date	September 26	September 17	October 11

Table 2. Fungicides tested in 2003.

Fungicides	Status

Penncozeb 75 DF	Registered
Topsin 85 WP, Topsin 4.5 F	Registered
Super Tin, Agritin, Triphenyltin hydroxide (TPTH) 80 WP	Registered
Headline 2.09 EC	Registered
Eminent 125 SL	Section 18 granted for 2003
Gem 25 WG	Registered
BAS 500 UHF 2.09 EC	Experimental
JAU 6476	Experimental
USF 2004	Experimental

Table 3. Cercospora leaf spot control at Crookston in 2003 with registered and experimental fungicides.

Treatment and rate/A	App. Interval	CLS*	Recoverable Sucrose (Lb/A)	Root Yield (T/A)	Sucrose Content	SLM**	Gross \$/T	Return \$/A	
Eminent 125 SL 13 fl oz (App 1)/ Topsin M 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	8683	345.5	25.1	18.23	0.95	43.43	1092
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	8646	347.5	24.9	18.40	1.03	43.88	1092
Eminent 125 SL 13 fl oz (App 1,3)/ Headline 2.09 EC 9 fl oz (App 2).....	21/14/21	2.4	8646	351.5	24.6	18.55	0.98	44.78	1101
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	2.1	8551	349.5	24.5	18.63	1.15	44.33	1085
Eminent 125 SL 13 fl oz (App 1,3)/ TPTH 80 WP 5 oz (App 2,4).....	14	2.3	8539	348.5	24.5	18.50	1.08	44.11	1080
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	2.1	8480	347.0	24.4	18.45	1.10	43.77	1070
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	2.4	8371	342.5	24.5	18.10	0.98	42.76	1044
Eminent 125 SL 13 fl oz (App 1,3)/ Headline 2.09 EC 9 fl oz (App 2,4).....	14	2.1	8351	341.0	24.5	18.13	1.08	42.42	1038
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	2.0	8322	344.0	24.2	18.28	1.08	43.09	1042
Headline UHF 2.09 EC 9 fl oz (App 1,3)/ TPTH 80 WP 5 oz (App 2,4).....	14	2.4	8218	345.5	23.8	18.30	1.03	43.43	1031
Headline 2.09 EC 9 fl oz (App 1,3)/ Eminent 125 SL 13 fl oz (App 2,4).....	14	1.9	8164	330.5	24.7	17.58	1.05	40.06	990
TPTH 80 WP 5 oz (App 1,3)/ Eminent 125 SL 13 fl oz (App 2,4).....	14	2.0	8107	336.5	24.1	17.93	1.10	41.41	997
TPTH 80 WP 5 oz (App 1,4)/ Eminent 125 SL 13 fl oz (App 2)/ Headline 2.09 EC (App 3).....	14	2.5	8072	341.5	23.7	18.10	1.03	42.53	1005
Eminent 125 SL 13 fl oz (App 1)/ Topsin M 4.5 F 10 fl oz + Penncozeb 75 DF 2.0 lb/ Headline 2.09 EC 9 fl oz.....	21/14/21	3.1	8070	333.5	24.2	17.75	1.08	40.73	986
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	1.9	8062	330.5	24.4	17.60	1.08	40.46	978
Headline 2.09 EC 9 fl oz (App 1)/ Eminent 125 SL 13 fl oz (App 2).....	21	2.9	7993	339.0	23.6	18.13	1.18	41.97	988
Eminent 125 SL 13 fl oz (App 1)/ Headline 2.09 EC 9 fl oz (App 2).....	21	3.0	7859	340.5	23.1	17.98	0.95	42.31	977
Headline 2.09 EC 9 fl oz (App 1,3)/ Topsin M 4.5 F 7.6 fl oz + TPTH 80 WP 3.75 oz (App 2,4).....	14	3.3	7836	344.0	22.8	18.20	1.00	43.09	982
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	2.5	7815	334.0	23.4	17.75	1.05	40.84	956
Gem 25 WG 7 oz (App 1,4)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3).....	14	2.0	7755	340.5	22.8	18.10	1.08	42.31	964
JAU6476 5 fl oz (App 1,4)/ TPTH 80 WP 5 oz (App 2)/ Gem 25 WG 7 oz (App 3).....	14	1.8	7558	334.0	22.6	17.75	1.05	40.84	924
Eminent 125 SL 13 fl oz (App 1,3)/ USF 2004 3.38 fl oz (App 2,4).....	14	2.3	7545	338.5	22.3	17.98	1.05	41.86	933
Eminent 125 SL 13 fl oz (App 1,3)/ Gem 25 WG 7 oz (App 2,4).....	14	2.3	7430	339.0	21.9	17.90	0.95	41.97	920
Check.....		6.5	5679	321.0	17.7	17.25	1.20	37.92	671
LSD (P= 0.05).....		0.60	679	15.8	1.7	0.75	0.14		

*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)
 **SLM: Sugar loss to molasses

Table 4. Cercospora leaf spot control at Foxhome in 2003 with registered and experimental fungicides.

Treatment and rate/A	App. Interval (days)	CLS* (16-Sep)	Recoverable Sucrose (lb/A) (lb/T)		Root Yield (T/A)	Sucrose Content (%)	SLM**	Return \$/A
Eminent 125 SL 13 fl oz (App 1,3)/ Gem 25 WG 7 oz (App 2,4)	14	2.3	5786	250	23.5	14.19	1.67	698
Gem 25 WG 7 oz (App 1,4)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	14	2.5	5719	254	22.7	14.68	1.95	690
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	3.6	5717	259	22.4	14.96	1.98	689
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	2.4	5698	268	21.6	15.42	2.05	687
Headline 2.09 EC 9 fl oz (App 1,3)/ Eminent 125 SL 13 fl oz (App 2,4)	14	2.4	5676	258	22.4	14.79	1.88	685
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	2.5	5548	258	21.7	14.58	1.70	669
Eminent 125 SL 13 fl oz (App 1)/ New Topsin 85 WP .31 lbs + TPTH 80 WP 3.75 oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	21/14/14	3.8	5521	264	21.2	14.94	1.75	666
Gem 25 WG 7 oz (App 1,3)/ TPTH 80 WP 5 oz (App 2,4)	14	3.1	5477	251	21.7	14.40	1.88	661
JAU 6476 5 fl oz (App 1,4)/ TPTH 80 WP 5 oz (App 2)/ Gem 25 WG 7 oz (App 3)	14	2.6	5474	252	22.0	14.50	1.88	660
Headline 2.09 EC 9 fl oz (App 1,3)/ TPTH 80 WP 5 oz (App 2,4)	14	2.9	5437	271	20.3	15.49	1.93	656
Eminent 125 SL 13 fl oz (App 1,3)/ Headline 2.09 EC 9 fl oz (App 2,4)	14	2.3	5408	243	22.5	13.83	1.67	652
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	3.8	5393	244	22.4	14.27	2.08	650
Eminent 125 SL 13 fl oz (App 1,3)/ TPTH 80 WP 5 oz (App 2,4)	14	2.8	5392	251	21.7	14.20	1.63	650
Headline 2.09 EC 9 fl oz (App 1)/ Eminent 125 SL 13 fl oz (App 2)	21	3.6	5368	253	21.3	14.74	2.10	647
Headline UHF 2.09 EC 9 fl oz (App 1,3)/ TPTH 80 WP 5 oz (App 2,4)	14	2.5	5357	260	20.9	14.77	1.78	646
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	2.5	5282	243	22.1	13.96	1.83	637
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	3.5	5178	242	21.8	13.93	1.83	624
Eminent 125 SL 13 fl oz (App 1)/ Headline 2.09 EC 9 fl oz (App 2)	21	3.5	5145	227	23.1	13.13	1.80	620
Eminent 125 SL 13 fl oz (1,3)/ USF 2004 6 fl oz (App 2,4)	14	2.6	5124	224	23.3	13.12	1.90	618
Eminent 125 SL 13 fl oz (App 1)/ Topsin 4.5 F 10 fl oz + Penncozeb 75 DF 2 lb (App 2)/ Headline 2.09 EC 9 fl oz (App 3)	21/14/14	4.0	5121	237	22.0	13.80	1.95	618
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)	14	3.5	5098	236	21.9	13.66	1.83	615
		8.1	3976	224	17.9	13.25	2.03	480
		0.4	1078	35	2.7	1.80	0.37	
Headline 2.09 EC 9 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)		8.4	14.38	10	8.9	8.92	14.1	
Untreated Check								
LSD (P=0.05)								
CV%								

*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).
**SLM: Sugar loss to molasses

Table 5. Cercospora leaf spot control at Renville in 2003 with registered and experimental fungicides.

Treatment and rate/A	App. Interval (d)	CLS* 11-Oct	Recoverable Sucrose (lb/A)	(lb/T)	Root Yield (T/A)	Sucrose Content (%)	Return \$/A
Headline 2.09 EC 9 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2,4)/ Eminent 125 SL13 fl oz (App 3).....	14	2	7007	297	23.6	18.46	838
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	6941	278	24.9	17.79	831
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	3	6726	281	24.0	17.53	805
JAU6476 5 fl oz (App 1, 4)/ TPTH 80 WP 5 oz (App 2)/ Gem 25 WG 7 oz (App 3)	14	3	6139	269	22.9	17.57	735
.....	14	3	5894	281	21.0	17.71	706
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	3	5804	271	21.2	17.52	695
Gem 25 WG 7oz (App 1, 4)/ TPTH 80 WP 5 oz (App 2)/ Eminent 125 SL 13 fl oz (App 3)	14	4	5708	281	20.3	17.04	683
.....	14	4	5620	272	20.6	17.24	673
Eminent 125 SL 13 fl oz (App 1,3)/ Gem 25 WG 7 oz (App 2,4)	14	4	5571	271	20.6	16.94	667
.....	14	4	5554	274	20.3	17.07	665
TPTH 80 WP 5 oz (App 1, 3)/ Eminent 125 SL 13 fl oz (App 2,4).....	14	5	5441	273	19.9	17.31	651
.....	21/14/21	4	5343	275	19.5	17.07	640
Eminent 125 SL 13 fl oz (App 1, 3)/ TPTH 80 WP 5 oz (App 2,4).....	14	4	5316	280	19.0	17.49	636
.....	21/14/14	5	5243	275	19.0	17.45	628
Headline 2.09 EC 9 fl oz (App 1, 3)/ Eminent 125 SL 13 fl oz (App 2,4)	14	5	5151	280	18.4	17.89	617
.....	14/21/21	5	5150	284	18.1	17.44	616
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	6	5048	296	17.1	18.13	604
Eminent 125 SL 13 fl oz (App 1, 3)/ USF 2004 3.38 fl oz (App 2,4)	14/21/21	4	4869	258	18.9	17.34	583
.....	14	5	4817	283	22.1	18.34	577
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	5	4714	271	17.4	17.36	564
Headline 2.09 EC 9 fl oz (App 1,3)/ Topsin 4.5 F 7.6 fl oz + TPTH 80 WP 3.75 oz (App 2,4).....	21/14/21	5	4512	261	17.1	17.38	540
TPTH 80 WP 5 oz (App 1)/ Eminent 125 SL 13 fl oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3).....	21/14/21	5	4240	243	17.3	17.74	508
.....		7	3901	283	13.9	17.54	467
Eminent 125 SL 13 fl oz (App 1,3)/ Headline 2.09 EC 9 fl oz (App 2)							
.....							
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Gem 25 WG 7 oz (App 3).....							
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).....							
Eminent 125 SL 13 fl oz (App 1, 3)/ Headline 2.09 EC 9 fl oz (App 2).....							
.....							
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Gem 25 WG 7 oz (App 3).....							
Eminent 125 SL 13 fl oz (App 1)/ TPTH 80 WP 5 oz (App 2)/ Headline 2.09 EC 9 fl oz (App 3).....							
Untreated Check.....							
.....							
LSD (P=0.05)		1.5	966	27	2.6	1.06	

* 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)