CATTANACH, ALLAN[1], LARRY J. SMITH[2], and MARK BREDEHOEFT[3]. [1]General Agronomist, American Crystal Sugar Company, 101 North Third Street, Moorhead, MN 56560, [2]Head, Northwest Experiment Station, Crookston, MN 56716, [3]Southern Minnesota Beet Sugar Co-op, Renville, MN 56284. **Cercospora Leafspot control in eastern North Dakota and Minnesota in 1998.**

Cercospora leafspot, caused by the fungus ***Cercospora beticola***, is the most serious disease of sugarbeet in the production area of Minnesota and North Dakota. This disease may cause reductions in tonnage, sucrose, and profitability and increase impurities. Losses as high as 30 percent in recoverable sucrose are fairly common under moderate disease conditions. Roots of affected plants do not store in the pile 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 (So. Mn) 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 Minnesota and North Dakota.

OBJECTIVES:

The research objectives of these trials were to evaluate the efficacy of new or existing fungicides for control of cercospora leafspot. 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 against buildup of tolerance or resistance to the fungicides. All 1998 test sites had known TPTH tolerance and benzimidazole resistance.

PROCEDURES:

Two test sites were established in So. Mn with single sites at Breckenridge and Crookston, Minnesota. The cultural practice and application dates for each location are given in **Table 1**. At all locations, plots were six rows wide 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. The Crookston and Breckenridge analysis was completed at the East Grand Forks American Crystal quality lab. So. Mn site samples were analyzed for quality at the Southern Minnesota Beet Sugar Cooperative lab at Renville, Minnesota. Each treatment was replicated four or six times. All treatments containing Dithane had CS-7 spreader sticker used at the recommended rate. Leafspot severity was rated on the KWS scale of 1 to 9. One is no disease, a 3 rating is at early stages of economic loss level, and a 9 rating has only new leaf growth living and severe economic loss.

All sites were planted in April, 1998, as opposed to similar trials in 1997, where planting was delayed due to wet soil conditions. The onset of disease was earlier at the two So. Mn locations and Crookston in 1998. All sites had rapid buildup of cercospora in the latter part of July and August which continued into September for the So. Mn and Crookston locations. Below normal precipitation at the Breckenridge site slowed the spread of cercospora in late August and into September.

The number of fungicide treatments varied by location, (So. Mn - 31, Breckenridge - 36, Crookston - 37). No treatments with the fungicide Topsin M were applied at the So. Mn locations because of the high level of benzimidazole resistance known to exist at these sites. The number of applications also

varied. The number of applications for the 14, 10/10 and 7/10 day splits at Crookston were 5, 7 and 8 respectively and for Breckenridge 4, 6 and 7. The number of applications for the 14, 14/10 and 10/10 day splits at the So. Mn locations were 6, 7 and 8 respectively.

RESULTS AND DISCUSSION:

The effect of the various fungicides or fungicide combinations for cercospora leafspot control for the test sites are shown in **Tables 2, 3, 4 and 5**. PLEASE NOTE. a number of the treatments shown for all sites with the registered fungicides exceeded the amounts registered for a given season (i.e. only 15 oz/A of Super Tin 80 WP is allowed per season). A section 18 was granted for the fungicide Quadris for 1998 only. Registration status of all experimental fungicides for the 1999 season is unknown at this time.

Crookston:

The degree of damage from cercospora leaf spot is clearly evident at the Crookston site **(Table 2)**. The best fungicide treatment of the registered compounds (Topsin M (app 2) /Super Tin (app 1,3,4) increased recoverable sucrose, root yield and sucrose content by 3142 lb/A, 43 lb/T, 6.4 T/A and 2.2% respectively. These increases translate to an increase of $491 in gross return/A using the ACSC 1998 sugarbeet payment schedule. The check treatment had only regrowth canopy and a KWS cercospora leafspot rating of 8.3 at harvest.

All fungicide treatments with the exception of Pro-Tex increased recoverable sucrose/A. The level of increase varied significantly among treatments, however. All resistance management strategies using the registered fungicides performed well, especially those with one application of Topsin M in the application scheme. This may well relate to a lower level of resistance to the benzimidazole fungicides at Crookston.

Three experimental fungicides or fungicide combinations (Eminent, Eminent + Echo 720, BASF.50000F and BASF.50001F) gave excellent cercospora control. Compared to what was observed in 1997 at Crookston, the fungicide Quadris performed well below expectations. Bravo alone, while significantly better than the check in cercospora control and recoverable sucrose/A, was not equal in performance to the above listed experimentals.

Breckenridge:

The resistance management strategies using the registered fungicides, with the exception of Penncozeb (app 1,3,4,5,6)/ Topsin M (app 2) treatment performed poorly at the Breckenridge site in contrast to the performance at Crookston. Higher levels of benzimidazole resistance and tolerance to the TPTH and mancozeb compounds were found at this test site. Sucrose percent and recoverable sucrose/T were not significant across treatments.

The experimental fungicides BASF 490, BASF.50001F, Stratego and fungicide combinations with Eminent gave excellent cercospora control and recoverable sucrose/A.. Quadris performed similar to that observed at this site in 1997.

Southern Minnesota:

The two So. Mn sites had cercospora leafspot development beginning in late June and continuing

through September. These sites had very high levels of benzimidazole resistance and TPTH tolerance. The loss in recoverable sucrose, % sucrose and root yield from cercospora, between the check treatment and the best fungicide treatment at both sites were the largest recorded in Minnesota or North Dakota cercospora control trials. All fungicide treatments increased yield and quality when compared to the check.

Blomkest Site:

Recoverable sucrose ranged from 2713 lb/A on the check treatment to a high of 9513 lb/A for the experimental fungicide Eminent + Echo 720, at the 26.0 oz rate of Eminent. The difference in % sucrose and root yield was 5.6% and 16.2T/A respectively.

The experimental fungicide Eminent in combination with Echo 720 or alternating with Super Tin significantly out performed the Eminent + Bac J treatment. Other experimentals that performed equal to the best registered treatment (Super Tin {app 1-3}/ Manzate 200 DF {app 4-8}) were: Stratego, BASF.50000F, BASF.50001F and Quadris/Super Tin alternating. All other registered and experimental treatments had significantly poorer performance relative to recoverable sucrose/A.

Lueschen Site:

The experimental fungicide or fungicide combinations that had significantly higher recoverable sucrose than the best registered fungicide treatment (Super Tin {app 1-3} / Manzate 200 {app 4-8}) were: all Eminent combinations, Eminent alternating with Super Tin, Stratego, CGA-279202, BASF.50000F, BASF.50001F and Quadris alternating with Super Tin. All other experimentals and registered treatments had significantly higher KWS cercospora leafspot ratings at harvest.

Combined Site Data:

The combined cercospora leafspot control data from the Crookston and Breckenridge sites with similar registered and experimental fungicide treatments is shown in **Table 6**. The best experimental fungicide from the two combined sites would have increased the gross sugarbeet payment by $373/A using the 1998 ACSC payment schedule. The best current registered treatment would have increased the payment by $330/A

The combined data from all sites with similar treatments is shown in **Table 7**. Using the same payment system above, the best experimental treatment would have increased gross return by $580/A and the best registered by $390/A.

SUMMARY AND CONCLUSIONS

A. Registered Fungicides

1. The 3.75 oz/A Super Tin rate should only be used in the northern end of the sugarbeet growing area of Minnesota and North Dakota. For maximum cercospora leafspot control, a 10-day application interval is recommended.

2. The 5.0 oz/A Super Tin rate should be used in areas of high TPTH tolerance (Moorhead Factory, MinDak and So. Mn) with an application interval of 10 days.

3. Cercospora control with a single benzimidazole (Topsin M) fungicide application in combination with or alternating with a protectant fungicide was superior at the Crookston site as compared to the Breckenridge site. No benzimidazole fungicides should be used in So. Mn and only one application in combination with a protectant fungicide used in the northern end of the sugarbeet growing region.

4. Data from So. Mn and Breckenridge suggest increased tolerance to the mancozeb fungicide may be developing. See Wieland article in this publication..

5. The resistance management strategies (alternating and combining fungicide treatments) worked best at the Crookston site.

B. Experimental Fungicides

1. A number of experimental fungicides consistently out performed or equaled the best currently registered fungicides or fungicide combinations for cercospora control. These experimentals would include BASF.50000F, BASF.50001F, Stratego, Eminent and Eminent combinations. Research on other experimentals used in combination with registered or other experimentals also show promise.

C. Other

1. The addition of an extra 30 lb/A of N above the recommended level did not improve cercospora control with the registered fungicides. For the most part, recoverable sucrose/A was reduced due to lower sucrose content.

2. Cercospora leafspot continued to develop into September and October in both 1997 and 1998.

3. The level of cercospora inoculum for 1999 will be greater than in 1998.

4. Playing "catch up" due to late first application of fungicides, stretching application intervals or reducing fungicide rates does not pay (reason for big inoculum potential for 1999).

5. The level of resistance to the benzimidazole fungicides and tolerance to the TPTH and mancozeb fungicides continues to increase.

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Table 1. Cultural Practices and Application Date Information For Each Research Site in 1998.

	Breckenridge	So. MN.	Crookston
Planting Date	April 22	April 26	April 27
Previous Crop	Wheat	Corn	Small Grains
Variety	HM Valley	VDH 66140	HM Valley
Weed Control	Betamix – micro	Benanex – micro	Betamix – micro
	Betanex – micro	Upbeet – micro	Betanex – micro
	Upbeet – micro	Stinger – micro	Upbeet – micro
	Stinger – micro	Oil – micro	Stinger – micro
	Poast – micro	Assure II	Select – micro
	Oil –micro	Hand Labor	Oil – micro
	Hand Labor	Cultivation	Ammonia
	Cultivation		Hand Labor
			Cultivation
Insecticide	Counter	None	Counter
Plant Pop. at Thinning	35,0000 plant/A	35,0000 plant/A	35,0000 plant/A

Spray Dates	**Breckenridge**	**So. MN.**	**Crookston**
1st	July 21	July 1	July 13
2nd	July 28	July 10	July 20
3rd	July 31	July 14	July 23
4th	August 4	July 21	July 27
5th	August 7	July 24	July 30
6th	August10	July 28	August 3
7th	August 14	August 1	August 6
8th	August 17	August 7	August 10
9th	August 20	August 8	August 12
10th	August 25	August 11	August 17
11th	August 27	August 17	August 20
12th	September 1	August 18	August 24
13th	September 3	August 21	August 27
14th	September 8	August 25	August 31
15th	September 10	August 28	September 11
16th		August 31	
17th		September 1	
18th		September 8	
19th		September 10	
Spray Volume (gpa)	20.5	20.0	20.0
Spray Pressure (psi)	110	120	100
Rain and/or wet conditions may have occasionally kept application intervals from being exactly correct.			
Harvest Date	September 24	October 20	September 28

Table 2. Cercospora leafspot control at Crookston in 1998 with registered and experimental fungicides.

Treatment	Label	App. Int. days	Comments	Rate (Acre)	CLS* 9/27	Rec. Sucrose (lb/A)	(lb/T)	Root Yield (ton/A)	Sucrose (%)	LTM (%)
BASF 0.50000F	No	14		0.15 a. i.	3.8	10264	341	30.1	18.6	1.6
BASF 0.50000F	No	14		0.20 a.i.	3.3	10065	344	29.3	18.7	1.5
Topsin M(app 2) / Super Tin (app 1,3,4)	Yes	14 / 14		0.5 lb / 3.75 oz	3.5	9960	333	29.9	18.4	1.7
Eminent + Echo 720	No	14	Tank Mix	26.0oz + 1.5pt	3.1	9929	340	29.2	18.5	1.5
Eminent + Echo 720	No	14	Tank Mix	13oz + 1.5pt	3.4	9871	338	29.3	18.4	1.6
Eminent + Echo 720	No	14	Tank Mix	19.5oz + 1.5pt	3.5	9810	329	29.8	18.1	1.6
Topsin M(app2)/Super Tin(app3,5)/Penncozeb(app1,4,6)	Yes	10 / 10 / 7		0.5 lb / 3.75 oz / 2.0 lb	3.5	9804	343	28.6	18.6	1.4
BASF 0.50001F	No	14		0.15 a.i.	3.4	9783	332	29.6	18.2	1.6
Eminent	No	14		13 oz	3.6	9761	328	29.8	18.0	1.6
Penncozeb (app1,3,4,5,6) / Topsin M (app 2)	Yes	7 / 10		2.0 lb / 0.5 lb	3.6	9716	341	28.6	18.7	1.7
BASF 490	No	14		0.20 a.i.	5.6	9698	323	30.1	17.7	1.6
Super Tin (app 1-3) / Manzate 200 (app 4-6)	Yes	10 / 10		5 oz / 2 lb	4.3	9692	340	28.6	18.5	1.5
Penncozeb(app2,5)/Super Tin(app1,4,6)/Topsin M(app3)	Yes	7 / 10 / 10		2.0 lb / 3.75 oz / 0.5 lb	3.5	9542	331	28.9	18.1	1.6
Super Tin (app 1-6)	No**	10		3.75 oz	4.6	9529	326	29.2	17.9	1.6
Super Tin + Tactic	No**	10	Tank Mix	3.75oz + 1pt	4.1	9423	326	28.9	17.8	1.5
Eminent + Bac J	No	14	Tank Mix	13 oz	4.4	9394	323	29.1	17.7	1.6
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.1538 lb / 1.5 pt	5.3	9348	321	29.1	17.6	1.5
Stratego (Tilt + CGA-279202)	No	10	Tank Mix	7 fl oz	4.0	9339	352	26.6	19.1	1.5
Govern + Latron / Super Tin	No	10 / 10	Alternate	2.7oz +.12%vv / 3.75 oz	3.8	9330	329	28.4	18.0	1.5
Super Tin + Manzate 200 (app 1-5)	No**	14	Tank Mix	5 oz + 2 lb	4.1	9317	330	28.3	18.1	1.6
Bravo Weather Stik / Quadris	No	14 / 14	Alternate	1.5 pt / 0.2308 lb	5.3	9189	314	29.3	17.3	1.6
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.2308 lb + 1.5 pt	5.0	9121	324	28.2	17.9	1.7
Super Tin(app 1,3,5) / Penncozeb (app 2,4,6)	Yes	10 / 7	Alternate	5 oz / 2.0 lb	4.7	9103	332	27.6	18.3	1.7
Govern + Latron / Quadris	No	10 / 10	Alternate	2.7oz +.12%vv / 0.2308 lb	3.9	9070	320	28.4	17.6	1.6
CGA-279202	No	10		1.8 oz	4.1	9068	331	27.5	18.0	1.5
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.3077 lb / 1.5 pt	5.1	9030	326	27.8	17.9	1.6
Super Tin(app 1,2,3) / Dithane (app 4,5,6)	Yes	14 / 10	30 lb/A N	5 oz / 2 lb	4.0	9015	317	28.5	17.4	1.6
Quadris	No	14		0.3077 lb	5.8	8992	332	27.2	18.1	1.5
Bravo Weather Stik	No	14		1.5 pt	5.5	8902	322	27.7	17.7	1.6
Bravo Weather Stik Zn	No	14		1.5 pt	6.2	8902	323	27.6	17.8	1.7
Quadris	No***	14		0.2308 lb	5.9	8767	331	26.6	18.1	1.6
Terrinal Cu	No	14		3.38 pt	4.8	8559	334	25.7	18.2	1.5
Quadris	No	14		0.1538 lb	6.4	8490	317	26.8	17.5	1.6
Super Tin + Early Harvest	No**	14	Tank Mix	5 oz + 1.5 oz	4.5	8412	314	26.9	17.3	1.6
Tilt	No	10		4 fl oz	5.6	8069	325	24.9	17.8	1.6
Pro-tex (app 1-5)	No**	14		1.6 qt	8.1	7195	309	23.3	17.1	1.7
Check					8.3	6818	290	23.5	16.2	1.7
				C.V. %	10.4	6.81	5.10	6.36	4.18	10.1
				LSD 0.5 %	0.68	877	23.4	2.5	1.05	NS

* KWS Scale 1-9 (least - most) *** Section 18 for 1998 only
** Rates above seasonal registration

Table 3. Cercospora leafspot control at Breckenridge in 1998 with registered and experimental fungicides.

Treatment	Label	App. Int. days	Comments	Rate (Acre)	CLS* 8/21	CLS* 9/10	Rec. Sucrose (lb/A)	Rec. Sucrose (lb/T)	Root Yield (ton/A)	Sucrose (%)	LTM (%)
Eminent + Bac J	No	14	Tank Mix	13 oz	2.1	3.3	9901	358	27.7	19.6	1.8
Eminent + Echo 720	No	14	Tank Mix	26.0oz + 1.5pt	15	2.8	9534	357	26.7	19.5	1.7
BASF 490	No	14		0.20 a.i.	2.8	3.8	9345	343	27.3	19.0	1.8
Eminent + Echo 720	No	14	Tank Mix	13oz + 1.5pt	2.1	3.3	9201	347	26.5	19.2	1.9
BASF 0.50001F	No	14		0.15 a.i.	2.2	3.3	9200	358	25.7	19.6	1.7
Penncozeb (app 1,3,4,5,6) / Topsin M (app 2)	Yes	7 / 10		2.0 lb / 0.5 lb	2.3	3.6	9127	351	26.0	19.1	1.6
Terrinal Cu	No	14		3.38 pt	3.8	4.8	9107	347	26.2	19.0	1.7
Stratego (Tilt + CGA-279202)	No	10	Tank Mix	7 fl oz	3.2	4.2	9096	357	25.5	19.4	1.6
Super Tin (app1,3,5) / Dithane (app2,4)	Yes	14 / 10	30 lb/A N	5 oz / 2 lb	3.3	4.7	9081	347	26.1	19.1	1.7
BASF 0.50000F	No	14		0.15 a.i.	3.1	4.2	9079	352	25.9	19.3	1.7
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.3077 lb / 1.5 pt	4.2	5.3	8986	356	25.3	19.4	1.6
Eminent + Echo 720	No	14	Tank Mix	19.5oz + 1.5pt	1.5	2.7	8949	364	24.6	19.8	1.6
CGA-279202	No	10		1.8 oz	3.3	4.9	8935	349	25.6	19.1	1.6
Super Tin + Manzate 200	No**	14	Tank Mix	5 oz + 2 lb	3.9	4.7	8910	347	25.8	19.0	1.6
Super Tin (app 1-6)	No**	10		3.75 oz	3.8	4.9	8910	344	26.0	18.9	1.7
Bravo Weather Stik / Quadris	No	14 / 14	Alternate	1.5 pt / 0.2308 lb	3.7	4.9	8766	341	25.8	18.7	1.6
Bravo Weather Stik	No	14		1.5 pt	3.7	5.1	8759	353	24.9	19.3	1.7
Govern + Latron / Super Tin	No	10 / 10	Alternate	2.7oz +.12%vv / 3.75 oz	3.9	5.0	8735	351	24.9	19.2	1.7
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.2308 lb + 1.5 pt	4.0	5.1	8731	348	25.1	19.1	1.7
Super Tin + Tactic	No**	10	Tank Mix	3.75oz + 1pt	3.8	5.3	8704	349	25.0	19.0	1.6
Quadris	No***	14		0.2308 lb	3.7	5.0	8679	337	25.9	18.6	1.8
Quadris	No	14		0.3077 lb	3.7	4.8	8665	352	24.6	19.3	1.7
Tilt	No	10		4 fl oz	3.5	4.6	8631	343	25.2	18.8	1.6
Super Tin (app1,3,5) / Penncozeb (app2,4,6)	Yes	10 / 7	Alternate	5 oz / 2.0 lb	3.8	4.7	8605	342	25.2	18.8	1.8
Super Tin + Early Harvest	No	14	Tank Mix	5 oz + 1.5 oz	3.6	4.9	8585	347	24.8	19.1	1.7
BASF 0.50000F	No	14		0.20 a.i.	2.5	3.7	8572	345	24.9	19.1	1.8
Super Tin (app1-3) / Manzate 200 (app4-6)	Yes	10 / 10		5 oz / 2 lb	4.1	5.5	8538	342	25.0	18.8	1.7
Govern + Latron / Quadris	No	10 / 10	Alternate	2.7oz +.12%vv / 0.2308 lb	3.5	4.6	8507	340	25.0	18.8	1.8
Quadris	No	14		0.1538 lb	3.7	5.0	8494	341	25.1	18.8	1.7
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.1538 lb / 1.5 pt	3.8	5.1	8464	345	24.6	19.0	1.7
Topsin M (app 2) / Super Tin (app 1,3,4)	Yes	14 / 14		0.5 lb / 3.75 oz	4.1	5.4	8448	343	24.7	18.7	1.6
Pro-tex	No**	14		1.6 qt	3.9	5.2	8416	349	24.2	19.2	1.7
Bravo Weather Stik Zn	No	14		1.5 pt	3.5	4.8	8372	345	24.3	19.0	1.7
Topsin M (app 2) / Super Tin (app 3,5) / Penncozeb (app 1,4,6)	Yes	10 / 10 / 7		0.5 lb / 3.75 oz / 2.0 lb	3.4	4.9	8123	336	24.2	18.6	1.8
Check					5.4	7.4	7966	342	23.3	18.8	1.7
Penncozeb (app2,5) / Super Tin (app1,4,6) / Topsin M (app 3)	Yes	7 / 10 / 10		2.0 lb / 3.75 oz / 0.5 lb	3.7	4.9	7646	350	21.9	19.2	1.7
				C.V. %	11.2	13.9	7.0	4.8	7.1	4.4	12.7
				LSD 0.5 %	0.4	0.7	702	NS	2.1	NS	NS

* KWS Scale 1-9 (least – most) *** Section 18 for 1998 only

** Rates above seasonal registration

Table 4. Cercospora leafspot control at Southern Minnesota Bloomkest Site in 1998 with registered and experimental fungicides.

Treatment	Label	App. Int. days	Comments	Rate (Acre)	CLS* 8/15	CLS* 10/15	Rec. Sucrose (lb/A)	Sucrose (lb/T)	Root Yield (ton/A)	Sucrose (%)	LTM (%)
Eminent + Echo 720	No	14	Tank Mix	26.0oz + 1.5pt	1.5	2.2	9513	310	30.7	17.2	1.7
Eminent / Super Tin	No	14 / 10	Alternate	19.5 oz / 3.75 oz	1.3	2.5	9073	307	29.6	17.2	1.9
Eminent + Echo 720	No	14	Tank Mix	19.5oz + 1.5pt	1.7	2.2	8652	307	28.2	17.1	1.8
Eminent + Echo 720	No	14	Tank Mix	13oz + 1.5pt	1.5	2.7	8296	283	29.3	16.1	1.9
Stratego (Tilt + CGA-279202)	No	10	Tank Mix	7 fl oz	2.0	3.0	8070	281	28.7	15.8	1.8
Super Tin (app1-3) / Manzate 200 (app4-8)	Yes	10 / 10		5 oz / 2 lb	3.7	5.8	7644	277	27.6	15.7	1.8
BASF 0.50000F	No	14		0.20 a.i.	1.8	2.8	7538	286	26.4	16.1	1.8
BASF 0.50001F	No	14		0.15 a.i.	2.3	3.3	7350	278	26.4	15.7	1.8
BASF 0.50000F	No	14		0.15 a. i.	3.2	4.2	7327	270	27.1	15.3	1.8
Quadris / Super Tin	No	14 / 10	Alternate	0.1538 lb / 3.75 oz	2.0	3.2	7326	283	25.9	16.0	1.9
Eminent + Bac J	No	14	Tank Mix	13 oz	1.8	3.8	6862	275	25.0	15.6	1.9
CGA-279202	No	10		1.8 oz	2.8	4.3	6478	276	23.5	15.7	1.9
Tilt	No	10		4 fl oz	5.8	6.7	6165	242	25.5	13.8	1.7
BASF 490	No	14		0.20 a.i.	4.0	4.7	5929	261	22.8	15.0	2.0
Super Tin + Manzate 200	No**	14	Tank Mix	5 oz + 2 lb	5.5	6.2	5907	234	25.3	13.6	1.9
Quadris	No	14		0.3077 lb	6.0	4.8	5824	240	24.3	13.8	1.8
Govern + Latron / Super Tin	No	10 / 10	Alternate	2.7oz .12%vv / 3.75 oz	5.3	5.7	5615	243	23.1	13.9	1.7
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.1538 lb / 1.5 pt	5.2	5.5	5586	251	22.4	14.3	1.8
Bravo Weather Stik	No	14		1.5 pt	5.7	5.0	5484	253	21.7	14.4	1.8
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.2308 lb + 1.5 pt	4.8	5.2	5482	235	23.4	13.6	1.8
Bravo Weather Stik / Quadris	No	14 / 14	Alternate	1.5 pt / 0.2308 lb	5.0	5.3	5396	239	22.6	13.9	2.0
Govern + Latron / Quadris	No	10 / 10	Alternate	2.7oz.12%vv/0.2308 lb	5.5	5.5	5369	238	22.5	13.8	1.9
Bravo Weather Stik Zn	No	14		1.5 pt	5.0	6.0	5246	237	22.1	13.8	2.0
Quadris	No***	14		0.2308 lb	5.8	4.8	5208	229	22.6	13.4	2.0
Super Tin (app1–4) / Manzate 200 (app5-8)	Yes	10 / 10		3.75 oz / 2 lb	5.2	6.0	5105	226	22.6	13.1	1.8
Pro-tex	No**	14		1.6 qt	5.7	6.0	4904	231	21.2	13.3	1.8
Super Tin + Tactic	No**	10	Tank Mix	3.75oz + 1pt	4.5	5.3	4846	232	20.9	13.5	1.8
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.3077 lb / 1.5 pt	5.3	4.2	4805	222	21.7	13.0	1.9
Quadris	No	14		0.1538 lb	5.7	5.5	4621	233	19.8	13.6	2.0
Super Tin (app 1-3) / Dithane (app 4-7)	Yes	14 / 10	30 lb N	5 oz / 2 lb	5.7	5.7	4615	213	21.7	12.6	1.9
Check					7.5	7.3	2713	188	14.5	11.6	2.2
				C.V. %	16.3	25.1	8.81	4.8	7.61	3.45	12.4
				LSD 0.5 %	0.77	1.34	626	13.9	2.1	0.57	NS

* KWS Scale 1-9 (least – most)
** Rates above seasonal registration
*** Section 18 for 1998 only

Table 5. Cercospora leafspot control at Southern Minnesota Lueschen Site in 1998 with registered and experimental fungicides.

Treatment	Label	App. Int. days	Comments	Rate (Acre)	CLS 8 /15	CLS* 10/15	Rec. (lb/A)	Sucrose (lb/T)	Root Yield (ton/A)	Sucrose (%)	LTM (%)
Eminent + Echo 720	No	14	Tank Mix	19.5oz + 1.5pt	1.2	1.2	7219	236	30.1	16.5	1.7
Eminent + Echo 720	No	14	Tank Mix	13oz + 1.5pt	1.2	1.3	6947	242	28.6	16.7	1.6
Stratego (Tilt + CGA-279202)	No	10	Tank Mix	7 fl oz	3.3	3.5	6925	250	27.7	16.0	1.5
Eminent + Echo 720	No	14	Tank Mix	26.0oz + 1.5pt	1.0	1.0	6890	230	30.0	16.1	1.6
Eminent / Super Tin	No	14 / 10	Alternate	19.5 oz / 3.75 oz	1.8	1.2	6881	234	29.4	16.6	1.6
CGA-279202	No	10		1.8 oz	3.5	3.8	6555	233	28.2	15.4	1.7
Eminent + Bac J	No	14	Tank Mix	13 oz	1.3	1.7	6432	233	27.6	16.3	1.6
BASF 0.50000F	No	14		0.20 a.i.	1.8	2.2	6372	234	27.3	15.8	1.7
BASF 0.50001F	No	14		0.15 a.i.	2.5	2.7	6176	240	25.7	16.2	1.5
Quadris / Super Tin	No	14 / 10	Alternate	.1538 lb / 3.75 oz	2.5	3.2	6008	224	26.8	16.0	1.5
BASF 0.50000F	No	14		0.15 a. i.	3.5	3.8	5865	225	26.2	15.0	1.8
BASF 490	No	14		0.20 a.i.	3.5	3.8	5722	225	25.4	15.8	1.7
Super Tin (app 1-3) / Manzate 200 (app4-8)	Yes	10 / 10		5 oz / 2 lb	3.1	4.3	5295	218	24.4	15.1	1.6
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.2308 lb + 1.5 pt	5.2	5.5	5251	226	23.3	14.9	1.5
Quadris	No	14		0.3077 lb	5.8	6.3	5227	232	22.6	15.0	1.4
Bravo Weather Stik / Quadris	No	14 / 14	Alternate	1.5 pt / 0.2308 lb	4.8	5.0	5199	222	23.4	14.8	1.7
Govern + Latron / Quadris	No	10 / 10	Alternate	2.7oz .12%vv/ 0.2308 lb	5.5	6.0	5130	218	23.6	14.6	1.7
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.3077 lb / 1.5 pt	5.5	5.8	5048	225	22.5	14.8	1.6
Govern + Latron / Super Tin	No	10 / 10	Alternate	2.7oz .12%vv / 3.75 oz	5.5	5.8	5019	229	21.9	15.1	1.6
Bravo Weather Stik	No	14		1.5 pt	5.7	6.5	5001	226	22.2	14.9	1.6
Quadris	No***	14		0.2308 lb	6.3	6.8	4964	228	21.8	14.9	1.6
Super Tin + Manzate 200	No**	14	Tank Mix	5 oz + 2 lb	4.7	5.5	4917	222	22.1	14.6	1.5
Quadris	No	14		0.1538 lb	5.7	6.2	4898	223	22.0	14.9	1.7
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.1538 lb / 1.5 pt	5.7	6.0	4867	216	22.5	14.4	1.6
Tilt	No	10		4 fl oz	6.5	6.8	4823	216	22.3	14.4	1.6
Super Tin (app1-4) / Manzate 200 (app5-8)	Yes	10 / 10		3.75 oz / 2 lb	5.7	5.5	4751	227	20.9	14.8	1.4
Super Tin (app1-3) / Dithane (app 4-7)	Yes	14 / 10	30 lb N	5 oz / 2 lb	6.5	6.8	4618	226	20.5	14.9	1.6
Super Tin + Tactic	No**	10	Tank Mix	3.75oz + 1pt	5.2	5.5	4603	225	20.5	14.9	1.7
Bravo Weather Stik Zn	No	14		1.5 pt	4.3	5.7	4601	221	20.7	14.6	1.6
Pro-tex	No**	14		1.6 qt	5.3	6.8	4568	214	21.4	14.4	1.7
Check					7.8	8.0	3104	216	14.4	12.4	1.6
				C.V. %	17.9	16.1	9.06	7.66	5.57	2.9	15.1
				LSD 0.5 %	0.87	0.86	566	NS	1.5	0.49	NS

* KWS Scale 1-9 (least – most)
** Rates above seasonal registration
*** Section 18 for 1998 only

Table 6. Combined Cercospora leafspot control data from Breckenridge and Crookston in 1998 with similar registered and experimental fungicides.

Treatment	Label	App. Int. days	Comments	Rate (Acre)	CLS*	Rec. Sucrose (lb/A)	Rec. Sucrose (lb/T)	Root Yield (ton/A)	Sucrose (%)	LTM (%)
Eminent + Echo 720	No	14	Tank Mix	26.0 oz + 1.5 pt	3.0	9731	348	28.0	19.0	1.6
BASF 0.50000F	No	14		0.15 a.i.	4.0	9672	346	28.0	18.9	1.6
Eminent + Bac J	No	14	Tank Mix	13 oz	3.7	9647	340	28.4	18.7	1.7
Eminent + Echo 720	No	14	Tank Mix	13 oz + 1.5 pt	3.3	9536	342	27.9	18.8	1.7
BASF 490	No	14		0.20 a.i.	4.5	9522	333	28.7	18.3	1.7
BASF 0.50001F	No	14		0.15 a.i.	3.3	9491	345	27.6	18.9	1.7
Penncozeb (app1,3,4,5,6) / Topsin M (app 2)	Yes	7 / 10		2.0 lb / 0.5 lb	3.6	9421	346	27.3	18.9	1.6
Eminent + Echo 720	No	14	Tank Mix	19.5 oz + 1.5 pt	3.0	9380	346	27.2	18.9	1.6
BASF 0.50000F	No	14		0.20 a.i.	3.5	9319	344	27.1	18.9	1.6
Super Tin	No**	10		3.75 oz	4.8	9220	335	27.6	18.4	1.6
Stratego (Tilt + CGA-279202)	No	10	Tank Mix	7 fl oz	4.1	9217	354	26.0	19.3	1.5
Topsin M (app 2) / Super Tin (app 1,3,4)	Yes	14 / 14		0.5 lb / 3.75 oz	4.7	9204	338	27.3	18.6	1.7
Super Tin (app 1-3) / Manzate 200 (app 4-6)	Yes	10 / 10		5 oz / 2 lb	5.0	9115	341	26.8	18.6	1.6
Super Tin + Manzate 200	No**	14	Tank Mix	5 oz + 2 lb	4.6	9114	339	27.0	18.5	1.6
Super Tin + Tactic	No**	10	Tank Mix	3.75oz + 1pt	4.7	9064	338	27.0	18.4	1.7
Govern + Latron / Super Tin	No	10 / 10	Alternate	2.7oz +.12%vv / 3.75 oz	4.5	9032	340	26.6	18.6	1.6
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.3077 lb / 1.5 pt	5.3	9008	341	26.5	18.6	1.6
CGA-279202	No	10		1.8 oz	4.3	9002	340	26.6	18.6	1.6
Bravo Weather Stik / Quadris	No	14 / 14	Alternate	1.5 pt / 0.2308 lb	5.1	8978	327	27.5	18.0	1.6
Topsin M (app2) / Super Tin (app3,5) / Penncozeb (app1,4,6)	Yes	10 / 10 / 7		0.5 lb / 3.75 oz / 2.0 lb	4.4	8964	339	26.4	18.6	1.6
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.2308 lb + 1.5 pt	5.1	8926	336	26.7	18.5	1.7
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.1538 lb / 1.5 pt	5.2	8906	333	26.9	18.3	1.6
Super Tin (app 1,3,5) / Penncozeb (app 2,4,6)	Yes	10 / 7	Alternate	5 oz / 2.0 lb	4.7	8854	337	26.4	18.6	1.7
Terrinal Cu	No	14		3.38 pt	4.8	8833	341	25.9	18.6	1.6
Bravo Weather Stik	No	14		1.5 pt	5.3	8830	337	26.3	18.5	1.6
Quadris	No	14		0.3077 lb	5.2	8829	342	25.9	18.7	1.6
Govern + Latron / Quadris	No	10 / 10	Alternate	2.7oz +.12%vv / 0.2308l	4.3	8789	330	26.7	18.2	1.7
Quadris	No***	14		0.2308 lb	5.4	8723	334	26.2	18.4	1.7
Bravo Weather Stik Zn	No	14		1.5 pt	5.4	8637	334	26.0	18.4	1.7
Penncozeb (app 2,5) / Super Tin (app1,4,6) / Topsin M (app 3)	Yes	7 / 10 / 10		2.0 lb / 3.75 oz / 0.5 lb	4.4	8594	340	25.4	18.7	1.6
Super Tin + Early Harvest	No**	14	Tank Mix	5 oz + 1.5 oz	4.8	8498	331	25.8	18.2	1.7
Quadris	No	14		0.1538 lb	5.6	8492	329	26.0	18.1	1.7
Tilt	No	10		4 fl oz	5.0	8350	334	25.1	18.3	1.6
Pro-tex	No**	14		1.6 qt	6.3	7805	329	23.7	18.1	1.7
Check					7.8	7392	316	23.4	17.5	1.7

* KWS Scale 1-9 (least – most)

** Rates above seasonal registration

*** Section 18 for 1998 only

Table 7. Combined Cercospora leafspot control data from All Sites in 1998 with similar registered and experimental fungicides.

Treatment	Label	App. Int. days	Comments	Rate (Acre)	Rec. Sucrose (lb/A)	Sucrose (lb/T)	Root Yield (ton/A)	Sucrose (%)	LTM (%)
Eminent + Echo 720	No	14	Tank Mix	26.0oz + 1.5pt	8966	309	29.2	17.8	1.6
Eminent + Echo 720	No	14	Tank Mix	19.5oz + 1.5pt	8658	309	28.3	17.9	1.7
Eminent + Echo 720	No	14	Tank Mix	13oz + 1.5pt	8579	302	28.4	17.6	1.7
Stratego (Tilt + CGA-279202)	No	10	Tank Mix	7 fl oz	8357	310	27.1	17.6	1.6
Eminent + Bac J	No	14	Tank Mix	13 oz	8147	297	27.3	17.3	1.7
BASF 0.50000F	No	14		0.20 a.i.	8137	302	27.0	17.4	1.7
BASF 0.50000F	No	14		0.15 a. i.	8134	297	27.3	17.0	1.7
BASF 0.50001F	No	14		0.15 a.i.	8127	302	26.8	17.4	1.7
Super Tin (app 1-3) / Manzate 200	Yes	10 / 10		5 oz / 2 lb	7792	294	26.4	17.0	1.7
CGA-279202	No	10		1.8 oz	7759	297	26.2	17.0	1.7
BASF 490	No	14		0.20 a.i.	7674	288	26.4	16.9	1.8
Super Tin + Manzate 200	No**	14	Tank Mix	5 oz + 2 lb	7263	283	25.4	16.3	1.7
Quadris	No	14		0.3077 lb	7177	289	24.7	16.6	1.6
Govern + Latron / Super Tin	No	10 / 10	Alternate	2.7oz +.12%vv / 3.75 oz	7175	288	24.6	16.5	1.6
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.2308 lb + 1.5 pt	7146	283	25.0	16.4	1.7
Bravo Weather Stik / Quadris	No	14 / 14	Alternate	1.5 pt / 0.2308 lb	7138	279	25.3	16.2	1.7
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.1538 lb / 1.5 pt	7066	283	24.6	16.3	1.7
Bravo Weather Stik	No	14		1.5 pt	7037	288	24.1	16.6	1.6
Govern + Latron / Quadris	No	10 / 10	Alternate	2.7oz .12%vv/ 0.2308lb	7019	279	24.9	16.2	1.7
Quadris / Bravo Weather Stik	No	14 / 14	Alternate	0.3077 lb / 1.5 pt	6967	282	24.3	16.3	1.7
Tilt	No	10		4 fl oz	6922	281	24.5	16.2	1.6
Quadris	No***	14		0.2308 lb	6904	281	24.2	16.3	1.7
Bravo Weather Stik Zn	No	14		1.5 pt	6780	282	23.7	16.3	1.7
Quadris	No	14		0.1538 lb	6626	279	23.4	16.2	1.7
Pro-tex	No**	14		1.6 qt	6271	276	22.5	16.0	1.7
Check					5150	259	18.9	14.8	1.8

** Rates above seasonal registration

*** Section 18 for 1998 only