CERCOSPORA LEAF SPOT CONTROL IN EASTERN NORTH DAKOTA AND MINNESOTA IN 2001

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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 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 2001 test sites had known TPTH tolerance and benzimidazole resistance.

PROCEDURES:

Research was conducted at Crookston, Breckenridge, and Gluek, 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 is 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 planted in May because of wet field condition in April. All sites were affected by Cercospora leaf spot, but disease severity was low to moderate depending on location.

The fungicides tested in 2001 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.

Crookston:

Cercospora leaf spot severity was low during July and August, but increased rapidly in September. All the fungicide treatments, except Messenger applied alone, increased recoverable sucrose per acre, and all treatments significantly reduced the level of Cercospora leaf spot (**Table 3**). Of the labeled fungicides, Eminent (with a Section 18 label) in alternation with TPTH, Topsin M plus Penncozeb, and other registered fungicides and experimentals gave consistent control and high recoverable sucrose per acre. The experimental compound, BAS 500, also gave consistent control when applied alone or with the adjuvant AG 01005; and in a rotation program with Eminent, TPTH, and a tank-mix of Topsin and Penncozeb.

Breckenridge:

Cercospora leaf spot severity was low during the season with the untreated check plots having a KWS Cercospora leaf spot rating of 4.6 ten days before harvest (**Table 4**).

Of the labeled fungicides, Eminent alternating with TPTH, and Eminent alternating with TPTH and a tank-mix of Topsin and Penncozeb resulted in high recoverable sucrose per acre. The experimental compound, BAS 500, gave good control when applied with the adjuvant AG 01005; and in alternation with Eminent; and in a rotation program with Eminent, TPTH, and a tank-mix of Topsin and TPTH. There was some phytotoxicity with Stratego alternating with TPTH.

Southern Minnesota:

Gluek:

Cercospora leaf spot severity was low with the untreated check plots having a KWS Cercospora leaf spot rating of 4.3 at harvest (**Table 5**)

Of the labeled fungicides, Eminent alternating with TPTH, resulted in high recoverable sucrose per acre. The experimental compound, BAS 500, gave good control and resulted in high recoverable sugar per acre when applied in alternation with Eminent; in alternation with TPTH; and in a rotation program with Eminent and TPTH.
No phytotoxicity was observed.

SUMMARY AND CONCLUSIONS

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 the Crookston location, consecutive days of wind (86 and 108 mph) caused severe leaf damage. The damage was the greatest on plots that received application on August 8, the day of the highest wind, as compared to the untreated check. At harvest, 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 ($r^2 = 0.92$). There was a significant correlation of this scale with the KWS scale. The difference observed in vigor cannot be explained at this time.

D. Other Comments [Please note that Eminent, and Bas 500 – to be called Headline – can only be used for the 2002 crop if they are 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 Headline or 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, 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, 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. Never use the same fungicide or fungicides from the same class of chemistry or same mode of action ‘back-to-back’.

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

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

Strobilurins	**Sterol Inhibitors**	**Ethylenebisdithiocarbamates (EBDC)**
Quadris	Eminent	Maneb
Gem (USF 2004)	RH-7592	Mancozeb
BAS 500	Stratego (**Tilt** + Flint)	Manzate
Stratego (**Flint** +Tilt)		Penncozeb

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 2001

	Crookston	Breckenridge	Gluek
Planting Date	May 4	May 11	May 4
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
			Ammonia
	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 18
2nd	August 8	August 6	August 2
3rd	August 16	August 14	August 8
4th	August 22	August 20	August 15
5th	August 30	August 28	
6th	September 7	September 4	
Spray Volume (gpa)	20	20	20
Spray Pressure (psi)	100	100	120
Harvest Date	October 2	September 24	October 4

Table 2. Fungicides tested in 2001.

Fungicides	Status
Penncozeb	Registered
Topsin M	Registered
Super Tin, Agritin, Triphenyltin hydroxide (TPTH)	Registered
Quadris	Registered
USF 2004	Experimental
Eminent	Section 18 granted for 2001
Stratego	Experimental
Messenger	Experimental
Armicarb 100	Experimental
Bas 500	Experimental
RH-7592	Experimental
DG 14161	Experimental

Table 3. Cercospora leaf spot control at Crookston in 2001 with registered and experimental fungicides.

Treatment and rate/A	App. Interval	CLS*	Recoverable Sucrose		Root Yield	Sucrose Content	LTM**
	(d)	1-Oct	(lb/A)	(lb/T)	(T/A)	(%)	(%)
BAS 500 2.09 EC 0.15 lb a.i + AG 01005 1% v/v……..	14	1.9	9529	359.5	26.5	19.2	1.2
BAS 500 2.09 EC 0.15 lb a.i / TPTH 80 WP 5 oz / Eminent 125 SL 13 fl oz……	14	2.4	9514	343	27.8	18.5	1.4
Topsin M 70 WSB 0.5 lb + Pennocozeb 75DF 2.0 lb / Eminent 125 SL 13 fl oz / TPTH 80 WP 5 oz / BAS 500 2.09 EC 0.15 lb a.i……..…….	14	2.5	9319	346	26.9	18.5	1.2
Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i..……	21	1.8	9219	342	27.0	18.4	1.3
Topsin M 70 WSB 0.375 lb + TPTH 80 WP 3.75 oz / Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i…..……	14	2.5	9196	338	27.2	18.2	1.3
Eminent 125 SL 13 fl oz / TPTH 80 WP 3.75 oz / BAS 500 2.09 EC 0.15 lb a.i..……	14	2.3	9158	334	26.6	18.4	1.4
Eminent 125 SL 13 fl oz / Stratego 2.1 EC 10 fl oz……	14	2.6	9136	341	26.8	18.4	1.4
Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i……..	14	2.1	9135	345	26.5	18.5	1.3
BAS 500 2.09 EC 0.15 lb a.i……..	14	2.1	9099	345	26.4	18.5	1.3
BAS 500 2.09 EC 0.15 lb a.i + Agridex COC 1% v/v……	14	2.1	9092	353	25.8	18.8	1.2
Eminent 125 SL 13 fl oz / Topsin M 70 WSB 0.375 lb + TPTH 80 WP 3.75 oz / TPTH 80 WP 5 oz……..……	14	2.9	9092	343	26.6	18.4	1.3
Eminent 125 SL 13 fl oz / TPTH 80 WP 5 oz……	14	2.8	9081	347	26.2	18.5	1.2
BAS 500 2.09 EC 0.15 lb a.i / TPTH 80 WP 5 oz……	14	2.3	9072	348	26.1	18.6	1.2
Eminent 125 SL 13 fl oz / Topsin M 70 WSB 0.375 lb + TPTH 80 WP 3.75 oz / BAS 500 2.09 EC 0.15 lb a.i ..…….	21/14/21	2.3	9028	337	26.8	18.2	1.3
Eminent 125 SL 13 fl oz / Quadris 2.08 SC 0.15 lb a.i ..……	14	2.0	8941	345	25.9	18.5	1.3
BAS 500 2.09 EC 0.15 lb a.i……..	21	2.0	8926	341	26.2	18.3	1.3
BAS 500 2.09 EC 0.15 lb a.i / RH-7592 2F + Agridex COC 1% v/v	14	2.6	8878	336	26.4	18.1	1.3
Eminent 125 SL 13 fl oz / TPTH 80 WP 5 oz……	21/14	2.4	8841	336	26.4	18.2	1.4
BAS 500 2.09 EC 0.15 lb a.i / Eminent 125 SL 13 fl oz……	14	2.0	8797	338	26.0	18.2	1.3
DG 14161 0.2 lb a.i...……	14	4.0	8747	339	25.8	18.3	1.4
USF 2004 2.5 oz..……	14	3.6	8710	341	25.5	18.4	1.3
RH-7592 2F + Agridex COC 1% v/v……..……	14	3.4	8707	342	25.5	18.4	1.3
Eminent 125 SL 13 fl oz / Flint 50 WG 2 oz……..	14	2.9	8664	334	26.0	18.0	1.4
Topsin M 70 WSB 0.375 lb + TPTH 80 WP 3.75 oz / Eminent 125 SL 13 fl oz / BAS 510 F 0.15 lb a.i……	14/21/21	2.8	8660	335	25.8	18.1	1.3
Eminent 125 SL 13 fl oz / USF 2004 2 oz…….	14	2.3	8660	336	25.8	18.2	1.4
Stratego 2.1 EC 10 fl oz ……	14	2.5	8620	329	26.2	17.8	1.3
USF 2004 3 oz……	14	2.6	8538	339	25.1	18.3	1.3
Armicarb 100 5lb /100 gal……	7/7/7/14/ 14	4.0	8428	329	25.6	17.9	1.5
BAS 510F 0.15 lb a.i……..……	14	4.8	8394	341	24.6	18.4	1.3
Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i / TPTH 80 WP 5 oz……	14	2.3	8337	325	25.7	17.7	1.4
Messenger 4.5 oz./ Messenger 4.5 oz + TPTH 80 WP 5 oz……..	14	4.5	8326	321	25.9	17.6	1.5
BAS 510F 0.25lb a.i……	14	5.0	8256	326	25.3	17.7	1.4
Quadris 2.08 SC 0.15 lb a.i / TPTH 80 WP 5 oz…….	14	2.6	8159	329	24.9	17.8	1.4
Messenger 4.5 oz…….	14	4.9	7860	332	23.7	17.9	1.3
Untreated Check		6.1	7357	322	23.2	17.4	1.5
LSD (P=0.05)		0.76	732	18.3	1.7	.81	.18
CV%		18.39	5.96	3.9	4.8	3.2	10.2

*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 2001 with registered and experimental fungicides.

Treatment and rate/A	App. Interval	CLS*	Recoverable Sucrose		Root Yield	Sucrose Content	LTM**
	(d)	11-Sep	(lb/A)	(lb/T)	(T/A)	(%)	(%)
BAS 500 2.09 EC 0.15 lb a.i + AG 01005 1% v/v……..	14	1.8	7441	316	23.9	17.1	1.4
Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i……..	14	1.3	7215	316	23.1	17.1	1.3
Eminent 125 SL 13 fl oz (App 1) /	21	1.5	7081	300	23.9	16.5	1.5
Topsin M 70 WSB 0.375 lb + TPTH 80 WP 3.75 oz (App 2) /	14						
BAS 500 2.09 EC 0.15 lb a.i (App 3)	21						
BAS 500 2.09 EC 0.15 lb a.i / Eminent 125 SL 13 fl oz……..	14	1.3	6669	327	20.6	17.7	1.4
BAS 500 2.09 EC 0.15 lb a.i (App 1, 4) / TPTH 80 WP 5 oz (App 2) / Eminent 125 SL 13 fl oz (App 3)……..	14	1.1	6392	319	20.2	17.3	1.4
Stratego 2.1 EC 10 fl oz…….	14	1.5	6383	306	21.1	16.7	1.4
DG 14161 250 SC 0.2 lb a.i……	14	2.1	6280	302	21	16.6	1.5
BAS 500 2.09 EC 0.15 lb a.i……..	21	2.0	6263	303	21.1	16.6	1.4
BAS 500 2.09 EC 0.15 lb a.i + Agridex COC 1% v/v……	14	1.3	6259	300	21.1	16.5	1.5
Eminent 125 SL 13 fl oz (App 1,4) / TPTH 80 WP 5 oz (App 2) / BAS 500 2.09 EC 0.15 lb a.i (App 3)……	14	1.1	6250	300	21	16.5	1.5
Eminent 125 SL 13 fl oz (App 1, 4) / BAS 500 2.09 EC 0.15 lb a.i (App 2) / TPTH 80 WP 5 oz (App 3)..……	14	1.3	6243	322	19.6	17.5	1.4
Quadris 2.08 SC 0.15 lb a.i (App 1,3) / TPTH 80 WP 5 oz (App 2,4)	14	1.6	6235	305	20.5	16.6	1.4
Eminent 125 SL 13 fl oz / USF 2004 3 oz……	14	1.4	6219	300	20.8	16.5	1.5
BAS 500 2.09 EC 0.15 lb a.i……..	14	1.3	6185	309	20.3	16.9	1.4
Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i……	21	1.3	6154	310	20.1	17.0	1.5
Eminent 125 SL 13 fl oz / TPTH 80 WP 5 oz……	21/14	1.4	6150	311	19.9	17.0	1.4
RH 7592- 2F+ Agridex COC 1% v/v…….	14	2.0	6118	310	19.9	16.9	1.4
BAS 500 2.09 EC 0.15 lb a.i /RH-7592 2F+Agridex COC 1% v/v…	14	1.3	6084	306	20.0	16.7	1.4
Eminent 125 SL 13 fl oz (App 1,4) / Topsin M 70 WSB 0.5 lb + Penncozeb 75DF 2.0 lb (App 2) / TPTH 80 WP 5 oz (App 3,)..…	14	1.2	6042	311	19.6	17.0	1.4
Eminent 125 SL 13 fl oz / TPTH 80 WP 5 oz……	14	1.2	6037	294	20.9	16.1	1.4
BAS 500 2.09 EC 0.15 lb a.i / TPTH 80 WP 5 oz	14	1.6	5949	301	20.0	16.5	1.5
Topsin M 70 WSB 0.375 lb + TPTH 80 WP 3.75 oz (App 1) / Eminent 125 SL 13 fl oz (App 2) / BAS 500 2.09 EC 0.15 lb a.i (App 3) ..……	14/21/21	1.8	5839	308	19.1	16.9	1.5
BAS 510 F 0.25 lb a.i……...	14	3.4	5790	287	20.1	15.9	1.6
Topsin M 70 WSB 0.5 lb + Pennocozeb 75DF 2.0 lb (App 1)/ Eminent 125 SL 13 fl oz (App 2) / TPTH 80 WP 5 oz (App 3) / BAS 500 2.09 EC 0.15 lb a.i (App 4)…….	14	1.3	5752	300	19.2	16.5	1.5
BAS 510 F 0.15 lb a.i……..	14	3.6	5569	298	18.9	16.4	1.5
USF 2004 3 oz……	14	1.2	5541	304	18.4	16.6	1.4
Stratego 2.1 EC 10 fl oz / TPTH 80 WP 5 oz……	14	1.1	5523	311	17.9	17.1	1.5
Topsin M 70 WSB 0.375 lb + Pennocozeb 75DF 2.0 lb (App 1)/ Eminent 125 SL 13 fl oz (App 2) / TPTH 80 WP 5 oz (App 3) / BAS 500 2.09 EC 0.15 lb a.i (App 4)…….	14	1.3	5473	299	18.4	16.4	1.4
Untreated Check……..		4.6	4680	309	15.3	16.9	1.4
LSD (P=0.05)		0.7	1246	27.4	3.7	1.2	0.2
CV%		29.4	14.55	6.4	13.2	5.3	9.2

*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 Gluek in 2001 with registered and experimental fungicides.

Treatment and rate/A	App. Interval	CLS*	Recoverable Sucrose		Root Yield	Sucrose Content	LTM**
	(d)	14-Sep	(lb/A)	(lb/T)	(T/A)	(%)	(%)
Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i …	21	1.5	6287	320.	19.6	17.1	1.1
BAS 500 2.09 EC 0.15 lb a.i / TPTH 80 WP 5 oz……	14	1.5	6083	320	19.0	17.1	1.1
BAS 510F 0.25lb a.i……	14	1.5	6066	314	19.4	16.8	1.1
Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i / TPTH 80 WP 5 oz……	14	1.5	6060	296	20.4	16.0	1.2
BAS 500 2.09 EC 0.15 lb a.i / TPTH 80 WP 5 oz……	14	1.5	6013	321	18.7	17.1	1.0
Eminent 125 SL 13 fl oz / TPTH 80 WP 5 oz / BAS 500 2.09 EC 0.15 lb a.i……	14	1.7	6012	312	19.2	16.7	1.1
BAS 500 2.09 EC 0.15 lb.……	14	1.3	5977	315	19.0	16.8	1.1
Eminent 125 SL 13 fl oz / TPTH 80 WP 3.75 oz.……	14	1.3	5957	306	19.6	16.4	1.1
BAS 500 2.09 EC 0.15 lb a.i + Agridex COC 1% v/v……	14	1.3	5900	302	19.4	16.2	1.1
Eminent 125 SL 13 fl oz.……	21	1.5	5899	324	18.3	17.2	1.1
BAS 500 2.09 EC 0.15 lb a.i……	21	1.2	5857	324	18.2	17.3	1.1
Eminent 125 SL 9 fl oz / TPTH 80 WP 3.75 oz / Eminent 125 SL 13 fl oz……	14	1.3	5833	311	18.9	16.7	1.1
Eminent 125 SL 13 fl oz / TPTH 80 WP 5 oz.……	14	1.3	5744	314	18.4	16.8	1.1
BAS 510 F 0.15 lb a.i……	14	1.5	5736	321	17.9	17.1	1.1
Eminent 125 SL 13 fl oz / TPTH 80 WP 5 oz……..	21/14	1.5	5716	304	18.9	16.3	1.1
BAS 500 2.09 EC 0.15 lb a.i + AG 01005 1% v/v……	14	1.5	5679	313	18.2	16.8	1.1
Eminent 125 SL 13 fl oz / USF 2004 3 oz……	14	1.3	5665	310	18.4	16.6	1.1
BAS 500 2.09 EC 0.15 lb a.i / Eminent 125 SL 13 fl oz…	14	1.8	5651	312	18.1	16.7	1.1
Eminent 125 SL 13 fl oz / Topsin M 70 WSB 0.375 lb + TPTH 80 WP 3.75 oz / BAS 500 2.09 EC 0.15 lb a.i……	21/14/21	1.5	5632	307	18.4	16.5	1.1
Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i….	14	1.7	5598	326	17.3	17.3	1.1
RH-7592 2F + Agridex COC 1% v/v……	14	3.5	5545	302	18.3	16.3	1.1
Eminent 125 SL 13 fl oz / Topsin M 70 WSB 0.5 lb + Penncozeb 75DF 2 lb/ TPTH 80 WP 3.75 oz……	14	1.2	5519	317	17.4	16.9	1.1
Eminent 125 SL 13 fl oz / BAS 500 2.09 EC 0.15 lb a.i…	14	1.3	5177	310	16.7	16.6	1.1
BAS 500 2.09 EC 0.15 lb a.i / RH-7592 2F + Agridex COC 1% v/v……	14	1.5	5057	305	16.5	16.4	1.1
Stratego 2.1 EC 10 fl oz……	14	3.3	4886	287	17.0	15.6	1.1
USF 2004 2.5 oz……..…….	14	3	4612	294	15.7	15.9	1.1
Untreated Check……..		4.3	4413	281	15.6	15.3	1.1
Quadris 2.08 SC 0.15 lb a.i / TPTH 80 WP 5 oz……	14	3.3	4306	283	15.2	15.4	1.1
LSD (P=0.05)		0.63	943	21.23	3.0	0.98	NS

[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