EFFICACY OF FUNGICIDES FOR CONTROLLING CERCOSPORA LEAF SPOT ON SUGARBEET

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Cercospora leaf spot, caused by the fungus *Cercospora beticola* Sacc., is present in all sugarbeet (*Beta vulgaris* L.) production areas in the United States (Ruppel, 1986; Kerr and Weiss, 1990), and is the most economically damaging foliar disease of sugarbeet in Minnesota and North Dakota. The disease reduces root and extractable sucrose yields, and increases impurity concentrations resulting in higher processing losses (Smith and Ruppel, 1973; Lamey et al., 1987; Shane and Teng, 1992; Lamey et al., 1996; Khan and Smith, 2005). Roots of diseased plants do not store well in storage piles that are processed in a 7 to 9 month period in North Dakota and Minnesota (Smith and Ruppel, 1973). Cercospora leaf spot is managed by planting disease tolerant varieties, reducing inoculum by crop rotation and tillage, and fungicide applications (Miller et al., 1994; Khan et al; 2007). Combining high levels of Cercospora leaf spot resistance with high yield in sugarbeet is difficult (Smith and Campbell, 1996). As a result, commercial varieties generally have only moderate levels of resistance and require fungicide applications to obtain acceptable levels of protection against Cercospora leaf spot (Miller et al., 1994).

The objective of this research was to evaluate the efficacy of fungicides to control Cercospora leaf spot on sugarbeet.

MATERIALS AND METHODS

A field trial was conducted at Foxhome, MN in 2008. The experimental design was a randomized complete block with four replicates. Field plots comprised of six 30-feet long rows spaced 22 inches apart. Plots were planted on 8 May with Beta 4554 which is resistant to Rhizomania and has a Cercospora leaf spot KWS rating of 5.0. Terbufos (Counter 15G) was applied modified in-furrow at 12 lbs/A during planting to control sugarbeet root maggot (*Tetanops myopaeformis* von Röder; Diptera: Ulidiidae). Plots were thinned manually at the 6-leaf stage to 41,580 plants per acre. Weeds were controlled with recommended herbicides (Khan, 2008), and hand weeding. Plots were inoculated with *C. beticola* inoculum provided by Margaret Rekoske (Betaseed, Shakopee, MN) on 9 and 25 July.

Fungicide spray treatments were applied with a CO_2 pressurized 4-nozzle boom sprayer calibrated to deliver 17 gpa of solution at 60 p.s.i pressure to the middle four rows of plots. Treatments with four applications at 14 d intervals were applied on 30 July, 15, 29 August, and 8 September. Treatments with three applications at 14 d intervals were applied on 30 July, 15 and 29 August. Treatments were applied at rates as indicated in Table 1.

Cercospora leaf spot severity was rated on the leaf spot assessment scale of 1 to 10. A rating of 1 indicated the presence of 1- 5 spots/leaf or 0.1% severity and a rating of 10 indicated 50% disease severity. Cercospora leaf spot severity was assessed throughout the season. However, the rating done on 22 September is reported.

Plots were defoliated mechanically and harvested using a mechanical harvester on 30 September. The middle two rows of each plot were harvested and weighed for root yield. Twelve to 15 representative roots from each plot, not including roots on the ends of the plot, were analyzed for quality at the American Crystal Sugar Company Quality Tare Laboratory, Moorhead, MN. The data analysis was performed with the ANOVA procedure of the Agriculture Research Manager, version 7.5 software package (Gylling Data Management Inc., Brookings, South Dakota, 1999). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant.

RESULTS AND DISCUSSIONS

Cercospora leaf spot symptoms were not observed 14 days after inoculation resulting in a re-inoculation. Symptoms were first observed a few days after the second inoculation in late July. Fungicide treatments commenced as soon as first symptoms were observed. Cercospora leaf spot progressed very slowly in the non-treated check and in plots where treatments were not effective. Disease severity did not reach economic levels until late August. At harvest, the non-treated check had severe disease and a Cercospora leaf spot rating of 7.0 which was significantly greater

than the fungicide treatments (Table 1). All fungicide treatments resulted in significantly greater root yield and recoverable sucrose compared to the non-treated check.

The alternation of different classes of fungicides provided effective disease control, and will also serve to prevent or delay the development of fungicide resistant isolates. In 2007, treatments where the first application was SuperTin used in a mixture with Topsin or Eminent, consistently provided better disease control and higher recoverable sucrose compared to treatments where only SuperTin or Eminent were used in the first application (Khan and Nelson, 2008). In 2008, SuperTin and Eminent did not consistently provided adequate control when used in the second application. Disease incidence and severity were higher at the end of August for most of the treatments where SuperTin was used in the second application in 2008. Fortunately, disease severity was not as high as in previous years and subsequent fungicide application(s) resulted in favorable disease control. Generally, treatments with three applications of effective fungicides provided excellent control of Cercospora leaf spot where the site was inoculated twice and conditions were favorable (high DIVs) for disease development on 20 July, and 10, 12 and 13 August. Based on our results, one would expect fungicide applications to be lower on growers' fields where inoculum pressure has been low for the past six to eight years because of fungicide use, crop rotation and usage of varieties with improved Cercospora leaf spot resistance. In addition, in 2008, conditions were favorable for disease development on a few days – 12 August at Fargo; 25 July, 4 and 12 August at Hillsboro; 25 July and 12 August at Grand Forks; and 25 July, 3 and 4 August at St. Thomas. However, two percent of fields had four fungicide applications and 38% of fields had three fungicide applications (see paper by Carlson, A. L; Luecke, J. L; Khan, M. F. R. – Survey of fungicide use in sugarbeet in Minnesota and eastern North Dakota – 2008 in other section of this Report). It is possible that fungicide applications could be further reduced by scouting for the presence of the disease and using information on the favorability for Cercospora leaf spot development based on weather conditions and is available on http://ndawn.ndsu.edu/ to better time fungicide applications.

This research suggests that fungicides with different modes of action should be used in alternation to provide effective disease control and maintain high yield of recoverable sucrose.

General comments for Cercospora leaf spot control in growers' fields in North Dakota and Minnesota where inoculum levels are very low and CLS tolerant (KWS ratings of 5.2 and less) varieties are grown:

1. The first fungicide application should be made when disease symptoms are first observed (which entails scouting after row closure). If the first application is late, control will be difficult all season.
2. Subsequent applications should be made when symptoms are present and environmental conditions (2 day DIV obtained at http://ndawn.ndsu.nodak.edu) are favorable for disease development.
3. Use fungicides that are effective at controlling Cercospora leaf spot in an alternation program.
4. Use the recommended rates of fungicides to control Cercospora leaf spot.
5. Only one application of a benzimidazole fungicide (such as Topsin M 4.5F) in combination with a protectant fungicide (such as SuperTin) should be used in the Hillsboro, East Grand Forks, Crookston, and Drayton factory districts.
6. Never use the same fungicide or fungicides from the same class of chemistry or same mode of action 'back-to-back'.
7. Limiting the use of triazoles and strobilurins to one application per season will prolong the effectiveness of these fungicides.
8. Use high volumes of water – 20 gpa for ground-rigs and 5 to 7 gpa for aerial application – with fungicides for effective disease control.
9. Alternate, alternate, alternate! Always alternate different chemistry fungicides.

The following fungicides in several classes of chemistry are registered for use in sugarbeet

Strobilurins	**Sterol Inhibitors**	**Ethylenebisdithiocarbamate (EBDC)**
Headline	Eminent	Penncozeb
Gem	Enable	Manzate
Quadris	Tilt	Maneb
	Inspire	
	Proline	

Benzimidazole	**TriphenylTin Hydroxide (TPTH)**
Topsin	SuperTin
	AgriTin

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Table 1. Effect of fungicides on Cercospora leaf spot control, and sugarbeet yield and quality at Foxhome, MN in 2008

Treatment and rate/A	App. Interval (days)	CLS*	Root yield (t/A)	Sucrose concen-tration (%)	Recoverable sucrose (lb/t)	Recoverable sucrose (lb/A)	Return ($/A)**
Super Tin 80 WP 5 oz / Eminent 125 SL 13 fl oz / Headline 2.09 EC 9 fl oz / Super Tin 80 WP 5 oz	14	3.8	30.5	15.9	293	8946	1163
Super Tin 80 WP 5 oz / Eminent 125 SL 13 fl oz / Headline 2.09 EC 9 fl oz	14	2.8	29.5	16.3	299	8796	1143
Topsin M 4.5F 7.6 oz + Super Tin 80 WP 3.75 oz / Proline 5 fl oz + Premier 90 NIS 0.125%v/v Headline 2.09 EC 9 fl oz /	14	1.5	28.8	16.4	303	8727	1135
Headline 2.09 EC 9 fl oz / Super Tin 80 WP 5 oz / Proline 5 fl oz + Premier 90 NIS 0.125%v/v	14	4.0	28.4	16.5	303	8598	1118
Super Tin 80 WP 5 oz / Inspire SB 7 fl oz / Headline 2.09 EC 9 fl oz / Super Tin 80 WP 5 oz	14	2.5	28.1	16.4	301	8461	1100
Super Tin 80 WP 5 oz / Proline 5 fl oz + Premier 90 NIS 0.125%v/v Headline 2.09 EC 9 fl oz	14	1.8	29.2	15.9	290	8450	1098
Super Tin 80 WP 5 oz / Inspire SB 7 fl oz / Headline 2.09 EC 9 fl oz	14	3.5	27.6	16.6	306	8442	1097
Topsin M 4.5F 10 fl oz Headline 2.09 EC 9 fl oz / Super Tin 80 WP 5 oz	14	3.3	26.8	16.7	310	8305	1080
Super Tin 80 WP 5 oz / Proline 5 fl oz + Premier 90 NIS 0.125%v/v Headline 2.09 EC 9 fl oz / Super Tin 80 WP 5 oz	14	2.0	28.0	16.0	293	8216	1068
Headline 2.09 EC 9 fl oz / Super Tin 80 WP 5 oz / Inspire SB 7 fl oz	14	3.0	27.5	16.0	294	8091	1052
Inspire SB 7 fl oz / Super Tin 80 WP 5 oz / Headline 2.09 EC 9 fl oz / Super Tin 80 WP 5 oz	14	3.8	27.7	16.0	292	8090	1052
Proline 5 fl oz + Premier 90 NIS 0.125%v/v / Topsin M 4.5F 7.6 oz + Super Tin 80 WP 3.75 oz / Headline 2.09 EC 9 fl oz	14	2.8	28.0	15.5	282	7899	1027
Inspire SB 7 fl oz / Super Tin 80 WP 5 oz / Headline 2.09 EC 9 fl oz	14	4.0	26.6	16.1	297	7897	1027
Proline 5 fl oz + Premier 90 NIS 0.125%v/v / Super Tin 80 WP 5 oz / Headline 2.09 EC 9 fl oz / Super Tin 80 WP 5 oz	14	4.8	26.5	15.9	293	7781	1012
Proline 5 fl oz + Premier 90 NIS 0.125%v/v / Topsin M 4.5F 7.6 oz + Super Tin 80 WP 3.75 oz / Gem 3.6 fl oz	14	2.0	27.3	15.4	283	7745	1007
Headline 2.09 EC 9 fl oz / Super Tin 80 WP 5 oz / Eminent 125 SL 13 fl oz	14	3.3	27.3	15.6	285	7772	1010
Untreated Check	-	7.0	21.8	15.2	276	5994	779
LSD (P= 0.05)		1.0	3.2***	0.7	3.8	1252	163

*Cercospora leaf spot measured on 1-10 scale (1 = 1- 5 spots/leaf or 0.1% severity and 10= 50% severity) on 22 September.
**Gross Return based on Minn-Dak payment system.
***Root yield analyzed at LSD (P=0.1)