EFFICACY OF FUNGICIDES FOR CONTROLLING CERCOSPORA LEAF SPOT ON SUGARBEET

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Cercospora leaf spot (CLS), caused by the fungus *Cercospora beticola* Sacc., is the most economically damaging foliar disease of sugarbeet in Minnesota and North Dakota. The disease reduces root yield and sucrose concentration, and increases impurity concentrations resulting in reduced extractable sucrose and higher processing losses (Smith and Ruppel, 1973; 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 integrating the use of tolerant varieties, reducing inoculum by crop rotation and tillage, and fungicide applications (Miller et al., 1994; Khan et al; 2007). It is difficult to combine high levels of Cercospora leaf spot resistance with high recoverable sucrose in sugarbeet (Smith and Campbell, 1996). Consequently, 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) under moderate and high disease severity.

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

MATERIALS AND METHODS

A field trial was conducted at Foxhome, MN in 2011. 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 10 May with BTS 86RR66 resistant to Rhizomania and with a Cercospora leaf spot KWS rating of 5.04. Seeds were treated with Tachigaren (45 g/kg seed) and Poncho beta, and Counter 15G was applied in-furrow (6 lb/A) at planting. Seed spacing within the row was 4.7 inches. Weeds were controlled with two applications (14 and 28 June) of glyphosate. Quadris was applied 14 June to help control Rhizoctonia. Plots were inoculated on 8 July with *C. beticola* inoculum not previously exposed to fungicides (Betaseed, Shakopee, MN).

Fungicide spray treatments were applied with a CO_2 pressurized 4-nozzle boom sprayer with 11002 TT TwinJet nozzles calibrated to deliver 17 gpa of solution at 60 p.s.i pressure to the middle four rows of plots. One treatment received a fungicide application on 1 July for Rhizoctonia root rot control and as a protectant for *C. beticola*; all other fungicide treatments were initiated on July 28. All treatments received three fungicide applications on 28 July, 9 and 22 August. One treatment received an additional fungicide application on July 1, prior to CLS inoculation (see Table 1). Treatments were applied at rates indicated in Table 1.

Cercospora leaf spot severity was rated on the leaf spot assessment scale of 1 to 10 (Jones and Windels, 1991). A rating of 1 indicated the presence of 1- 5 spots/leaf or 0.1% disease severity and a rating of 10 indicated 50% or higher disease severity. Cercospora leaf spot severity was assessed three times during the season. The rating performed on 1 September is reported.

Plots were defoliated mechanically and harvested using a mechanical harvester on 22 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 8 software package (Gylling Data Management Inc., Brookings, South Dakota, 2010). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant.

RESULTS AND DISCUSSIONS

Environmental conditions were favorable for development of *C. beticola* and first symptoms were visible during the week of 18 July. Fungicide treatments were delayed by 10 days after first symptoms were observed because of wet field conditions. Cercospora leaf spot progressed very rapidly in the non-treated check and reached economic injury level by early-August. By mid-August, the non-treated check had severe disease and a Cercospora leaf spot rating of 10 which was significantly greater than the fungicide treatments (Table 1). The 10-day delay of the first fungicide application made it difficult to effectively control the disease later in the season, particularly when only one fungicide chemistry was used in an application. Over the past decade, three single-chemistry applications were as effective as four single-chemistry applications. However, in 2011, three single-chemistry applications could not provide season long control even though fungicide chemistries were rotated from one application timing to the next. Tank mixing two fungicides with different modes of action (triphenyltin hydroxide + thiophanate methyl) for the first application provided good early season control. The use of thiophanate methyl alone was significantly better than triphenyltin hydroxide alone in a separate experiment at the same site. Treatments with tank-mixtures in the first application followed by tank-mixtures in the second application typically had better disease control and higher recoverable sucrose compared to the use of single-chemistry applications in rotation. Dry conditions from early August through harvest resulted in low root yields. As such, most treatments that did not effectively control *C. beticola* gave low sucrose concentrations which adversely affected recoverable sucrose.

This research suggests that fungicides should be applied promptly at first symptoms of CLS; and the use of tank-mixtures of two fungicide chemistries in a rotation program provides effective disease control in high inoculum conditions.

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 (DIV ≥7) 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. The mixture of SuperTin (6 fl oz) and Topsin (7.6 fl oz) provided the best early season leaf spot control.
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 for *C. beticola* control 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 chemistries of fungicides.

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

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

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

Table 1. Effect of fungicides on Cercospora leaf spot control and sugarbeet yield and quality at Foxhome, MN in 2011.

Treatment and rate/A	App. Interval	CLS*	Root yield	Sucrose concentration	Recoverable sucrose		Gross Income**
	days	1-10	Ton/A	%	lb/Ton	lb/A	$/A
***Proline 5.7 fl oz + Premier 90 NIS 0.125%v/v / Super Tin 4SC 6 fl oz +Topsin M 4.5F 7.6 oz / Headline 2.09 EC 9 fl oz / Super Tin 4SC 8fl oz	14	6.9	21.9	15.1	276	6059	851
Super Tin 4SC 6 fl oz +Topsin M 4.5F 7.6 oz / Topsin 7.6 oz + Inspire XT 2.08 EC 5.25 fl oz/ Headline 2.09 EC 9 fl oz	14	7.3	21.5	15.1	274	5890	819
Super Tin 4SC 6 fl oz +Topsin M 4.5F 7.6 oz / Inspire XT 2.08 EC 7 fl oz/ Headline 2.09 EC 9 fl oz	14	7.3	20.2	15.1	271	5494	752
Super Tin 4SC 6 fl oz +Topsin M 4.5F 7.6 oz / Topsin 7.6 oz +P-line 3.75 fl oz +NIS 0.125%v/v/ Headline 2.09 EC 9 fl oz	14	7.0	19.7	15.3	278	5453	767
Super Tin 4SC 6 fl oz +Topsin M 4.5F 7.6 oz / S-Tin 6 fl oz+P-line 3.75 fl oz +NIS 0.125%v/v/ Headline 2.09 EC 9 fl oz	14	7.3	19.9	15.0	270	5370	730
Super Tin 4SC 6 fl oz +Topsin M 4.5F 7.6 oz / Eminent 125 SL 13 fl oz / Headline 2.09 EC 9 fl oz	14	7.4	19.5	14.8	267	5230	700
Headline 2.09 EC 9 fl oz / Super Tin 4SC 8 fl oz / Inspire XT 2.08 EC 7 fl oz	14	8.5	18.2	15.5	283	5171	751
Agritin 6 fl oz + Topsin M 4.5F 7.6 oz / Inspire XT 2.08 EC 7 fl oz/ Headline 2.09 EC 9 fl oz	14	7.3	18.3	15.1	275	5042	706
Eminent 125 SL 13 fl oz + Topsin M 4.5F 7.6 oz / Super Tin 4SC 8fl oz / Headline 2.09 EC 9 fl oz	14	8.5	18.2	14.7	267	4886	658
Super Tin 4SC 6 fl oz +Topsin M 4.5F 7.6 oz / SuperTin 6 fl oz + Inspire XT 2.08 EC 5.25 fl oz/ Headline 2.09 EC 9 fl oz	14	7.5	18.2	14.8	268	4862	652
Agritin 6 fl oz + Topsin M 4.5F 7.6 oz / Proline 5 fl oz + Premier 90 NIS 0.125%v/v/ Headline 2.09 EC 9 fl oz	14	7.3	17.2	15.3	279	4829	692
Super Tin 4SC 8fl oz / Proline 5 fl oz + Premier 90 NIS 0.125%v/v / Headline 2.09 EC 9 fl oz	14	8.8	18.1	14.7	266	4816	638
Inspire XT 2.08 EC 7 fl oz/ Super Tin 4SC 8 fl oz / Headline 2.09 EC 9 fl oz	14	8.0	17.4	15.0	270	4704	638
Headline 2.09 EC 9 fl oz / Super Tin 4SC 8 fl oz / Proline 5 fl oz + Premier 90 NIS 0.125%v/v	14	8.9	17.3	14.9	268	4607	615
Super Tin 4SC 8fl oz / Inspire XT 2.08 EC 7 fl oz/ Headline 2.09 EC 9 fl oz	14	9.2	16.6	14.7	269	4482	609
Proline 5 fl oz + Premier 90 NIS 0.125%v/v/ SuperTin 4SC 8fl oz / Headline 2.09 EC 9 fl oz	14	8.9	15.5	15.0	275	4257	595
Eminent 125 SL 13 fl oz + Topsin M 4.5F 7.6 oz / Headline 2.09 EC 9 fl oz/ Super Tin 4SC 8fl oz	14	7.5	16.8	14.0	252	4205	504
Eminent 125 SL 13 fl oz / Super Tin 4SC 8 fl oz / Headline 2.09 EC 9 fl oz	14	9.0	15.1	14.2	257	3912	497
Nontreated Check	-	10	15.3	13.4	238	3636	393
LSD (P=0.05)	**-**	**1.2**	**NS**	**1.0**	**21**	**1387**	**235**

*Cercospora leaf spot measured on 1-10 scale (1 = 1- 5 spots/leaf or 0.1% severity and 10 = 50% severity) on 1 September.
**Gross Return based on American Crystal payment system.
***Proline at 5.7 fl oz + NIS at 0.125%v/v was applied July 1, prior to CLS inoculation

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