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; 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 (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 2015. 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 29 May with BTS 89RR10. Seeds were treated with Tachigaren (45 g/kg seed), Kabina 14g and Poncho Beta. Seed spacing within the row was 4.7 inches. Weeds were controlled with one glyphosate application on 12 June. Quadris was applied 12 June to help control Rhizoctonia. Plots were inoculated on 2 July with *C. beticola* inoculum.

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 8 July as a protectant for *C. beticola*; all other fungicide treatments were initiated on 20 July. Most treatments included three fungicide applications on 20 July, 3 and 17 August and a few treatments had a fourth fungicide application on August 28. 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 five times during the season. The rating performed on 16 September is reported.

Plots were defoliated mechanically and harvested using a mechanical harvester on 28 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 on 17 July. Cercospora leaf spot progressed slowly in July and August and progressed rapidly in September. In late September, the non-treated check had severe disease and a Cercospora leaf spot rating of 10 which was significantly greater than any of the fungicide treatments (Table 1). 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 fungicides or mixture of fungicides with different modes of action used in a rotation program starting at first symptoms resulted in effective control of *C. beticola* and significantly higher tonnage and recoverable sucrose compared to the non-treated check.

This research suggests that fungicides should be applied promptly at first symptoms of CLS; and the use of fungicides with different modes of action in mixtures or individually in a rotation program will provide 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 will probably be high in 2016 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 consecutive days 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). The mixture of SuperTin (6 fl oz) and Topsin (7.6 fl oz) provided effective early season leaf spot control. The use of TPTH or Topsin mixed with a QoI or DMI fungicide will increase the effectiveness of the QoIs and DMIs.
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 especially Qoi's (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	
Priaxor	Minerva Duo	
	Minerva	
	Topguard	

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 2015.

Treatment and rate/A	CLS*	Root yield	Sucrose concentration	Recoverable sucrose		Gross Income**
	1-10	Ton/A	%	lb/Ton	lb/A	$/A
Super Tin 6 fl oz + Inspire XT 5.25 fl oz/ Super Tin 6 fl oz + Topsin 7.6 fl oz/ Headline 9 fl oz	3.5	32.60	18.05	342.7	11,184	1,496.70
Proline 5 fl oz + NIS 0.125 %v/v/ Super Tin 8 fl oz/ Headline 9 fl oz/ Super Tin 8 fl oz	3.3	33.70	17.88	337.3	11,364	1,479.66
Super Tin 6 fl oz + Topsin 7.6 fl oz***/ Inspire XT 7 fl oz/ Headline 9 fl oz/ Super Tin 8 fl oz	3.3	33.35	17.75	334.2	11,145	1,440.03
Priaxor 6.7 fl oz/ Super Tin 8 fl oz/ Inspire XT 7 fl oz	4.5	32.53	17.80	336.9	10,935	1,428.78
Super Tin 6 fl oz + Proline 3.75 fl oz/ Super Tin 6 fl oz + Topsin 7.6 fl oz/ Headline 9 fl oz	3.0	31.75	18.10	340.5	10,786	1,427.67
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Proline 5 fl oz / Headline 9 fl oz	3.5	31.28	17.95	338.3	10,568	1,381.69
Proline 5 fl oz + NIS 0.125 %v/v/ Super Tin 8 fl oz/ Headline 9 fl oz	3.8	31.70	17.65	334.2	10,604	1,374.17
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz/ Priaxor 6.7 fl oz	4.5	30.65	17.90	339.7	10,410	1,371.47
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Proline 5 fl oz + NIS 0.125 %v/v/ Headline 9 fl oz	4.0	30.45	18.03	339.4	10,325	1,355.66
Inspire XT 7 fl oz/ Super Tin 8 fl oz/ Priaxor 6.7 fl oz	3.8	30.45	17.90	337.7	10,297	1,348.87
Headline 9 fl oz/ Super Tin 8 fl oz/ Proline 5 fl oz + NIS 0.125 %v/v	4.5	30.23	17.75	335.4	10,134	1,314.35
Inspire XT 7 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz/ Super Tin 8 fl oz	3.5	31.13	17.54	330.8	10,500	1,309.13
Headline 9 fl oz/ Super Tin 8 fl oz/ Inspire XT 7 fl oz	4.3	30.50	17.63	332.0	10,093	1,294.98
Inspire XT 7 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz	4.0	31.45	17.40	325.9	10,241	1,291.79
Eminent 13 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz	4.3	31.13	17.40	327.4	10,182	1,290.92
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	4.0	29.73	17.73	333.2	9,937	1,286.85
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Headline 9 fl oz	5.5	29.65	17.58	331.2	9,813	1,279.32
Super Tin 8 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	4.3	30.93	17.45	327.2	10,078	1,271.17
Headline 9 fl oz/ Super Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz	4.3	29.08	17.65	333.1	9,680	1,247.55
Super Tin 6 fl oz + Inspire XT 5.25 fl oz/ Proline 5 fl oz / Headline 9 fl oz	4.0	31.00	17.88	336.0	10,409	1,246.76
Super Tin 8 fl oz/ Proline 5 fl oz + NIS 0.125 %v/v/ Headline 9 fl oz	5.0	31.88	17.55	317.2	10,092	1,223.41
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	4.0	31.45	16.75	314.7	9,900	1,196.55
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Eminent 13 fl oz/ Headline 9 fl oz	4.5	30.13	17.00	320.4	9,655	1,190.53
Nontreated Check	10.0	24.50	15.90	290.6	7,115	811.71
LSD (P=0.05)	**0.97**	**2.99**	**NS**	**22.127**	**1,092**	**204.78**

*Cercospora leaf spot measured on 1-10 scale (1 = 1- 5 spots/leaf or 0.1% severity and 10 = 50% severity) on 23 September.
**Gross Return based on American Crystal payment system.
***Treatment applied on 8 July

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