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 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 under moderate and high disease severity.

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

MATERIALS AND METHODS

A field trial was conducted at Foxhome, MN in 2012. 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 Beta 89RR10. Seeds were treated with Tachigaren (45 g/kg seed) and Poncho beta. Seed spacing within the row was 4.7 inches. Weeds were controlled with two applications (24 May and 21 June) of glyphosate. Plots were inoculated on 3 July with grounded *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. Quadris was applied to all plots on 22 May; all other fungicide treatments were initiated on 17 July. Most treatments were three fungicide applications on 17 July, 2 and 17 August. 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 during the season. The rating done on 29 August is reported.

Plots were defoliated mechanically and harvested using a mechanical harvester on 27 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, East Grand Forks, 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 13 July. Fungicide treatments were initiated four days later. 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 most effective treatments were those where the fungicide mixtures of triphenyltin hydroxide and thiophanate methyl were used in the first application and followed by another mixture with two modes of action or

followed by Inspire XT or Proline, and Headline as the third application. The plots at this site received only 59% of the average rainfall for a typical year, with less than 1/3 inch of rainfall in the final six weeks before harvest. However, yield averaged over 25 tons per acre with a record high sucrose concentration.

This research indicates that fungicides should be applied to control *C. beticola* starting at first symptoms; and the use of mixtures, starting with TPTH and thiophanate mixture, in a rotation program with other effective mixtures or effective fungicide when used alone, 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 in the Hillsboro, East Grand Forks, Crookston, and Drayton factory districts. 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	
	Topguard	
Benzimidazole	**TriphenylTin Hydroxide (TPTH)**	
Topsin	SuperTin	
	AgriTin	

References

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Table 1. Effect of fungicides on Cercospora leaf spot control, and sugarbeet yield and quality at Foxhome, MN in 2012

Treatment and rate/A	App. Interval (days)	CLS*	Root yield (t/A)	Sucrose concen-tration(%)	Recoverable sucrose (lb/t)	Recoverable sucrose (lb/A)	Net Rev ($/A)**
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Agri Tin 6 fl oz + Proline 3.75 fl oz + NIS 0.125% v/v/ Headline 9 fl oz	14	5.0	27.4	19.2	352	9,642	1,849
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	14	5.0	27.0	19.4	354	9,534	1,834
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Topsin 7.6 fl oz + Proline 3.75 fl oz + NIS 0.125% v/v/ Headline 9 fl oz	14	5.0	26.2	19.9	363	9,494	1,821
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	14	5.0	25.8	20.1	366	9,443	1,815
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Agri Tin 6 fl oz + Eminent 9.75 fl oz/ Headline 9 fl oz	14	5.0	27.1	18.9	345	9,337	1,793
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Topsin 7.6 fl oz + Inspire XT 5.25 floz Headline 9 fl oz	14	5.0	26.0	19.4	356	9,252	1,777
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Proline 5 fl oz + NIS 0.125% v/v/ Headline 9 fl oz	14	5.0	25.7	19.6	358	9,172	1,755
Agri Tin 6 fl oz + T-Methyl 7.6 fl oz/ Agri Tin 6 fl oz + Headline 9 fl oz/ Eminent 13 fl oz	14	5.0	25.9	19.3	352	9,119	1,706
Inspire XT 7 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz	14	6.0	26.4	18.9	345	9,110	1,751
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Proline 5 fl oz + NIS 0.125% v/v/ Headline 9 fl oz	14	5.0	24.4	20.3	373	9,105	1,742
Proline 5.7 fl oz + NIS 0.125% v/v/ Super Tin 6 fl oz + Topsin 7.6 fl oz/ Headline 9 fl oz/ Super Tin 8 fl oz	14	5.0	25.4	19.6	357	9,053	1,715
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Eminent 13 fl oz/ Headline 9 fl oz	14	5.0	26.1	19.1	347	9,052	1,738
Headline 9 fl oz/ Super Tin 8 fl oz/ Proline 5 fl oz + NIS 0.125% v/v	14	6.0	25.4	19.3	351	8,893	1,702
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Agri Tin 6 fl oz + Inspire XT 5.25 fl oz/ Headline 9 fl oz	14	6.0	25.2	19.1	347	8,780	1,681
Headline 9 fl oz/ Super Tin 8 fl oz/ Inspire XT 7 fl oz	14	6.0	24.1	20.0	364	8,766	1,682
Inspire XT 7 fl oz/ Super Tin 8 fl oz	14	7.0	24.7	19.4	350	8,622	1,687
Super Tin 8 fl oz/ Proline 5 fl oz + NIS 0.125 v/v/ Headline 9 fl oz	14	6.0	24.9	19.1	347	8,616	1,646
Proline 5 fl oz + NIS 0.125% v/v/ Super Tin 8 fl oz/ Headline 9 fl oz	14	7.0	24.6	19.1	348	8,542	1,638
Proline 5 fl oz + NIS 0.125% v/v/ Super Tin 8 fl oz/	14	7.0	23.6	19.9	360	8,493	1,656
Super Tin 8 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	14	6.0	24.1	19.2	345	8,340	1,597
Eminent 9.75 fl oz + Topsin 7.6 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz	14	7.0	24.5	18.9	339	8,314	1,593
Eminent 13 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz	14	8.0	23.7	18.6	334	7,902	1,516
Nontreated Check	-	10.0	19.2	16.5	291	5,593	1,119
LSD (P=0.05)	-	0.7	1.83	1.14	24.3	919.2	183

*Cercospora leaf spot measured on 1-10 scale (1 = 1- 5 spots/leaf or 0.1% severity and 10 = 50% severity) on August 29.

**Net Revenue calculated by multiplying Recoverable Sucrose (lb/A) by $0.20 and subtracting estimated pesticide costs and application costs.