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 2013. 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 14 May with Beta 89RR10. Seeds were treated with Tachigaren (45 g/kg seed) and Nipsit. Seed spacing within the row was 4.7 inches. Weeds were controlled with three applications (7 June, 1 July and 9 August) of glyphosate. Plots were inoculated on 12 July with grounded *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. Quadris was applied to all plots on 7 June; other fungicide treatments were initiated on 18 July. Most treatments were three fungicide applications on 24 July, 8 and 21 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 9 October. 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 unfavorable for development of *C. beticola* in 2013 and first symptoms were not visible until the 4th week of July. Fungicide treatments were initiated on 24 July. Cercospora leaf spot progressed very slowly in the non-treated check because of cold conditions in July, and limited rainfall in August and the disease reached economic injury level until the rains came in early September. Thereafter, disease progressed rapidly in the non-treated check and a Cercospora leaf spot rating of 8 which was significantly greater than the fungicide treatments (Table 1). All fungicide treatments resulted in significantly greater tonnage and recoverable sucrose than the non-treated check. The alternation of individual fungicides from different classes, or with fungicide

mixtures from different classes provided effective disease control. For this trial, the average tonnage (25.2) was similar to that of Minn-Dak Farmers Cooperative (25.38 tons/A) where the trial was conducted; however sucrose concentration was 1.4% higher in the trial where fungicides were used.

This research indicates that fungicides should be applied to control *C. beticola* starting at first symptoms; and the use of mixtures 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) or with a triazoles or strobilurin 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 for *C. beticola* control and alternating with other chemistries 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 2013

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)**
Inspire XT 7 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz	14	5.0	26.7	18.2	343	9,139	1,079
Priaxor 6.7 fl oz/ Super Tin 8 fl oz/ Inspire XT 7 fl oz	14	4.0	26.1	18.1	339	8,861	1,030
Agri Tin 6 fl oz + T-Methyl 7.6 fl oz/ Agri Tin 6 fl oz + Inspire XT 5.6 fl oz/ Headline 9 fl oz/ Agri Tin 8 fl oz	14	4.0	26.9	17.8	334	8,987	1,011
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	14	4.0	25.6	18.1	340	8,688	1,011
Headline 9 fl oz/ Super Tin 8 fl oz + Topsin 7.6 fl oz/ Proline 5 fl oz + NIS 0.125% v/v	14	4.0	26.8	17.7	332	8,888	997
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Headline 9 fl oz	14	4.0	24.2	18.2	341	8,282	987
Eminent 13 fl oz + Topsin 7.6 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz	14	3.0	25.8	18.2	342	8,830	981
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Eminent 13 fl oz/ Headline 9 fl oz	14	4.0	26.5	17.9	336	8,929	969
Inspire XT 7 fl oz/ Super Tin 8 fl oz/ Priaxor 6.7 fl oz	14	3.0	25.2	17.9	336	8,470	968
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Proline 5 fl oz + NIS 0.125% v/v/ Headline 9 fl oz	14	4.0	24.7	18.1	340	8,382	967
Super Tin 8 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	14	3.0	23.9	18.3	343	8,199	962
#Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	14	3.0	24.7	18.0	337	8,330	956
Proline 5 fl oz + NIS 0.125% v/v/ Super Tin 8 fl oz/ Headline 9 fl oz	14	3.0	25.5	17.8	331	8,405	938
Headline 9 fl oz/ Super Tin 8 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz	14	4.0	25.4	17.8	333	8,457	937
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz	14	3.0	25.0	17.4	325	8,127	922
Inspire XT 7 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz/ Super Tin 8 fl oz	14	4.0	25.2	17.7	330	8,300	918
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Proline 5 fl oz + NIS 0.125% v/v/ Headline 9 fl oz	14	4.0	26.0	17.5	330	8,566	910
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz/ Headline 9 fl oz	14	4.0	24.6	17.7	331	8,135	910
Headline 9 fl oz/ Super Tin 8 fl oz/ Proline 5 fl oz + NIS 0.125% v/v	14	4.0	24.3	17.7	331	8,027	892
Eminent 13 fl oz/ Super Tin 8 fl oz/ Headline 9 fl oz	14	4.0	23.6	17.8	333	7,852	887
Proline 5 fl oz + NIS 0.125% v/v/ Super Tin 8 fl oz/ Headline 9 fl oz/ Super Tin 8 fl oz	14	4.0	24.5	17.6	328	8,051	874
Super Tin 8 fl oz/ Proline 5 fl oz + NIS 0.125% v/v/ Headline 9 fl oz	14	4.0	24.4	17.4	325	7,918	858
Headline 9 fl oz/ Super Tin 8 fl oz/ Inspire XT 7 fl oz	14	3.0	24.0	17.4	325	7,768	846
Nontreated Check	-	8.0	21.3	17.0	314	6,681	753
LSD (P=0.05)	-	1.4	1.9	0.7	14	746	129

*Cercospora leaf spot measured on 1-10 scale (1 = 1- 5 spots/leaf or 0.1% severity and 10 = 50% severity) on September 30.
**Net Revenue calculated based on American Crystal Sugar 2013 payment estimates.
Treatments applied starting on July 18 instead of July 24 and applied on alternate weeks from other treatments