EFFICACY OF FUNGICIDES FOR CONTROLLING CERCOSPORA LEAF SPOT ON SUGARBEET

Mohamed F. R. Khan[1] and Peter C. Hakk[2]

[1]Extension Sugarbeet Specialist, North Dakota State University & University of Minnesota
[2]Research Technician, Plant Pathology Department, North Dakota State University

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 2014. 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 12g and Poncho Beta; and Counter 20G was applied in-furrow (9 lb/A) at planting. Seed spacing within the row was 4.7 inches. Weeds were controlled with two applications of glyphosate on 3 July and 16 July. Quadris was applied 3 July to help control Rhizoctonia. Plots were inoculated on 17 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 14 July as a protectant for *C. beticola*; all other fungicide treatments were initiated on 5 August. Fungicide applications were also made on 20 and 28 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 five times during the season. The rating performed on 16 September is reported.

Plots were defoliated mechanically and harvested using a mechanical harvester on 23 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 not favorable for rapid development of *C. beticola* in July and August. Conditions for disease development improved in September with symptoms approaching the economic injury level appearing just before harvest in the non-treated check. In mid-September, the non-treated check had a Cercospora leaf spot rating of 6.8 which was significantly greater than the fungicide treatments (Table 1). However, although the non-treated check had significantly greater leaf spot rating than fungicide treatments, there were no significant differences in tonnage, quality, or recoverable sucrose between any of the fungicide treatments and the non-treated check. All the fungicide treatments included the use of different modes of action in a rotation program and they all resulted in effective leaf spot control.

This research clearly demonstrated that for diseases development to occur there needs to be a susceptible host, infective pathogen and a favorable environment. The research also showed that the sugarbeet crop can tolerate a certain level of leaf spot without adversely impacting yield, quality and recoverable sucrose. Finally, the research indicated that fungicides used in a rotation program effectively controlled *C. beticola* but should only be used when justified by the economics.

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 2014.

Treatment and rate/A	CLS*	Root yield	Sucrose concentration	Recoverable sucrose		Gross Income**
	1-10	Ton/A	%	lb/Ton	lb/A	$/A
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire 7 fl oz	3.0	20.83	18.58	347.8	7,249	851.09
Super Tin 8 fl oz/ Inspire 7 fl oz/ Headline 9 fl oz	3.0	20.63	18.93	353.8	7,307	843.68
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Proline 5 fl oz + NIS 0.125% v/v	2.5	20.23	18.88	353.6	7,139	841.32
Eminent 13 fl oz	4.5	20.15	18.60	345.4	6,947	839.65
Proline 5 fl oz + NIS 0.125% v/v/ Headline 9 fl oz	3.5	20.70	18.6	348.1	7,209	818.43
Inspire 7 fl oz	3.3	19.45	18.35	342.5	6,664	779.29
Agri Tin 6 fl oz + Topsin 7.6 fl oz***/ Inspire 7 fl oz/ Headline 9 fl oz	2.5	19.73	18.70	349.7	6,883	776.93
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire 7 fl oz/ Headline 9 fl oz	2.5	19.73	18.65	347.6	6,850	767.93
Headline 9 fl oz	4.5	19.70	18.30	339.9	6,693	765.50
Proline 5 fl oz + NIS 0.125% v/v	3.8	19.83	18.15	337.7	6,714	763.30
Super Tin 8 fl oz/ Proline 5 fl oz + NIS 0.125% v/v/ Headline 9 fl oz	2.8	21.20	18.15	336.4	7,133	762.42
Priaxor 6.7 fl oz	4.3	19.33	18.25	341.4	6,600	757.79
Eminent 9.75 fl oz + Topsin 7.6 fl oz/ Super Tin 8 fl oz	3.5	19.6	18.20	338.3	6,654	757.75
Headline 9 fl oz/ Super Tin 8 fl oz	3.3	19.55	18.3	340.8	6,672	754.33
Inspire 7 fl oz/ Headline 9 fl oz	4.0	19.90	18.2	339.3	6,769	753.04
Super Tin 6 fl oz + Topsin 7.6 fl oz/ Eminent 13 fl oz/ Headline 9 fl oz	2.5	19.30	18.5	346.3	6,714	752.49
Inspire 7 fl oz/ Super Tin 8 fl oz	3.0	19.65	18.0	334.9	6,582	736.90
Headline 9 fl oz/ Super Tin 6 fl oz + Topsin 7.6 fl oz/ Proline 5 fl oz + NIS 0.125% v/v	2.8	20.5	18.2	335.7	6,902	734.87
Agri Tin 6 fl oz + Topsin 7.6 fl oz/ Headline 9 fl oz	4.0	19.48	18.1	336.2	6,567	730.31
Headline 9 fl oz/ Super Tin 6 fl oz + Topsin 7.6 fl oz	3.3	19.83	18.1	333.5	6,604	724.87
Nontreated Check	6.8	18.48	17.6	323.8	5,997	677.01
LSD (P=0.05)	**1.4**	**NS**	**NS**	**NS**	**NS**	**NS**

*Cercospora leaf spot measured on 1-10 scale (1 = 1- 5 spots/leaf or 0.1% severity and 10 = 50% severity) on 16 September.
**Gross Return based on American Crystal payment system.
***Treatment applied before inoculation on 14 July

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