PRELIMINARY REPORT ON THE EFFECT OF ADJUVANTS WITH FUNGICIDES FOR CONTROLLING CERCOSPORA LEAF SPOT

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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. Since 2016, the pathogen has developed resistance to QoI fungicides and reduced sensitivity to several other modes of action. Fungicide mixtures are typically applied during a period when there may be regular rainfall soon after fungicide applications. Growers will like to know if adjuvants will help to improve the efficacy of fungicides for controlling CLS.

The objective of this trial was to determine if adjuvants added to fungicide mixtures used in a rotation program improved control of Cercospora leaf spot.

MATERIALS AND METHODS

A field trial was conducted at Foxhome, MN in 2020. 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 4 May with a variety susceptible to Cercospora Leaf Spot. Seeds were treated with Tachigaren (45 g/kg seed), CruiserMaxx and Vibrance. Seed spacing within the row was 4.7 inches. Weeds were controlled with herbicide applications (Ethotron @ 6 pt) on 11 May, (Roundup Powermax @ 32 fl oz; Outlook @ 12 fl oz; Class Act 1%v/v; Interlock @ 4 fl oz per acre) on 29 May and (Roundup Powermax @ 32 fl oz; Outlook @ 12 fl oz; Class Act 1% v/v; Interlock @ 4 fl oz per acre; Stinger @ 2.5 fl oz) 16 June and (Roundup Powermax @ 32 fl oz; Outlook @ 12 fl oz; Class Act 1% v/v; Interlock 4 fl oz) on 29 June as well as hand weeding throughout the summer. Quadris (14.3 fl oz per acre) was applied on 5 June and 23 June to control *Rhizoctonia solani*. Plots were inoculated on 6 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. Fungicide treatments were initiated on 22 July. Treatments included five fungicide applications on 22 July (application A), 3 August (application B), 13 August (application C), 26 August (application D) and 4 September (application E). 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 31 August is reported.

Plots were defoliated mechanically and harvested using a mechanical harvester on 30 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 2019.4 software package (Gylling Data Management Inc., Brookings, South

Dakota). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant.

RESULTS AND DISCUSSIONS

The research site near Foxhome received measurable amounts of rainfall for 48 of the 95 days of the crop (over 14.5 inches). There were several instances of water-logging that adversely impacted plant growth with row closure occurring around mid-July. Inoculation was done on July 6 and characteristic CLS lesions were observed about two weeks later with the first fungicide application on July 20. Subsequent fungicide applications were reduced to 10 to 12 days interval instead of 14 days because frequent regular rainfall events were washing off the fungicides. Disease development then increased rapidly with economic damage occurring in the non-treated check in mid-August when fungicides with and without adjuvants were significantly reducing disease severity compared to the check. By mid-September, all treatments were ineffective at controlling CLS; none of the treatments with adjuvants appeared to improve the efficacy of fungicides at controlling the disease.

Wet conditions for most of the growing season combined with severe CLS resulted in low tonnage across all treatments with no significant increase in tonnage where fungicides were used compared to the non-treated check. However, since fungicides did significantly reduced disease severity compared to the check until mid-August, these treatments resulted in significantly higher sugar concentration than the check. The addition of Cerium Elite and Complex to Penncozeb did help in reducing disease severity but only at one rating period; unfortunately, there was no concurrent increase in tonnage or recoverable sucrose in those treatments. Overall, there was no gain in any of the parameters (tonnage, sucrose concentration and recovered) evaluated when adjuvants were added to fungicides in 2020.

Table 1. Effect of fungicides and adjuvants on Cercospora leaf spot control and sugarbeet yield and quality near Foxhome, MN in 2020.

Treatment and rate/A and timing	CLS Rating	Root yield	Sucrose concentration	Recoverable sucrose	
	0-10	Ton/Acre	%	Lb/Ton	Lb/Acre
Penncozeb 2 lb (ABCDE)	8.5	9.90	13.93	260	2,573
Badge SC 2 pt (ABCDE)	8.5	10.08	13.25	248	2,511
Inspire XT 7 fl oz (ABCDE)	8.5	12.33	13.94	260	3,204
Super Tin 8 fl oz + Badge SC 2 pt (A) Manzate Max 1.6 qt + Badge SC 2 pt (B) Super Tin 8 fl oz + Manzate Max 1.6 qt (C) Manzate Max 1.6 qt + Badge SC 2 pt (D) Super Tin 8 fl oz + Badge SC 2 pt (E)	7.8	9.78	13.88	259	2,516
Penncozeb 2 lb + Cerium Elite 1 qt/100gal (ABCDE)	7.5	8.88	13.64	252	2,229
Badge SC 2 pt + Cerium Elite 1 qt/100gal (ABCDE)	8.5	10.35	13.67	254	2,625
Inspire XT 7 fl oz + Cerium Elite 1 qt/100gal (ABCDE)	8.3	10.68	13.87	258	2,774
Super Tin 8 fl oz + Badge SC 2 pt + Cerium Elite 1 qt/100gal (A) Manzate Max 1.6 qt + Badge SC 2 pt + Cerium Elite 1 qt/100gal (B) Super Tin 8 fl oz + Manzate Max 1.6 qt + Cerium Elite 1 qt/100gal gal (C) Mankocide 4.3 lb + Cerium Elite 1 qt/100gal (D) Super Tin 8 fl oz + Badge SC 2 pt + Cerium Elite 1 qt/100gal (E)	7.0	8.60	14.22	267	2,296
Penncozeb 2 lb + Complex 2 pt/100 gal (ABCDE)	7.5	9.25	13.90	261	2,412
Badge SC 2 pt + Complex 2 pt/100 gal (ABCDE)	8.8	10.55	13.43	246	2,603
Inspire XT 7 fl oz + Complex 2 pt/100 gal (ABCDE)	8.3	8.10	13.60	251	2,043
Super Tin 8 fl oz + Badge SC 2 pt + Complex 2 pt/100 gal (A) Mankocide 4.3 lb + Complex 2 pt/100 gal (B) Super Tin 8 fl oz + Manzate Max 1.6 qt + Complex 2 pt/100 gal (C) Mankocide 4.3 lb + Complex 2 pt/100 gal (D) Super Tin 8 fl oz + Badge SC 2 pt + Comples 2 pt/100gal (E)	7.3	11.05	14.42	273	3,022
Penncozeb 2 lb + Transfix 6 fl oz/100 gal (ABCDE)	8.3	10.13	13.75	256	2,577
Badge SC 2 pt + Transfix 6 fl oz /100 gal (ABCDE)	8.8	9.63	13.34	249	2,397
Inspire XT 7 fl oz + Transfix 6 fl oz /100 gal (ABCDE)	8.3	10.08	13.66	253	2,551
Super Tin 8 fl oz + Badge SC 2 pt + Transfix 6 fl oz /100 gal (A) Mankocide 4.3 lb + Transfix 6 fl oz /100 gal (B) Super Tin 8 fl oz + Manzate Max 1.6 qt + Transfix 6 fl oz /100 gal (C) Mankocide 4.3 lb + Transfix 6 fl oz /100 gal (D) Super Tin 8 fl oz + Badge SC 2 pt + Transfix 6 fl oz/100gal (E)	7.5	9.08	14.27	266	2,417
Untreated Check	9.3	9.48	12.58	231	2,187
LSD (P=0.10)	**0.7**	**2.4**	**0.5**	**11**	**647**

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