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. Fungicides are typically applied during a period when there may be regular rainfall. 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 fungicides improved control of Cercospora leaf spot.

MATERIALS AND METHODS

A field trial was conducted at Foxhome, MN in 2021. 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 2 May with a variety susceptible to Cercospora Leaf Spot. Seeds were treated with Tachigaren (45 g/kg seed), Kabina, and Poncho Beta. Seed spacing within the row was 4.7 inches. Weeds were controlled with herbicide applications (Ethotron 6 pt) on 7 May, (Roundup Powermax @ 32 fl oz; Outlook @ 12 fl oz; Amsol 1 %v/v; Interlock @ 4 fl oz and Stinger 3 fl oz per acre) on 26 May and (Roundup Powermax @ 32 fl oz; Outlook @ 12 fl oz; Amsol 1% v/v; Interlock @ 4 fl oz per acre) 10 June as well as hand weeding throughout the summer. Azoxy 2SC (14.3 fl oz per acre) was applied on 28 May and Quadris (14.3 fl oz) on 17 June to control *Rhizoctonia solani*. Govern (1 pt) was applied on 3 June to control insect pests. Plots were inoculated on 30 June 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 8 July. Treatments included five fungicide applications on 8 July (application A), 20 July (application B), 2 August (application C), 13 August (application D) and 26 August (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 13 September 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

Later than normal planting and unfavorable growing conditions resulted in slow plant growth and row closure in mid-July. Likewise, development of *C. beticola* was very slow after inoculation with first observed symptoms about 10 days later. On 20 August, CLS rating for the non-treated check was 5.8, still below the CLS rating (6.0) at which economic losses typically occur. Warmer conditions in late-August and early September resulted in more favorable conditions for rapid disease development as indicated by a CLS rating of 9.0 and 10.0 for the non-treated check on September 3 and 13, respectively.

All the fungicide treatments provided significantly better disease control than the non-treated check (Table 1). Most of the fungicide treatments resulted in significantly higher tonnage, sucrose concentration and recoverable sucrose than the non-treated check. The results suggest that the use of Transfix with Penncozeb and Badge SC may adversely impact tonnage, sucrose concentration and recoverable sucrose. Preference and Complex adjuvants did not have an adverse effect on any of the parameters evaluated. Badge SC mixed with Complex resulted in better disease control and significantly higher recoverable sucrose compared to the use of Badge SC alone. The addition of adjuvants to mixtures of fungicides in a rotation program did not significantly impact disease control nor yield (tonnage and recoverable sucrose).

Table 1. Effect of fungicides and adjuvants on Cercospora leaf spot control and sugarbeet yield and quality at Foxhome, MN in 2021.

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)	4.5	39.58	17.06	312	12,371
Badge SC 2 pt (ABCDE)	5.0	39.73	16.86	308	12,219
Inspire XT 7 fl oz (ABCDE)	6.5	36.03	16.29	299	10,796
Super Tin 8 fl oz + Badge SC 2 pt (A) Mankocide 4.3 lb (B) Super Tin 8 fl oz + Manzate Max 1.6 qt (C) Mankocide 4.3 lb (D) Super Tin 8 fl oz + Badge SC 2 pt (E)	4.3	39.03	17.64	325	12,698
Penncozeb 2 lb + Preference 2 pt/100 gal (ABCDE)	4.5	42.13	17.01	314	13,182
Badge SC 2 pt + Preference 2 pt/100 gal (ABCDE)	5.0	39.00	17.23	319	12,440
Inspire XT 7 fl oz + Preference 2 pt/100 gal (ABCDE)	6.3	35.93	16.36	300	10,796
Super Tin 8 fl oz + Badge SC 2 pt + Preference 2 pt/100 gal (A) Mankocide 4.3 lb + Preference 2 pt/100 gal (B) Super Tin 8 fl oz + Manzate Max 1.6 qt + Preference 2 pt/100 gal (C) Mankocide 4.3 lb + Preference 2 pt/100 gal (D) Super Tin 8 fl oz + Badge SC 2 pt + Preference 2 pt/100 gal (E)	4.3	40.53	18.01	336	13,583
Penncozeb 2 lb + Complex 2 pt/100 gal (ABCDE)	4.5	39.28	16.72	306	12,021
Badge SC 2 pt + Complex 2 pt/100 gal (ABCDE)	5.3	39.48	16.79	308	12,142
Inspire XT 7 fl oz + Complex 2 pt/100 gal (ABCDE)	6.5	35.40	16.24	297	10,493
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 + Complex 2 pt/100 gal (E)	4.3	39.58	18.37	343	13,564
Penncozeb 2 lb + Transfix 6 fl oz/100 gal (ABCDE)	5.0	38.85	17.05	313	12,134
Badge SC 2 pt + Transfix 6 fl oz /100 gal (ABCDE)	5.0	38.00	16.64	304	11,544
Inspire XT 7 fl oz + Transfix 6 fl oz /100 gal (ABCDE)	5.5	36.25	17.01	314	11,366
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/100 gal (E)	4.5	39.18	17.75	329	12,839
Untreated Check	10.0	34.40	15.03	272	9,355
LSD (P=0.05)	**0.68**	**3.77**	**1.09**	**24.2**	**1,320**

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