EFFECT OF FUNGICIDE MIXTURES AT CONTROLLING CERCOSPORA LEAF SPOT ON SUGARBEET

Mohamed F. R. Khan[1] and Randy Nelson[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, caused by the fungus *Cercospora beticola* Sacc., is the most important foliar disease of sugarbeet in Minnesota (MN) and North Dakota (ND). The disease reduces root and extractable sucrose yields, and increases sugar loss to molasses resulting in higher processing losses (Smith and Ruppel, 1973; Lamey et al., 1987; Shane and Teng, 1992; Lamey et al., 1996; Khan and Smith, 2005). Cercospora leaf spot is managed using an integration of planting disease tolerant varieties, using crop rotation and tillage to reduce inoculum, and fungicide applications (Miller et al., 1994; Khan et al; 2007). Prolonged usage and overuse of fungicides generally result in development of resistance in the pathogen. In 1998, growers lost millions of dollars as a result of the Cercospora leaf spot epidemic. *C. beticola* had developed tolerance to triphenyltin hydroxide resulting in poor disease control in fields. In 2005, 12.4% of isolates tested were resistant to more than 1 ppm of tetraconazole (Secor et al., 2006). It was possible that overuse of Eminent influenced development of resistant isolates. Research was conducted to determine if available fungicides could be mixed and used in an alternation program to provide effective disease control and delay the development of resistant isolates.

The objective of this research was to evaluate the efficacy of fungicides as stand alone products and in mixtures and alternations for controlling Cercospora leaf spot on sugarbeet.

MATERIALS AND METHODS

Field trial was conducted in Foxhome, MN in 2007. 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 Betaseed variety resistant to Rhizomania but susceptible to Cercospora leaf spot. Terbufos (Counter 15G) was applied modified in-furrow at 12 lbs/A during planting to control sugarbeet root maggot (*Tetanops myopaeformis* von Röder; Diptera: Ulidiidae). Plots were thinned manually at the 6-leaf stage on 19 June to 41,580 plants per acre. Weeds were controlled with recommended herbicides (Khan, 2007), and hand weeding. Plots were inoculated on 12 July with dried infected leaves provided by Margaret Rekoske (Betaseed, Shakopee, MN). Infected leaves were mixed with talc (2:1 by weight) and applied between each row at a rate of 5 lb per acre.

Fungicide spray treatments were applied with a 4-nozzle boom sprayer calibrated to deliver 20 gpa of solution at 100 p.s.i pressure to the middle four rows of plots. Treatments were applied on 25 July, 7 and 21 August. Treatments were applied at rates as indicated in Table 1.

Cercospora leaf spot severity was rated on the KWS scale of 1 to 9. A rating of 1 indicated no disease, a rating of 3 indicated that all outer leaves displayed typical symptoms and was the early stages of economic loss level, and a rating of 9 indicated that the plants had only new leaf growth, all earlier leaves being dead. Cercospora leaf spot severity was assessed throughout the season. However, the rating done three days prior to harvest is reported.

Plots were defoliated mechanically and harvested using a mechanical harvester on 24 September. The middle two rows of each plot were harvested and weighed for root yield. Twelve to 15 random 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 6.0 software package (Gylling Data Management Inc., Brookings, South Dakota, 1999). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant (P=0.05).

RESULTS AND DISCUSSIONS

Cercospora leaf spots were observed at very low levels in mid July. Fungicide treatments commenced on July 25 when disease incidence was uniform in all plots. CLS progressed slowly in the untreated check until late August, after which disease development progressed rapidly. At harvest, the untreated check had a KWS Cercospora leaf spot rating of 8.0 which was significantly higher than the fungicide treatments (Table 1). Fungicide treatments resulted in higher root yield, sucrose concentration, and recoverable sucrose compared to the untreated check.

Fungicide treatments generally provided good disease control. The main reason for effective season-long control was that first application was done when disease severity level was approaching 0.01% which was equivalent to one lesion per lower leaf. Effective disease control early in the season resulted in only three fungicide application since the disease was not developing further in treated plots. Both Eminent and SuperTin provided better disease control at the full rate compared to reduced rates when used alone. Reduced efficacy may be due to development of resistant isolates. In addition, conditions were very dry at Foxhome during July and August which may have affected fungicide efficacy. As such, full rates would be expected to provide better disease control than reduced rates. It should be noted that the use of individual fungicides back-to-back was done to determine efficacy throughout the season. In practice, fungicides from different classes should be used in a rotation system to manage resistance. Mixtures of Eminent and SuperTin at reduced rates provided better disease control than using Eminent alone, probably as a result of overcoming any isolates resistant or tolerant to one of the fungicides. Mixtures with reduced rates of Headline or Eminent with reduced rate of SuperTin provided comparative levels of control to similar treatments using full rates. The research indicated that using fungicides from different classes in mixtures at recommended reduced rates in alternation with an efficacious product provided good disease control and acceptable economic returns.

References

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Table 1. Cercospora leaf spot control at Foxhome in 2007 with fungicides.

Treatment and rate/A	CLS[x]	Recoverable Sucrose (lb/A)	Recoverable Sucrose (lb/T)	Root yield (t/A)	Sucrose concen-tration (%)	LTM[x] (%)	Return ($/A)[x]
Untreated Check	8.0	5769	326	18.0	18.3	2.0	767
Eminent 125 SL 13 fl oz	2.3	7087	334	21.5	18.4	1.7	943
Headline 2.09 EC 9 fl oz	2.0	6990	346	20.5	18.9	1.6	930
Super Tin 80 WP 5 oz	2.1	6831	336	20.6	18.6	1.8	909
(Eminent 125 SL 13 fl oz + Super Tin 80 WP 5 oz) / Headline 2.09 EC 9 fl oz	2.0	6973	340	20.7	18.5	1.5	727
(Eminent 125 SL 10 fl oz + Super Tin 80 WP 4 oz) / Headline 2.09 EC 9 fl oz	2.0	7125	350	20.6	19.1	1.6	948
(Headline 2.09 EC 9 fl oz + Super Tin 80 WP 5 oz) / Eminent 125 SL 13 fl oz	2.0	6844	346	20.1	19.0	1.7	910
(Headline 2.09 EC 7.2 fl oz + Super Tin 80 WP 4 oz) / Eminent 125 SL 13 fl oz	2.0	7023	347	20.5	19.0	1.6	934
Eminent 125 SL 10 fl oz	2.5	7127	332	21.8	18.2	1.6	948
Headline 2.09 EC 7.2 fl oz	2.0	7069	341	21.2	18.7	1.6	940
Super Tin 80 WP 4 oz	2.3	6952	334	21.2	18.3	1.6	925
(Eminent 125 SL 10 fl oz + Super Tin 80 WP 4 oz)	2.0	7133	330	22.0	18.2	1.7	949
(Headline 2.09 EC 7.2 fl oz + Super Tin 80 WP 4 oz)	2.0	7087	339	21.2	18.6	1.7	943
LSD (P= 0.05)	0.2	965	20	3.2	0.9	0.3	128

[x]Cercospora leaf spot measured on KWS scale 1-9 (1 = no leaf spot; 9 = dead outer leaves, inner leaves severely damaged, regrowth of new leaves).
[y]LTM: Sugar loss to molasses.
[z]Gross Return based on Minn-Dak payment system.