

EFFECT OF FUNGICIDES IN THE ABSENCE OF DISEASE ON SUGARBEET YIELD AND QUALITY

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Fungicides are commonly used by sugarbeet (*Beta vulgaris* L.) growers in North Dakota and Minnesota to control Cercospora leaf spot, caused by the fungus *Cercospora beticola* Sacc (Khan and Smith, 2005). Cercospora leaf spot is the most devastating foliar disease of sugarbeet and results in significant economic losses when the disease is not controlled. In England, sugarbeet growers are advised to use a fungicide because they always have low to moderate levels of foliar diseases such as powdery mildew, rust and Ramularia leaf spot that start early in the season. English growers are encouraged to use either a triazole or strobilurin fungicide since these will result in effective disease control and yield gains (May and Stevens, 2008). The use of Headline has been recommended, even in the absence of disease, to increase sugarbeet yield and quality in North Dakota and Minnesota. It is very important that we determine the effect of widely used strobilurin and triazole fungicides on sugarbeet yield and quality in the absence of disease.

The objective of this research was to determine the effect of fungicides on sugarbeet yield, quality, and respiration rate in the absence of disease.

MATERIALS AND METHODS

Field trials were conducted in St. Thomas and Prosper, ND, and Foxhome, MN in 2008. The experimental design was a randomized complete block with four replicates. Field plots comprised of six 30-foot long rows spaced 22 inches apart. Plots were planted with Beta 1301 which was resistant to Rhizomania and had good resistance to Cercospora leaf spot (KWS rating of 4.7) and Aphanomyces root rot (rating of 4.0). Seed were also treated with Tachigaren at 20 g/kg seed to provide early season protection against *Aphanomyces cochlioides*. Planting was done on 2, 6, 8, May at St. Thomas, Prosper, and Foxhome, respectively. 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 to 41,580 plants per acre. Weeds were controlled with recommended herbicides (Khan, 2008), and hand weeding.

The fungicides used were Headline, Eminent, Proline plus Premier 90 NIS, and Inspire at rates indicated in Table 1. Fungicide application dates were 31 July and 26 August; 22 July and 4 September; and 30 July and 29 August at St. Thomas, Prosper, and Foxhome, respectively. A non-treated check was also included in the treatments. Fungicides were applied with a CO₂ pressurized 4-nozzle boom sprayer equipped with 11002 TurboTee TwinJett and calibrated to deliver 17 gpa of solution at 60 p.s.i pressure to the middle four rows of plots.

Chlorophyll content (NDIV and Red/NIR) of leaves of each plot was determined using a Greenseeker® about seven days after each fungicide application at Prosper. Chlorophyll content readings at all sites were taken on 9 September and this data is reported.

At St. Thomas and Foxhome, plots were defoliated mechanically and harvested using a mechanical harvester on 16 and 30 September, respectively. 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 Prosper, harvesting was done by hand on 29 October. Eight roots from each plot harvested 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 7.5 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

At St. Thomas, no *Cercospora* leaf spot symptoms were observed the entire growing season. Some plants that had leaves with two to three *Phoma* leaf spots, but not enough to impact yield. None of the plants showed symptoms of *Aphanomyces cochlioides*, *Rhizoctonia solani*, *Fusarium species* or Beet necrotic yellow vein virus. There were no significant differences in chlorophyll content (NDIV values) of the leaves of plants treated with fungicides compared to the nontreated check. Similarly, there were no significant differences in yield, sucrose concentration, or recoverable sucrose between any of the fungicide treatments applied at any time and the nontreated check (Table 1).

At Foxhome, some plants had a few leaf lesions symptomatic of *Cercospora* leaf spot, but disease severity level was very low. No symptoms of any of the other common diseases affecting sugarbeet were observed. There were no significant differences in chlorophyll content of the leaves of plants treated with fungicides compared to the nontreated check. Similarly, there were no significant differences in yield, sucrose concentration, or recoverable sucrose between any of the fungicide treatments applied at any time and the nontreated check (Table 2).

At Prosper, *Cercospora* leaf spot symptoms were not observed. It was not possible to harvest the site mechanically in late October due to wet conditions as a result of heavy rainfall in October (3.9 inches rainfall compared to the normal average of 1.7 inches). There were no visible foliar differences after a frost between the nontreated check and any of the fungicide treatments. There were no significant differences in chlorophyll content of the leaves of any of the fungicide treatments and the nontreated check earlier in the season. There were no significant differences in yield (data not shown), sugar concentration or sugar loss to molasses of plots treated with fungicides compared to the nontreated control (Table 3).

The yield, sucrose concentration and recoverable sucrose were very similar for the Foxhome and St. Thomas site, with the latter having a slightly lower average yield and average sugar concentration, probably because it was harvested earlier. 'Greening' of sugarbeet (where plants in a plot looked distinctly greener as if it had extra nitrogen), a common characteristic of the effect of strobilurin and triazole fungicides in England (May and Stevens, 2008) was not observed in any of the treatments at any of the sites. Since there was no 'greening', it was not surprising that none of the fungicide treatments resulted in a significant increase in chlorophyll content compared to the nontreated check. The NDVI range was consistent with what would be expected of healthy, well fertilized plants.

This research, based on one year's data, suggested that fungicide applications in the absence of disease do not significantly change sugarbeet yield or quality compared to a non-treated check.

References

Khan, M. 2008. 2008 Sugarbeet Production Guide. North Dakota State University and University of Minnesota Extension Services, pp. 22-50.

Khan, M.F.R; Smith, L.J. 2005. Evaluating fungicides for controlling *Cercospora* leaf spot on sugarbeet. J. Crop Prot. 24, 79-86.

May, M; Stevens, M. 2008. Fungicides for 2008. In: Sugar Beet Review 76(2):14-19.

Table 1. Effect of fungicides on sugarbeet yield and quality at St. Thomas, ND in 2008.

Treatment and rate/A	Application date	NDVI*	Root yield (t/A)	Sucrose concentration (%)	Recoverable sucrose (lb/A)
Nontreated check		0.85293 a	26.4 a	14.4 a	6601 a
Headline 9 oz	31 July	0.85713 a	27.4 a	13.8 a	6411 a
Headline 9 oz	26 August	0.85590 a	27.9 a	14.2 a	6873 a
Headline 9 oz	31 July, 26 Aug	0.85317 a	26.2 a	14.5 a	6663 a
Eminent 13 fl oz	31 July	0.84786 a	26.0 a	14.6 a	6667 a
Eminent 13 fl oz	26 August	0.85089 a	27.3 a	14.5 a	6914 a
Eminent 13 fl oz	31 July, 26 Aug	0.85200 a	27.3 a	14.3 a	6814 a
Proline 5oz + Premier 90 NIS 0.125% v/v	31 July	0.85511 a	28.8 a	13.9 a	6878 a
Proline 5oz + Premier 90 NIS 0.125% v/v	26 August	0.84705 a	27.3 a	14.4 a	6815 a
Proline 5oz + Premier 90 NIS 0.125% v/v	31 July, 26 Aug	0.85587 a	27.8 a	13.7 a	6521 a
Inspire 7 oz	31 July	0.85142 a	27.4 a	14.2 a	6668 a
Inspire 7 oz	26 August	0.85271 a	27.7 a	14.2 a	6791 a
Inspire 7 oz	31 July, 26 Aug	0.84899 a	25.6 a	14.5 a	6468 a
LSD (P= 0.05)		NS	NS	NS	NS

*NDVI – Normalized difference vegetative index was measured using a Greenseeker® on 9 September

Table 2. Effect of fungicides on sugarbeet yield and quality at Foxhome, MN in 2008.

Treatment and rate/A	Application date	NDVI*	Root yield (t/A)	Sucrose concentration (%)	Recoverable sucrose (lb/A)
Nontreated check		0.86010 a	26.9 a	14.4 a	6978 a
Headline 9 oz	30 July	0.85487 a	28.6 a	14.7 a	7587 a
Headline 9 oz	29 August	0.84784 a	26.9 a	14.7 a	7189 a
Headline 9 oz	30 July, 29 Aug	0.85771 a	28.5 a	14.0 a	7099 a
Eminent 13 fl oz	30 July	0.84792 a	28.7 a	14.5 a	7535 a
Eminent 13 fl oz	29 August	0.85071 a	26.8 a	14.7 a	7157 a
Eminent 13 fl oz	30 July, 29 Aug	0.85193 a	27.6 a	14.5 a	7237 a
Proline 5oz + Premier 90 NIS 0.125% v/v	30 July	0.84576 a	28.0 a	14.6 a	7401 a
Proline 5oz + Premier 90 NIS 0.125% v/v	29 August	0.85433 a	28.0 a	14.2 a	7177 a
Proline 5oz + Premier 90 NIS 0.125% v/v	30 July, 29 Aug	0.84338 a	27.1 a	14.7 a	7218a
Inspire 7 oz	30 July	0.85224 a	28.3 a	14.1 a	7197 a
Inspire 7 oz	29 August	0.84580 a	28.3 a	14.4 a	7229 a
Inspire 7 oz	30 July, 29 Aug	0.85137 a	28.0 a	14.5 a	7363 a
LSD (P= 0.05)		NS	NS	NS	NS

*NDVI – Normalized difference vegetative index was measured using a Greenseeker® on 9 September

Table 3. Effect of fungicides on sugarbeet yield and quality at Prosper, ND in 2008.

Treatment and rate/A	Application date	NDVI*	Sucrose concentration (%)
Nontreated check		0.83472 a	15.1 a
Headline 9 oz	22 July	0.83234 a	15.8 a
Headline 9 oz	4 September	0.84372 a	15.3 a
Headline 9 oz	22 July, 4 September	0.84188 a	15.6 a
Eminent 13 fl oz	22 July	0.84040 a	15.8 a
Eminent 13 fl oz	4 September	0.83049 a	16.1 a
Eminent 13 fl oz	22 July, 4 September	0.84305 a	15.9 a
Proline 5oz + Premier 90 NIS 0.125% v/v	22 July	0.84191 a	15.0 a
Proline 5oz + Premier 90 NIS 0.125% v/v	4 September	0.83677 a	15.5 a
Proline 5oz + Premier 90 NIS 0.125% v/v	22 July, 4 September	0.83671 a	15.9 a
Inspire 7 oz	22 July	0.84115 a	15.5 a
Inspire 7 oz	4 September	0.84114 a	15.1 a
Inspire 7 oz	22 July, 4 September	0.83892 a	15.8 a
LSD (P= 0.05)		NS	NS

*NDVI – Normalized difference vegetative index was measured using a Greenseeker® on 9 September