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

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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. Cercospora leaf spot is the most devastating foliar disease of sugarbeet and results in significant economic losses when the disease is not controlled (Khan and Smith, 2005). In England, sugarbeet growers are advised to always use a fungicide application 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 whether the widely used strobilurin and triazole fungicides do result in increased yield 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 trial was conducted in Prosper, ND, and Foxhome, MN in 2009. 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 with Beta 87RR38 which was resistant to Rhizomania, and had good resistance to Cercospora leaf spot (KWS rating of 4.1). Seed were also treated with Tachigaren at 20 g/kg seed to provide early season protection against *Aphanomyces cochlioides*. Planting was done on 18 and 27 May at Foxhome and Prosper, respectively. At Prosper, 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 to 175 plants per 100' of row on 16 June at Prosper and 30 June at Foxhome. Weeds were controlled with recommended herbicides (Khan, 2009), and hand weeding.

The fungicides used were Headline, Eminent, Proline mixed with Premier 90 NIS, and Inspire at rates indicated in Table 1. Fungicide application dates were 22 July and 25 August; and 23 July and 25 August, at Prosper and Foxhome, respectively. A non-treated check was also included in the treatments. Fungicides were applied with a 4-nozzle (TT TWINJT 11002) boom sprayer calibrated to deliver 17 gpa of solution at 60 p.s.i pressure to the middle four rows of plots.

The chlorophyll content (NDIV) of leaves of each plot was determined using a Greenseeker® three times during the season.

At Prosper and Foxhome, plots were defoliated mechanically and harvested using a mechanical harvester on 12 and 13 October, respectively. 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 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 Prosper, the plants did not show any symptoms of root rot or Cercospora leaf spot. There were no significant differences in chlorophyll content as determined by NDIV of the leaves of any of the fungicide treatments and the nontreated control during season. There were no significant differences in tonnage, sugar concentration, sugar loss to molasses, or recoverable sucrose per acre of plots treated with fungicides compared to the nontreated control.

At Foxhome, none of the plants showed any symptoms of root rot. There were some plants with a few leaf lesions symptomatic of Cercospora leaf spot late in the season but disease severity level was very low (less than 2 on the KWS scale). There were no significant differences in NDIV of the leaves of plants treated with fungicides compared to the nontreated check. Eminent applied early resulted in significantly higher tonnage than the nontreated control. However, there were no significant differences in sucrose concentration, sugar loss to molasses, or recoverable sucrose between any of the fungicide treatments, including early application of Eminent, and the nontreated check. Please note that treatments where fungicides were applied twice without alternating with a fungicide having a different mode of action were not included in the tables.

The sucrose concentration and recoverable sucrose were similar for both Foxhome and Prosper although the latter was planted 10 days later. 'Greening' (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 during the season and before a frost. Since there was no 'greening', it was not surprising that none of the fungicide treatments resulted in a significant increase in chorophyll content compared to the nontreated check. The NDVI range was consistent with what would be expected of healthy, well fertilized plants. Both sites were impacted by frost just prior to harvest. At Prosper, foliage of fungicide treated plots was similar in appearance to the nontreated plots. At Foxhome, the petioles in the nontreated plots were generally more erect and the top leaves became brown and scorched in appearance compared to the fungicide treated plots where the petioles were more flaccid or stooped (curved) but the leaves remained green. At both sites, the beet roots were not affected by the frost. There were no problems encountered during defoliation.

This research suggested that triazole and strobilurin fungicide applications in the absence of disease, may result in plants retaining green leaves after a frost, but did not significantly increase quality or recoverable sucrose.

**References**

Khan, M. 2009. 2009 Sugarbeet Production Guide. North Dakota State University and University of Minnesota Extension Services, pp. 22-53.

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: British Sugar Beet Review 76(2):14-19.

**Table 1. Effect of fungicides on sugarbeet leaf greenness, yield and quality at Prosper, ND, 2009.**

| Treatment and rate/A | Application date | NDVI* 7/17 | NDVI* 8/4 | NDVI* 9/1 | Root yield (t/A) | Sucrose concentration (%) | SLM** (%) | Recoverable sucrose (lb/A) |
|---|---|---|---|---|---|---|---|---|
| Nontreated check | | 0.7452 | 0.8240 | 0.8383 | 33.8 | 15.3 | 1.16 | 9528 |
| Headline 9 oz | 22 July | 0.7628 | 0.8325 | 0.8424 | 33.2 | 15.2 | 1.14 | 9303 |
| Headline 9 oz | 25 August | 0.7956 | 0.8411 | 0.8400 | 34.9 | 15.3 | 1.11 | 9876 |
| Eminent 13 fl oz | 22 July | 0.7882 | 0.8332 | 0.8377 | 34.9 | 15.5 | 1.06 | 10066 |
| Eminent 13 fl oz | 25 August | 0.8001 | 0.8323 | 0.8382 | 35.0 | 15.5 | 1.13 | 10093 |
| Proline 5oz + Premier 90 NIS 0.125% v/v | 22 July | 0.8038 | 0.8346 | 0.8361 | 34.3 | 15.4 | 1.08 | 9791 |
| Proline 5oz + Premier 90 NIS 0.125% v/v | 25 August | 0.8080 | 0.8372 | 0.8412 | 35.1 | 15.6 | 1.11 | 10185 |
| Inspire XT 7 oz | 22 July | 0.7911 | 0.8386 | 0.8463 | 34.9 | 15.0 | 1.23 | 9578 |
| Inspire XT 7 oz | 22 August | 0.7218 | 0.8149 | 0.8355 | 31.7 | 14.8 | 1.16 | 8656 |
| LSD (P=0.05) | | NS† | NS | NS | NS | NS | NS | NS |
| CV | | 6.4 | 2.72 | 0.77 | 8.03 | 3.05 | 10.8 | 8.19 |

*NDVI – Normalized difference vegetative index was measured using a Greenseeker®
** SLM – Sugar lost to molasses
† NS – not statistically significant

**Table 2. Effect of fungicides on sugarbeet leaf greenness, yield and quality at Foxhome, MN, 2009.**

| Treatment and rate/A | Application date | NDVI* 7/17 | NDVI* 8/6 | NDVI* 9/1 | Root yield (t/A) | Sucrose concentration (%) | SLM** (%) | Recoverable sucrose (lb/A) |
|---|---|---|---|---|---|---|---|---|
| Nontreated check | | 0.8585 | 0.8608 | 0.8180 | 32.7 | 15.9 | 1.24 | 9560 |
| Headline 9 oz | 23 July | 0.8638 | 0.8678 | 0.8238 | 34.2 | 15.5 | 1.21 | 9819 |
| Headline 9 oz | 25 August | 0.8599 | 0.8619 | 0.8223 | 34.4 | 15.8 | 1.15 | 10066 |
| Eminent 13 fl oz | 23 July | 0.8628 | 0.8677 | 0.8333 | 37.4 | 15.5 | 1.29 | 10622 |
| Eminent 13 fl oz | 25 August | 0.8577 | 0.8613 | 0.8206 | 34.1 | 15.7 | 1.13 | 9948 |
| Proline 5oz + Premier 90 NIS 0.125% v/v | 23 July | 0.8636 | 0.8626 | 0.8277 | 32.2 | 15.8 | 1.12 | 9415 |
| Proline 5oz + Premier 90 NIS 0.125% v/v | 25 August | 0.8564 | 0.8633 | 0.8272 | 33.3 | 15.7 | 1.21 | 9634 |
| Inspire XT 7 oz | 23 July | 0.8620 | 0.8684 | 0.8265 | 34.5 | 16.0 | 1.18 | 10219 |
| Inspire XT 7 oz | 25 August | 0.8648 | 0.8706 | 0.8313 | 34.5 | 15.7 | 1.23 | 9982 |
| LSD (P=0.05) | | NS† | NS | NS | 2.40 | NS | NS | NS |
| CV | | 1.1 | 0.96 | 0.98 | 4.87 | 3.49 | 9.9 | 5.92 |

*NDVI – Normalized difference vegetative index was measured using a Greenseeker®
**SLM – Sugar lost to molasses
† NS – not statistically significant