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Evaluating fungicides for controlling Cercospora leaf spot on sugar beet

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Abstract

Cercospora leaf spot, caused by the fungus, *Cercospora beticola*, continues to be a devastating foliar disease of sugar beet (*Beta vulgaris*), in Minnesota and North Dakota. Commercial sugar beet varieties grown in Minnesota and North Dakota generally have only moderate resistance and require fungicide applications to obtain adequate levels of protection against *C. beticola*. Trials were conducted in 1999 at Foxhome and Crookston, Minnesota and in 2000 at Breckenridge and Crookston, Minnesota to determine the efficacy of labeled and experimental fungicides for controlling Cercospora leaf spot. Natural inocula were relied on for infection, and disease pressure was high at all sites in both years. Except for azoxystrobin applied alone at Foxhome, and azoxystrobin, and fentin hydroxide, applied alone, and fenbuconazole applied with an adjuvant at Breckenridge, the fungicide treatments provided better Cercospora leaf spot control, and resulted in higher recoverable sucrose yields than non-treated controls. Tetraconazole and pyraclostrobin, when applied alone, consistently provided effective Cercospora leaf spot control and resulted in high sucrose yield.

Keywords: *Cercospora beticola*; *Beta vulgaris*; Fungicides; Strobilurin; Pyraclostrobin

1. Introduction

Cercospora leaf spot, caused by the fungus *Cercospora beticola* Sacc., occurs in all sugar beet (*Beta vulgaris* L.) production areas in the United States (Ruppel, 1986; Kerr and Weiss, 1990), and is the most destructive foliar disease of sugar beet in Minnesota and North Dakota. The disease reduces root and extractable sucrose yields, and increases impurity concentrations, resulting in higher processing losses (Smith and Ruppel 1973; Lamey et al., 1987; Shane and Teng, 1992; Lamey et al., 1996). Losses in recoverable sucrose as high as 30% are common under heavy disease conditions and revenue losses as high as 43% have been reported (Lamey et al., 1987; Shane and Teng, 1992; Lamey et al., 1996). Roots of diseased plants do not store as well as roots from healthy plants in storage piles that are processed in a 7–9 month period in North Dakota and Minnesota (Smith and Ruppel, 1973). Cercospora leaf spot is managed by fungicide applications, reducing inoculum by crop rotation and tillage, and by planting disease tolerant varieties (Miller et al., 1994). Four to five genes are responsible for Cercospora leaf spot resistance (Smith and Gaskill, 1970). Combining high levels of Cercospora leaf spot resistance with high yield in sugar beet is difficult (Smith and Campbell, 1996). As a result, commercial varieties generally have only moderate levels of resistance and require fungicide applications to obtain adequate levels of protection against Cercospora leaf spot (Miller et al., 1994).

In 1998, revenue losses by American Crystal growers in Minnesota and North Dakota were over $45 M from reduced tonnage and quality despite the use of $20 M in fungicide applications (Cattanach, 2000). The major

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fungicides used in 1998 were fentin hydroxide, mancozeb and thiophanate methyl (Dexter and Luecke, 1999). Most growers experienced inconsistent leaf spot control, probably because of ineffective fungicides as a result of a high population of benzimidazole resistant and fentin hydroxide tolerant strains of *C. beticola* (Bugbee, 1982; Bugbee, 1995; Weiland and Smith, 1999), or untimely applications. Cercospora leaf spot was most severe in the warmer southern Minnesota sugar beet growing district, resulting in some growers applying 11 fungicide applications compared to about 3–4 applications in most years. There was an urgent need to find new chemistry fungicides that will provide effective Cercospora leaf spot control and result in high extractable sucrose. The acreage of sugar beet grown in the United States is small relative to corn (*Zea mays* L.), wheat (*Triticum aestivum* L.), cotton (*Gossypium hirsutum* L.), and soybean (*Glycine max* (L.) Merrill). As such, very few fungicides are developed primarily for controlling diseases of sugar beet. The availability of triazoles and strobilurins used on other crops presented and opportunity to test these products for controlling Cercospora leaf spot of sugar beet. Data could then be used to obtain registration for use on sugar beet.

The objective of this research was to evaluate the efficacy of labeled and experimental fungicides to control Cercospora leaf spot on sugar beet.

2. Materials and methods

Field trials were conducted at Foxhome and Crookston, Minnesota in 1999, and Breckenridge and Crookston, Minnesota, in 2000. The research sites were about 150 km apart. All experiments were arranged in a randomized complete block design with four replications. Treatments were considered fixed effects and replicates random effects for the analysis of variance. The least significant difference (LSD) procedure was used to compare treatments when the *F*-test for treatments was significant ($p = 0.05$). 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).

Field plots consisted of six 11-meter rows spaced 56 cm apart. Plots were planted with a commercial planter on 26 April in 1999 at Foxhome and Crookston, and 24, 26 April in 2000 at Crookston and Breckenridge, respectively. 'HM Valley', a sugar beet cultivar susceptible to Cercospora leaf spot with a Kleinwanzlebener Saatzucht (KWS) scale score of 5.16 (see below) (Steen, 1999), was planted at all sites. Terbufos (Counter 15G) was applied at 3.7 kg a.i/ha modified in-furrow at planting time to control sugar beet root maggot (*Tetanops myopaeformis* von Röder; Diptera: Otitidae). Plots were thinned manually at the six-leaf stage to 86,450 plants ha^{-1}. Weeds were controlled with recommended herbicides (Khan, 1999), cultivation, and hand weeding.

Fungicide spray treatments were applied with a four-nozzle boom sprayer calibrated to deliver 690 k Pa pressure at 187 l ha^{-1} of solution to the middle four-rows of plots. The fungicides applied, either alone, in alternation, or in mixtures were mancozeb (ethylenebis-dithiocarbamate, penncozeb 75 DF, Cerexagri, Section 3 Label—see below) at 1.65 kg a.i/ha; thiophanate methyl (benzimidazole, Topsin M 70 WSB, Cerexagri, Section 3 Label) at 0.39 kg a.i/ha; fentin hydroxide (triphenyltin hydroxide, Super Tin 80 WP, Griffin LLC, Section 3 Label) at 0.28 kg a.i/ha; azoxystrobin (strobilurin, Quadris 2.08 SC, Syngenta, Section 3 Label) at 0.17 kg a.i/ha; tetraconazole (triazole, Eminent 125 SL, Sipcam Agro USA Inc., Section 18 Emergency Exemption—see below—in 1999 and 2000) at 0.11 kg a.i/ha; propiconazole + trifloxystrobin mixture (triazole + strobilurin, Stratego 2.1 EC, Bayer CropScience, Experimental Compound) at 0.18 kg a.i/ha ; pyraclostrobin (strobilurin, BAS 500 2.09 EC, BASF, Experimental Compound that received a Section 3 label in 2002) at 0.17 kg a.i/ha; fenbuconazole (triazole, RH-7592 75 WP, Dow Agro Sciences, Experimental Compound) at 0.14 kg a.i/ha + Latron CS-7 (adjuvant, Rohm and Haas) at 0.12% v/v; and non-treated controls. Fungicides with Section 3 label indicate they were approved by the Environmental Protection Agency (EPA) of the United States for use on sugar beet. Section 18 exemption by the EPA indicates that the compound was unregistered, but the EPA authorized its use under specific conditions.

Foxhome, 1999

Fungicides were applied 19 July, 2, 17, 30 August, and 10 September for 14-day treatment interval, and 19 July, 9, and 30 August for 21-day treatment interval.

Crookston, 1999

Fungicides were applied 16, 30 July, 19, 27 August, and 10 September for 14-day treatment interval, and 16 July, 6 and 27 August for 21-day treatment interval.

Breckenridge, 2000

Fungicides were applied 25 July, 8, 22, August, and 7 September for 14-day treatment interval, and 25 July, 15 August, and 7 September for 21-day treatment interval.

Crookston, 2000

Fungicides were applied 26 July, 9, 22 August, and 7 September for 14-day treatment interval, and 26 July, 16 August, and 7 September for 21-day treatment interval.

Treatments were applied as close as possible to the 14- or 21-day interval as field and weather conditions permitted. There were five applications of treatments at 14-day interval in 1999, and four applications of