EVALUATION OF POSTEMERGENCE FUNGICIDES AND APPLICATION METHOD ON SUGAR BEET FOR CONTROL OF RHIZOCTONIA CROWN AND ROOT ROT, 2023

[1]Austin K. Lien and [2]Ashok K. Chanda

[1]Researcher 3 and Graduate Student; [2]Associate Professor and Extension Sugarbeet Pathologist
University of Minnesota, Department of Plant Pathology & Northwest Research and Outreach Center, Crookston, MN

Corresponding Author: Ashok Chanda, achanda@umn.edu

Rhizoctonia damping-off and crown and root rot (RCRR) caused by *Rhizoctonia solani* AG 2-2 have been the most common root diseases of sugarbeet in Minnesota and North Dakota for over the past decade (Brantner and Windels 2009, 2011; Crane et al. 2013; Brantner 2015; Brantner and Chanda 2017, 2019; Lien et al. 2022). Disease can occur throughout the growing season and reduce plant stand, root yield, and quality, especially when warm and wet soil conditions favor infection. Disease management options include rotating with non-host crops (small grains), planting early when soil temperatures are cool, improving soil drainage, planting partially resistant varieties, and applying fungicides as seed treatments, in-furrow (IF), and/or postemergence (Chanda et al. 2016). Postemergence applications of Quadris can result in the reduction of root rot and increased yield and recoverable sucrose (Chanda et al., 2017, 2018, 2019, 2020). However, limited trials have been conducted to compare currently labeled fungicides for postemergence management of RCRR, and it is unclear if efficacy is reduced when fungicides are applied as a broadcast application compared to a 7-in. band.

OBJECTIVES

A field trial was established to evaluate various postemergence fungicide treatments as a 7-in. band or broadcast application for 1) control of early-season damping-off and RCRR and 2) effect on plant stand, yield, and quality of sugarbeet.

MATERIALS AND METHODS

The trial was established at the University of Minnesota, Northwest Research and Outreach Center (NWROC), Crookston on a Hegne-Fargo silty clay soil with an organic matter content of 5.2%. The preceding crop was soybeans, and field plots were fertilized in the fall for optimal yield and quality. A moderately susceptible variety (Crystal 793RR) with a 2-year average Rhizoctonia rating of 4.5 (Brantner and Moomjian 2023) was used. All seeds were treated with standard rates of Allegiance, Thiram, Tachigaren (45g/unit), and Kabina (14g/unit). Treatments were arranged in a randomized complete block design with four replicates. The trial was sown in six-row plots (22-in. row spacing, 30-ft rows) with a 4.5-in. seed spacing on May 11. Paralign starter fertilizer (5-15-3 + 0.8% Zn) was applied in-furrow at a rate of 2 gal/A with a total application volume of 6 gal/A across all treatments.

Counter 20G (7.5 lb/A) was applied at planting for control of sugarbeet root maggot. For the control of weeds, ethofumesate (6 pt/A) was applied before planting with a spray boom mounted to the front of the Rau seedbed finisher to incorporate the product parallel with the direction of rows, glyphosate (3 lb ae/gal; 32 fl oz/A) plus clopyralid (1.8 fl/A) was applied on May 23, and Sequence (glyphosate + S-metolachlor, 2.5 pt/A) with additional glyphosate (4.5 lb ae/gal; 8 fl oz/A) was applied on June 07. For postemergence control of sugarbeet root maggot, Asana XL + Exponent (9.6 fl + 8 fl oz/A) was applied on June 08. Cercospora leaf spot was controlled by applying Inspire XT + Manzate Pro-Stick (7 fl oz + 2 lbs/A) on July 13, SuperTin 4L + Topsin 4.5FL (8 + 10 fl oz/A) on July 26, Proline 480 SC + Manzate Pro-Stick (5.7 fl oz + 2 lbs/A) on Aug 17, and SuperTin 4L + Priaxor Xemium (8 + 6.7 fl oz/A) on Aug 30.

On the morning of June 21 (10-leaf stage), fungicide treatments (see table) were applied to the center four rows within plots. Each fungicide was evaluated in two separate treatments: a 7-in. band and a broadcast application, using Teejet 8002 or 11002 nozzles, respectively, each with an application volume of 10 gal/A at 30 psi. Following the appropriate re-entry intervals, the center four rows within each plot were inoculated in the afternoon of June 21; the inoculum consisted of 20 g per row of ground barley infested with *R. solani* AG 2-2. A tractor-mounted Gandy delivery system spread the inoculum over the sugar beet crowns.

Plant stands were evaluated on June 14 (34 DAP) and June 27 (47 DAP) by counting the number of live plants in the center two rows of each plot. Data were collected for disease severity, the number of harvested roots, and yield at harvest. On Sept 13, plots were defoliated, and the center two rows of each plot were harvested mechanically and weighed for root yield. Twenty roots per plot were arbitrarily selected and were rated for the severity of Rhizoctonia crown and root rot (RCRR) on the root surface using a 0 to 10 scale with a 10% incremental increase per each unit of rating (i.e., 0=0%, 5 = 41-50%, 10=91-100%). Each rating was mid-point transformed to percent severity for statistical analysis. Ten representative roots from each plot were analyzed for sugar quality at the American Crystal Sugar Company Quality Tare Laboratory, East Grand Forks, MN. Statistical analysis was conducted in SAS (version 9.4; SAS Institute, Cary, NC). A mixed-model analysis of variance was performed using the GLIMMIX procedure, with treatments defined as the fixed factor and replication as the random factor. Treatment means were separated based on the least square means test at the 0.05 significance level using the LSMEANS statement. The CONTRAST statement was used to compare the means of the 7-in. Band vs. the Broadcast application method.

RESULTS AND DISCUSSION

Following fungicide applications and inoculation of *R. solani*, the site received 0.55 in. of rain and provided conditions that favored the establishment of the Rhizoctonia inoculum. However, lower-than-average rainfall for the remainder of the growing season was unfavorable for disease development which resulted in low to moderate disease pressure. There were significant ($P < 0.05$) differences among treatments for the severity and incidence of Rhizoctonia root rot (RCRR) where all fungicide treatments resulted in lower disease than the nontreated control (Table 1). There were no significant differences in the number of harvested roots, plant loss, root yield, sugar percentage, or recoverable sucrose. However, there were numerical differences in which the nontreated control resulted in the greatest plant loss as well as the lowest root yield and recoverable sucrose while AZterknot and Quadris applied at 14.5 fl oz per acre resulted in the greatest recoverable sucrose (Table 1 and Fig. 1A). There were no significant differences for any of the parameters evaluated when comparing the means of the band applications vs. the broadcast applications according to the contrast analysis (Table 1). Despite disease severity and incidence being slightly higher for the broadcast applications than the band applications, recoverable sucrose was slightly higher for broadcast applications (Fig. 1B). Moreover, data reported by Lien and Chanda (2023) shows that 7-in band applications resulted in slightly lower disease severity and higher recoverable sucrose, although differences were not significant.

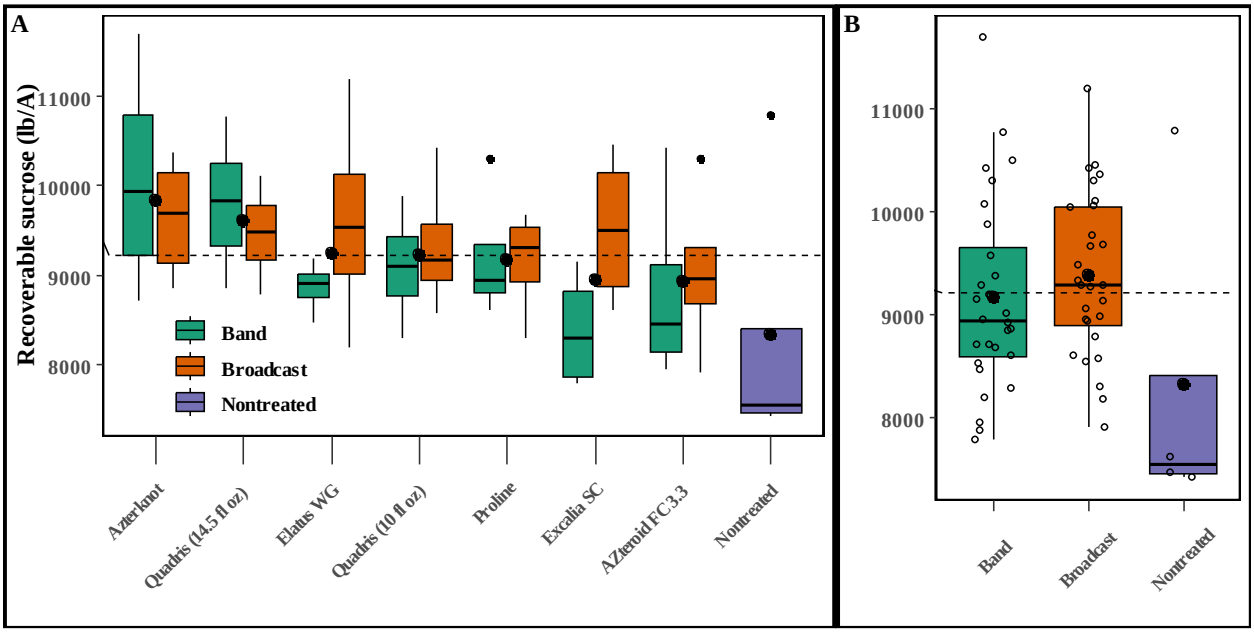

Figure 1. Effect of postemergence fungicide treatments on recoverable sucrose (lbs/A) in sugarbeets (A) and averages of 7-in. band applications and broadcast applications compared to the nontreated control (B) in a sugarbeet field trial inoculated with *Rhizoctonia solani* AG 2-2 in Crookston, MN. Boxplots display the distribution of data for each treatment (minimum, first quartile, median, third quartile, and maximum); hollow dots represent each data point; filled dots represent treatment means. The dashed horizontal line represents the mean of all treatments in this trial.

Table 1. Effects of postemergence fungicide treatments applied as either a 7-in band or broadcast application on Rhizoctonia crown and root rot and sugarbeet yield and quality in a field trial inoculated with *Rhizoctonia solani* at the University of Minnesota, Northwest Research and Outreach Center, Crookston.

Treatment and (rate/acre) [z]	Plant Stand at Harvest[y]	Plant Loss (%)[x]	RCRR Severity (%)[w,v]	RCRR Incidence (%)[u]	Sugar (%)	SLM (%)[t]	Yield (tons/A)	Sucrose (lb/A)[s]
Nontreated	153	20.0	12.6 a	56.2 a	19.7	1.29	22.7	8327
Elatus WG (7.1 oz) [r]	176	11.5	0.1 b	1.2 c	20.1	1.32	23.7	8870
Elatus WG (7.1 oz) [q]	192	8.5	1.4 b	7.5 bc	20.1	1.24	25.5	9612
Excalia SC (0.64 fl oz) [r]	173	12.7	0.9 b	8.8 bc	19.7	1.42	23.0	8386
Excalia SC (2 fl oz) [q]	183	6.5	0.2 b	3.8 bc	20.0	1.36	25.5	9516
Quadris (10 fl oz) [r]	173	11.6	1.0 b	7.5 bc	20.1	1.29	24.2	9100
Quadris (10 fl oz) [q]	185	9.2	2.1 b	12.5 b	20.3	1.20	24.4	9335
Quadris (14.5 fl oz) [r]	190	7.6	1.2 b	6.2 bc	20.8	1.16	24.9	9742
Quadris (14.5 fl oz) [q]	189	8.0	0.9 b	10.0 bc	21.1	1.25	23.9	9463
AZteroid FC[3.3] (9.2 fl oz) [r]	167	12.0	0.5 b	6.2 bc	19.9	1.20	23.6	8819
AZteroid FC[3.3] (9.2 fl oz) [q]	183	7.7	1.2 b	8.8 bc	19.5	1.31	24.9	9036
AZterknot (16.6 fl oz) [r]	195	5.8	0.5 b	7.5 bc	20.0	1.31	27.0	10074
AZterknot (16.6 fl oz) [q]	183	7.6	0.5 b	6.2 bc	20.0	1.37	25.8	9579
Proline 480 SC (5.7 fl oz) [r]	188	12.1	0.3 b	6.2 bc	20.7	1.25	23.6	9198
Proline 480 SC (5.7 fl oz) [q]	189	9.8	0.4 b	7.5 bc	20.6	1.29	23.7	9153
P- value	0.2083	0.0886	**<0.0001**	**<0.0001**	0.1404	0.4277	0.6584	0.3455
Contrast analysis of 7-in. Band Treatments vs. Broadcast Treatments								
7-in. Band	180	10.4	0.6	6.2	20.2	1.29	24.3	9170
Broadcast	186	8.2	1.0	8.0	20.2	1.29	24.8	9385
P- value	0.2625	0.1227	0.5942	0.3523	0.8699	0.8122	0.4580	0.3770

[z] The active ingredient and FRAC group of each treatment follows: Excalia SC is inpyrfluxam (7), Quadris and AZteroid FC[3.3] is azoxystrobin (11), Proline 480 SC is prothioconazole (3), AZterknot is azoxystrobin (11) + Extract of *Reynoutria sachalinensis* (P 05), and Elatus WG is azoxystrobin (11) + benzovindiflupyr (7)

[y] Plants stands are equal to number of roots per 100 ft of row

[x] Plant loss percent equals 100 * (Maximum number of live plants – number of harvested roots) / (Maximum number of live plants)

[w] Means within a column followed by a common letter are not significantly different by LSMEANS test at the 0.05 level of significance

[v] Percent severity of Rhizoctonia crown and root rot based on a 0 to 10 scale with a 10% incremental increase per each unit of rating (i.e., 0=0%, 5 = 41-50%, 10=91-100%). Each rating was mid-point transformed to percent severity for statistical analysis.

[u] Percent incidence of rated roots with > 0% of rot on the root surface

[t] Percent sugar loss to molasses (SLM)

[s] Recoverable sucrose per acre; equal to yield*(percent sugar – percent SLM) *20))

[r] 7-inch band application

[q] Broadcast application

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