EVALUATION OF AT-PLANTING FUNGICIDE TREATMENTS FOR CONTROL OF *RHIZOCTONIA SOLANI* ON SUGARBEET

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Rhizoctonia damping-off and crown and root rot (RCRR) caused by *Rhizoctonia solani* AG 2-2 have been the most common root diseases on sugarbeet in Minnesota and North Dakota for several years (1-2, 4-5, 8). Disease can occur throughout the growing season and reduce plant stand, root yield, and quality. Warm and wet soil conditions favor infection. Disease management options include rotating with non-host crops (cereals), planting partially resistant varieties, planting early when soil temperatures are cool, improving soil drainage, and applying fungicides as seed treatments, in-furrow (IF), and/or postemergence. An integrated management strategy should take advantage of multiple control options to reduce Rhizoctonia crown and root rot.

OBJECTIVES

A field trial was established to evaluate various at-planting fungicide treatments (seed treatment and in-furrow) for 1) control of early-season damping-off and RCRR and 2) effect on yield and quality of sugarbeet.

MATERIALS AND METHODS

The trial was established at the University of Minnesota, Northwest Research and Outreach Center (NWROC), Crookston. Field plots were fertilized for optimal yield and quality. A moderately susceptible variety (Crystal 101RR) with a 2-year average Rhizoctonia rating of 4.8 was used (9). A randomized complete block design with four replications was used. Seed treatments and rates are summarized in Table 1 and were applied by Germains Seed Technology, Fargo, ND. In-furrow fungicides (Table 1) were applied down the drip tube in 6 gallons total volume A^{-1}. The untreated control included no Rhizoctonia active seed or in-furrow fungicide treatment at planting. Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley applied by seeding with a grain drill at 41 kg ha^{-1}. The trial was sown in six-row plots (22-inch row spacing, 25-ft rows) on May 11 at 4.5-inch seed spacing. Starter fertilizer (3 gallons A^{-1} 10-34-0) was applied in-furrow across all treatment combinations. Counter 20G (8.9 lb A^{-1}) was applied at planting and Lorsban (1 pt A^{-1}) was applied June 4 for control of sugarbeet root maggot. Sequence (glyphosate + S-metolachlor, 2.5 pt/A) was applied on May 29 and glyphosate (4.5 lb product ae/gallon) was applied on June 18 (28 oz/A), and July 9 (32 oz/A) for control of weeds. Cercospora leaf spot was controlled by Supertin + Topsin M (6 + 10 oz/A) on August 2 applied in 17 gallons water/A with 8002 flat fan nozzles at 90 psi.

Table 1. Application type, product names, active ingredients, and rates of fungicides used at planting in a field trial for control of *Rhizoctonia solani* AG 2-2 on sugarbeet. Standard rates of Allegiance + Thiram and 45 g/unit Tachigaren were on all seed. In-furrow fungicides were applied down the drip tube in a total volume of 6 gal/A.

Application	Product	Active ingredient	Rate[Y]
None	-	-	-
Seed	Kabina ST	Penthiopyrad	14 g a.i./unit seed
Seed	Metlock Suite + Kabina ST	Metcon + Rizo + Penthio	0.21 + 0.5 + 7 g a.i./unit seed
Seed	Metlock Suite + Vibrance	Metcon + Rizo + Sedaxane	0.21 + 0.5 + 1.0 g a.i./unit seed
Seed	Systiva	Fluxapyroxad	5 g a.i./unit seed
Seed	Vibrance	Sedaxane	1.5 g a.i./unit seed
In-furrow	AZteroid	Azoxystrobin	11.9 fl oz product A^{-1}
In-furrow	Quadris	Azoxystrobin	9.5 fl oz product A^{-1}
In-furrow	Xanthion	Pyraclostrobin + Bacillus amyloliquefaciens	9.0 + 1.8 fl oz product A^{-1}
In-furrow	Elatus[Z]	Azoxystrobin + Benzovindiflupyr	9.5 oz product A^{-1}

[Y] 11.9 fl oz AZteroid and 9.5 fl oz Quadris each contain approximately 70 g azoxystrobin; 9 + 1.8 fl oz Xanthion contains 67 g pyraclostrobin + ~1.2 x 10^{12} viable spores of *Bacillus amyloliquefaciens* strain MBI 600; 9.5 oz Elatus contains 80 g azoxystrobin and 40 g benzovindiflupyr

[Z] Elatus is not currently registered for use on sugarbeet

Stand counts were done beginning 11 days after planting through 8 weeks after planting. The trial was harvested on September 24. Data were collected for number of harvested roots, yield, and quality. Twenty roots per plot also were arbitrarily selected and rated for severity of RCRR using a 0 to 7 scale (0 = healthy root, 7 = root completely rotted and foliage dead). Disease incidence was reported as the percent of rated roots with a root rot rating of > 2. Data were subjected to analysis of variance using SAS Proc GLM (SAS Institute, Cary, NC). Treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance. Orthogonal contrasts were used to compare seed treatment versus in-furrow fungicides and seed treatment and in-furrow fungicides versus the untreated control.

RESULTS AND DISCUSSION

Emergence in plots with Rhizoctonia seed treatment fungicides was similar to the untreated control so that by 3 weeks after planting, stands were greater than 160 plants per 100 ft of row (Fig. 1). Emergence in plots with in-furrow fungicides was reduced compared with the untreated control with just over 140 plants per 100 ft of row at 3 weeks after planting (Fig. 1). After 3 weeks, stand remained steady for plots with seed treatment or in-furrow fungicides, but declined in the untreated control plots so that stand from 5 to 8 weeks after planting was similar for the untreated control and plots treated with in-furrow fungicides and higher for plots with seed treatment fungicides (Fig. 1). It is not unusual for stand establishment to be reduced for in-furrow fungicides compared to seed treatments. Soil moisture during emergence was low with rainfall at the NWROC of 0.14 and 1.72 inches in April and May, respectively. Stand establishment at 8 weeks after planting for individual treatments is shown in Table 2. Stand was highest for plots with seed treated with Metlock Suite + Kabina 7g, Systiva, and Vibrance, lowest for the untreated control, AZteroid in-furrow, and Quadris in-furrow, and intermediate for Kabina ST, Metlock Suite + Vibrance 1g, Xanthion in-furrow, and Elatus in-furrow (Table 2).

Rainfall was high in June (7.82 inches), but low in July and August (1.47 and 1.67 inches, respectively). Soil moisture was low throughout most of July and August, resulting in low late-season Rhizoctonia disease pressure in this trial. The number of harvested roots was highest for most seed treatments and Xanthion in-furrow and lower for other in-furrow fungicides and the untreated control (Table 2). There were no significant differences among individual treatments for Rhizoctonia crown and root rot or yield and quality parameters (Table 2). Root rot ratings were low for all treatments with means ranging from 0.3 to 0.9 on the 0-7 scale (Table 2), reflecting the low disease pressure from *R. solani*. Disease incidence, reported as the percent of roots with a disease rating >2 ranged from 3 to 15% (Table 2). Root and sucrose yields were good for all treatments with root yields ranging from 30.5 to 35.2 ton A^{-1} and sucrose ranging from 16.9 to 17.7%. Contrast analysis of seed treatment versus in-furrow fungicides showed higher number of harvested roots, but also Rhizoctonia root rot ratings and incidence for seed treatment compared to in-furrow fungicides (Table 2). Lack of significant differences for root and sucrose yield in 2018 is similar to 2017 when July and August were also very dry but in contrast with typical years with higher disease pressure, where in-furrow fungicides resulted in lower root rot ratings and higher yields at harvest compared to seed treatments (6-7).

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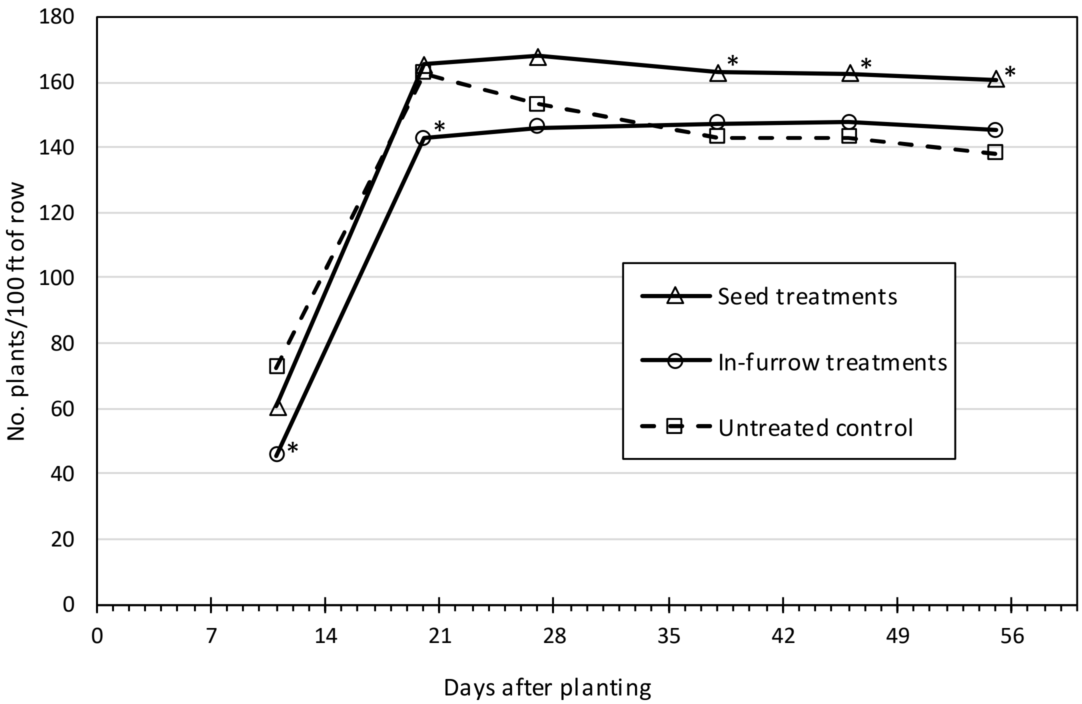

Fig. 1. Emergence and stand establishment for seed treatment and in-furrow fungicides compared to an untreated control in a sugarbeet field trial infested with *Rhizoctonia solani* AG 2-2. For each stand count date, symbols marked with an asterisk indicate stands significantly (P = 0.05) different than the untreated control (dotted line).

Table 2. Effects of at-planting (seed treatment or in-furrow) fungicide treatments on Rhizoctonia crown and root rot and sugarbeet yield and quality in a *Rhizoctonia*-infested field trial at the University of Minnesota, Northwest Research and Outreach Center, Crookston.

Treatment	8-wk stand Plants/100 ft[W]	No. harv. Roots/100 ft[W]	RCRR (0-7)[WX]	RCRR % incidence[WY]	Yield[W]	Sucrose[W] %	Sucrose[W] lb ton^{-1}	Sucrose[W] lb A^{-1}
Untreated control	138 b	136 cd	0.7	9	33.0	16.9	314	10357
Kabina ST	152 ab	144 abcd	0.9	15	34.3	17.0	311	10645
Met. Suite + 7 g Kabina	167 a	158 a	0.6	10	33.0	17.3	321	10601
Met. Suite + 1 g Vibrance	153 ab	153 ab	0.9	14	30.9	17.4	320	9944
Systiva	167 a	148 abcd	0.7	10	30.6	17.4	323	9855
Vibrance	167 a	152 abc	0.5	6	35.2	17.2	318	11153
AZteroid in-furrow	139 b	137 bcd	0.5	8	33.5	17.5	324	10850
Quadris in-furrow	138 b	132 d	0.3	4	30.5	17.7	328	9989
Xanthion in-furrow	156 ab	156 a	0.5	6	33.3	17.7	330	10969
Elatus in-furrow[Z]	149 ab	138 bcd	0.4	3	31.7	17.5	325	10303
ANOVA P-value	0.0159	0.0269	0.1840	0.5250	0.2958	0.7847	0.7872	0.5072
LSD (P = 0.05)	20.0	16.4	NS	NS	NS	NS	NS	NS
Contrast analysis Seed vs in-furrow								
Mean of Seed trts.	161 a	151 a	0.7 a	11 a	32.8	17.2	319	10440
Mean of In-furrow trts.	145 b	141 b	0.4 b	5 b	32.2	17.6	327	10528
P-value	0.0023	0.0122	0.0188	0.0413	0.5527	0.1418	0.1213	0.7799

[W] Values represent mean of 4 plots, NS = not significantly different
[X] RCRR = Rhizoctonia crown and root rot; 0-7 scale, 0 = root clean, no disease, 7 = root completely rotted and plant dead
[Y] RCRR = Rhizoctonia crown and root rot; percent of roots with rating > 2
[Z] Elatus is not currently registered for use on sugarbeet

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