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, 3-4, 6). Disease can occur throughout the growing season and reduces 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), 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 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, Crookston. Field plots were fertilized for optimal yield and quality. A moderately resistant variety (Crystal 986RR) with a 2-year average Rhizoctonia rating of 4.1 was used (7). 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}. Control included no seed or in-furrow fungicide treatment at planting. Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley (35 kg ha^{-1}). The trial was sown in six-row plots (22-inch row spacing, 25-ft rows) on May 5 at 4.5-inch seed spacing. Counter 20G (8 lb A^{-1}) was applied at planting for control of sugarbeet root maggot and 3 gallons A^{-1} starter fertilizer (10-34-0) was applied across all treatment combinations. Due to excessive rainfall after planting and poor emergence, inoculum was spread again as described above and the trial was replanted (with no starter fertilizer) on June 24. Glyphosate (4.5 lb product ae/gallon) was applied on June 7 and 13, and August 15 (22 oz A^{-1}) for control of weeds. Cercospora leaf spot was controlled by Supertin + Topsin M (6 + 7.5 oz product in 19 gallons of water/A) applied with 8002 flat fan nozzles at 100 psi on August 9.

Stand counts were done beginning 11 days after planting through 6 weeks after planting. The trial was harvested on September 23. 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). 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.

RESULTS

There were significant differences between treatments for initial stands at 2, 3, 4, 5 and 6 weeks after planting (WAP), which can be explained by high early season disease pressure. By 6 WAP in-furrow fungicides had higher stands compared to seed treatments and untreated control. There were significant differences (P=0.05) between treatments for adjusted root rot rating, number of harvested roots pet 100 ft of row, and root rot incidence. Yield, percent sugar, recoverable sugar T^{-1}, and recoverable sugar A^{-1} (RSA) were not significantly different. The in-furrow

(IF) fungicides Quadris, Headline, and Satori (generic azoxystrobin) had lower adjusted root rot rating compared to seed treatments Kabina (7 and 14g), 1.5g Vibrance, 5g Systiva, Metlock Suite, and Metlock + 7g Kabina. Root rot incidence was lowest for Quadris and Satori, followed by Headline and highest for all the seed treatments and untreated control. When we performed a contrast analysis of seed treatments vs in-furrow treatments, in-furrow treatments had higher number of harvested roots, lower root rot rating, higher yield, and higher % sucrose, RST, and RSA compared to seed treatments (Table 2).

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 Apron + Thiram and 45 g/unit Tachigaren were on all seed. In-furrow azoxystrobin or pyraclostrobin was applied down the drip tube in a total volume of 6 gal/A.

Application	Product	Active ingredient	Rate
None	-	-	-
Seed	Kabina ST	Penthiopyrad	14 g a.i./unit seed
Seed	Kabina ST	Penthiopyrad	7 g a.i./unit seed
Seed	Systiva	Fluxapyroxad	5 g a.i./unit seed
Seed	Vibrance	Sedaxane	1.5 g a.i./unit seed
Seed	Metlock Suite	Metconazole + Rizolex	0.21 + 0.5 g a.i./unit seed
Seed	Metlock Suite + Kabina ST	Metcon + Rizo + Penthio	0.21 + 0.5 + 7 g a.i./unit seed
In-furrow	Quadris	Azoxystrobin	10.0 fl oz product A^{-1}
In-furrow	Satori	Azoxystrobin	10.0 fl oz product A^{-1}
In-furrow	Headline	Pyraclostrobin	9.0 fl oz product A^{-1}

Table 2. Effects of at-planting (seed or in-furrow) fungicide treatments on Rhizoctonia crown and root rot and sugarbeet yield and quality.

					Sucrose		
Treatment[Y]	No. harv. Roots/100 ft.[W]	RCRR (0-7)[Z W]	RCRR % incidence[V W]	Yield	%	lb ton^{-1}	lb A^{-1}
Untreated control	99bc	3.1a	19ab	16.5	13.9	253	4198
14 g Kabina ST	119ab	2.6a	25a	17.0	13.2	237	4030
Metlock Suite	104bc	3.2a	23a	16.5	13.2	234	3858
Met. Suite + 7 g Kabina	108bc	2.6a	14abc	17.0	13.9	251	4277
7 g Kabina ST	117abc	2.4a	18abc	16.9	12.9	229	3864
5 g Systiva	102bc	3.0a	20ab	14.4	14.0	253	3654
1.5 g Vibrance	96c	3.2a	18abc	15.5	13.5	243	3759
9 fl oz Headline IF	116abc	2.3a	16bcd	16.7	14.0	255	4255
10 fl oz Quadris IF	130a	1.1b	0cd	17.6	14.4	262	4609
10 fl oz Satori IF	133a	1.1b	5d	18.2	14.2	258	4704
ANOVA P-value	0.0037	0.0003	0.0092	0.0913	0.1367	0.1141	0.0725
LSD (P = 0.05)[X]	21.1	1.1	12.6	NS	NS	NS	NS
Contrast analysis Seed vs in-furrow							
Mean of Seed trts.	105	2.9	19.8	16.1	13.5	243	3915
Mean of In-furrow trts.	126	1.5	7.1	17.5	14.2	258	4522
P-value	0.0006	0.0001	0.0008	0.0152	0.0107	0.0101	0.0026

[V]RCRR = Rhizoctonia crown and root rot; percent of roots with rating > 2
[W] Numbers followed by the same letter are not significantly different; LSD = Least Significant Difference, P = 0.05
[X] NS = not significantly different
[Y] Values represent mean of 4 plots
[Z] RCRR = Rhizoctonia crown and root rot; 0-7 scale (adjusted rating), 0 = root clean, no disease, 7 = root completely rotted and plant dead

DISCUSSION

Inoculation with *R. solani* (35 kg/ha) and replanting on June 24 into warm (4 inch soil temp. 75°F) and moist soils (~ 8 in. rainfall May 01 – June 24) resulted in high early season disease pressure. June was dry with only 1.8 in rain and July (3.5 in) and August (3.3 in) received moderate rainfall keeping the disease low to moderate level until the end of the season. The generic azoxystrobin, Satori, again in 2016 performed similar to Quadris (5). As shown in 2015, in-furrow fungicides offered protection against Rhizoctonia for extended time period compared to seed treatments and had higher number of harvested roots (5). This trial clearly indicates that Rhizoctonia is a full season pathogen; a susceptible variety needs an at-planting treatment (seed or in-furrow) and a properly timed postemergence fungicide application to effectively manage Rhizoctonia root rot (2).

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