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 4.7 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 seed or in-furrow fungicide treatment at planting. Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley broadcast at 35 kg ha^{-1} and incorporated with a Rau seedbed finisher. The trial was sown in six-row plots (22-inch row spacing, 25-ft rows) on May 11 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. Glyphosate (4.5 lb product ae/gallon) was applied on June 5 (22 oz A^{-1}) and 21 (28 oz A^{-1}), and July 5 (32 oz A^{-1}) for control of weeds. Cercospora leaf spot was controlled by Supertin + Topsin M (6 + 10 oz product in 19 gallons of water A^{-1}) applied with 8002 flat fan nozzles at 100 psi on July 25 and Inspire (7 oz product in 19 gallons of water A^{-1}) on August 8.

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 fungicides were applied down the drip tube in a total volume of 6 gal/A.

Application	Product	Active ingredient	Rate[Z]
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	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	10.0 fl oz product A^{-1}
In-furrow	Xanthion	Pyraclostrobin +	9.0 fl oz product A^{-1}
		Bacillus amyloliquefaciens	1.8 fl oz product A^{-1}

[Z] 11.9 fl oz AZteroid and 10 fl oz Quadris contain 0.15 and 0.16 lb azoxystrobin, respectively

Stand counts were done beginning 2 weeks after planting through 9 weeks after planting. The trial was harvested on October 5. 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.

RESULTS AND DISCUSSION

There were significant differences among treatments for plant stands at 2 through 9 weeks after planting (Fig. 1). At 2 weeks after planting, Systiva seed treatment had higher stand than the untreated control (Fig. 1). From 3 to 7 weeks after planting, all seed treatments resulted in significantly higher plant stand than the untreated control (Fig. 1). At 9 weeks after planting, only Metlock Suite + Kabina and Systiva were significantly higher in plant stand than the untreated control (Fig. 1). In-furrow fungicides resulted in stands similar to the untreated control throughout the first 9 weeks after planting (Fig. 1). For all stand counts, mean plant stand for seed treatments was significantly higher than the mean plant stand for in-furrow fungicides according to orthogonal contrasts ($P = 0.05$). It is not unusual for stand establishment to be reduced for in-furrow fungicides compared to seed treatments. Soil moisture and temperature were lower than normal at the NWROC during the period of emergence. Rainfall at the NWROC was just 0.94 inch during the month of May compared to a 30-year average of 3.04 inches for May. Average four-inch bare soil temperatures at the NWROC were 52.4 °F and 61.9 °F for the months of May and June, respectively. Average four-inch soil temperature did not cross 65 °F until July 4.

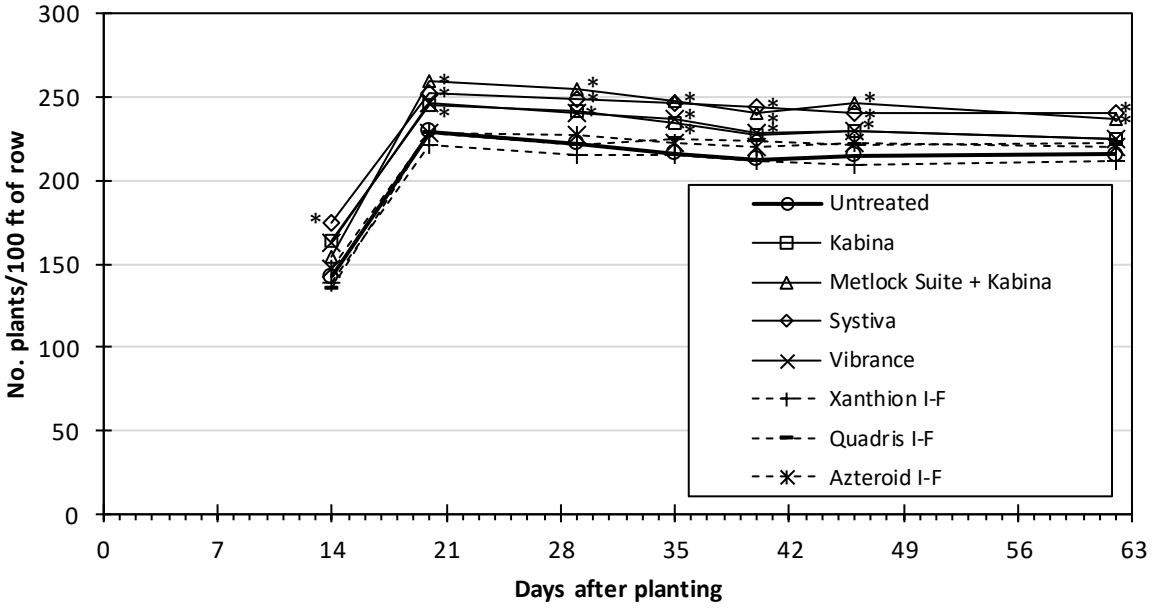

Fig. 1. Emergence and stand establishment for seed treatment (solid lines) and in-furrow (I-F, dotted lines) fungicides in a sugarbeet field trial infested with *Rhizoctonia solani* AG 2-2. For each stand count date, symbols marked with an asterisk represent stands significantly (P = 0.05) higher than the untreated control (bold solid 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	No. harv. Roots/100 ft.[X]	RCRR (0-7)[XY]	RCRR % incidence[XZ]	Yield[X]	Sucrose[X]		
					%	lb ton^{-1}	lb A^{-1}
Untreated control	174	1.2	24	30.2	17.8	337	10170
Kabina ST	193	0.7	15	31.9	18.0	340	10844
Met. Suite + 7 g Kabina	200	1.3	25	31.3	17.7	333	10430
Systiva	205	1.1	21	33.9	18.0	339	11494
Vibrance	183	1.5	28	29.4	18.0	341	10063
AZteroid in-furrow	193	0.6	14	33.8	18.3	349	11767
Quadris in-furrow	191	0.9	15	31.7	17.8	337	10681
Xanthion in-furrow	189	0.8	15	31.9	18.1	342	10947
ANOVA P-value	0.2138	0.2437	0.3962	0.3233	0.8594	0.6769	0.2532
LSD ($P = 0.05$)[X]	NS	NS	NS	NS	NS	NS	NS
Contrast analysis Seed vs in-furrow							
Mean of Seed trts.	195	1.1	22	31.6	17.9	339	10708
Mean of In-furrow trts.	191	0.7	15	32.4	18.0	343	11132
P-value	0.4391	0.0706	0.0771	0.3635	0.5758	0.3726	0.2261

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

Soil moisture remained low throughout the growing season, resulting in low Rhizoctonia disease pressure in this trial. Total rainfall for the four months of May to August was 6.54 inches in 2017 compared to a 30-year average of 12.88 for the same four months. As a result, there were no significant differences among 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 0.6 to 1.2 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 14 to 28% (Table 2). Root and sucrose yields were good for all treatments with root yields ranging from 29.4 to 33.8 ton A^{-1} and sucrose ranging from 17.7 to 18.3%. Lack of significant differences at harvest in 2017 is in contrast with typical years with higher disease pressure, where in-furrow fungicides typically result in lower root rot ratings and higher yields at harvest compared to seed treatments (6-7).

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