COMPARISON OF POSTEMERGENCE FUNGICIDES FOR CONTROL OF RHIZOCTONIA CROWN AND ROOT ROT OF SUGARBEET

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Rhizoctonia crown and root rot (RCRR) caused by the soilborne fungus *Rhizoctonia solani* AG 2-2 is a common problem in the sugarbeet growing areas of Minnesota and North Dakota. The disease can cause damping-off on seedlings and infect older roots throughout the growing season. Warm (65°F+) soil combined with excess moisture conditions favor infection and disease development. Control methods include rotating with non-host (cereal) crops such as wheat, sowing partially resistant varieties, and the use of seed treatment, in-furrow, and/or postemergence fungicides. Several options are available to sugarbeet growers for control of Rhizoctonia, including some newly registered products. Data is needed to compare new fungicides alongside established postemergence fungicides.

OBJECTIVES

A field trial inoculated with *R. solani* AG 2-2 was established to evaluate postemergence application of several registered and other fungicides for control of Rhizoctonia crown and root rot and effect on sugarbeet yield and quality.

MATERIALS AND METHODS

The trial was established at the University of Minnesota, Northwest Research and Outreach Center, Crookston on a Hegne-Fargo complex soil. 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 with the moderately susceptible cultivar 'Crystal 101RR' in six-row plots (22-inch row spacing) on May 8 at 4.5-inch seed spacing. Seed treatments included standard rates of Apron + Thiram, Tachigaren (45 g product/unit), and Kabina ST (14 g a.i./unit). Counter 20G (8 lb/A) was applied at planting for control of root maggot. 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. Treatments were assigned to plots (6 rows wide, 25 ft long) arranged in a randomized block design with four replicates. Postemergence fungicides were applied June 16 in a 7-inch band using 10 gallons of water/A with the exception of a broadcast application of the 14 fl oz A^{-1} rate of Quadris. Fungicides, active ingredients, and rates are summarized in Table 1, including 17.6 fl oz A^{-1} AZteroid (azoxystrobin), 10 and 14 fl oz A^{-1} Quadris (azoxystrobin), 7 fl oz A^{-1} Topguard EQ (azoxystrobin + flutriafol), 6.7 fl oz A^{-1} Priaxor (fluxapyroxad + pyraclostrobin) plus 0.25% non-ionic surfactant (NIS), and 5.7 fl oz A^{-1} Proline (prothioconazole) plus 0.125% NIS by volume. Plants were inoculated 3 days after fungicide treatments by applying *R. solani*-infested ground barley inoculum (23 g/25 ft of row) over each of the center four rows by hand. Following inoculation, plots were cultivated and loosened soil was hand-raked into crowns to create a favorable environment for infection with *R. solani*. A no-fungicide, inoculated control was also included. Stand counts were taken on June 9, 19, and 26.

Table 1. Product names, active ingredients, and rates used in a field trial evaluating postemergence fungicides for control of *Rhizoctonia solani* AG 2-2 on sugarbeet. Standard rates of Apron + Thiram, 45 g product/unit Tachigaren, and 14 g a.i./unit Kabina were on all seed. Fungicides were applied June 16 in a 7-inch band or broadcast using 10 gallons of water/A.

Product	Active ingredient	Product rate	Active ingredient rate	Application
Untreated control	-	-	-	-
AZteroid	Azoxystrobin	17.6 fl oz A^{-1}	103 g A^{-1}	Band
Quadris	Azoxystrobin	10 fl oz A^{-1}	73 g A^{-1}	Band
Quadris	Azoxystrobin	14 fl oz A^{-1}	103 g A^{-1}	Band
Quadris	Azoxystrobin	14 fl oz A^{-1}	103 g A^{-1}	Broadcast
Topguard EQ[Z]	Azoxystrobin + Flutriafol	7 fl oz A^{-1}	61 + 45 g A^{-1}	Band
Priaxor + NIS (0.25%)	Pyraclostrobin + Fluxapyroxad	6.7 fl oz A^{-1}	66 + 33 g A^{-1}	Band
Proline + NIS (0.125%)	Prothioconazole	5.7 fl oz A^{-1}	81 g A^{-1}	Band

[Z] Topguard EQ is registered in sugar beet only for use on foliar diseases

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. The trial was harvested on October 4 and data were collected for number of harvested roots, yield, and quality. The number of harvested roots and baseline stand counts at the time of inoculation (June 19) were used to calculate percent stand loss. 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). Means were separated by Fisher's Protected Least Significant Difference ($P = 0.05$).

RESULTS AND DISCUSSION

Harvest data is summarized in Table 2. Moderate rainfall in June (3.41 inches) resulted in adequate disease pressure for some infection, but low rainfall in July and August (1.42 and 0.77 inch, respectively) slowed development of disease. Percent stand loss, RCRR rating and incidence, and root and sucrose yields were significantly different ($P = 0.05$) among treatments (Table 2). Percent stand loss and RCRR ratings and incidence were lower for all postemergence fungicides compared to the untreated control (Table 2). Among fungicide treatments, root and sucrose yields were highest for Topguard EQ, lowest for Priaxor, and intermediate for AZteroid, Quadris treatments, and Proline (Table 2). Percent sucrose and sucrose per ton were highest for the band applications of Quadris and Proline, lowest for the untreated control and Priaxor, and intermediate for AZteroid, broadcast Quadris and Topguard EQ (Table 2).

Stand loss in the untreated control was 66%, while RCRR rating and incidence averaged 3.7 and 75%, respectively, indicating a fairly high level of disease, despite dry soil conditions throughout July and August. Yet all postemergence fungicides provided significant control of RCRR and increased root and sucrose yield compared to the untreated control. In this trial, the broadcast application of Quadris and band application of Proline performed similarly to the band applications of Quadris. In past trials, these treatments have given mixed results. This trial was inoculated both prior to planting and at the time of fungicide application. Properly timed postemergence fungicides have good potential for decreasing RCRR and increasing root and sucrose yield.

Table 2. Effect of postemergence fungicides on percent stand loss, RCRR ratings and incidence, and root and sucrose yields in a sugar beet field trial inoculated with *Rhizoctonia solani* AG 2-2.

Treatment[V]	Percent stand loss[WX]	RCRR[W] (0-7)[Y]	RCRR[W] % Incidence[Z]	Yield[W] T/A	Sucrose[W] %	Sucrose[W] lb/ton	Sucrose[W] lb recov./A
Untreated control	66 a	3.7 a	75 a	23.2 c	16.9 c	314 b	7324 c
AZteroid @ 17.6 fl oz A^{-1}	22 b	0.7 b	15 b	33.6 ab	17.6 ab	330 ab	11084 ab
Quadris @ 10 fl oz A^{-1}	15 b	0.9 b	16 b	33.5 ab	17.9 a	336 a	11272 a
Quadris @ 14 fl oz A^{-1}	27 b	1.2 b	25 b	31.9 ab	17.7 a	334 a	10659 ab
Quadris @ 14 fl oz A^{-1} broadcast	14 b	1.1 b	21 b	33.4 ab	17.4 abc	327 ab	10944 ab
Topguard EQ @ 7 fl oz A^{-1}	23 b	1.1 b	20 b	35.5 a	17.5 abc	330 ab	11715 a
Priaxor @ 6.7 fl oz A^{-1} + NIS (0.25%)	25 b	1.5 b	26 b	31.0 b	16.9 bc	316 b	9809 b
Proline @ 5.7 fl oz A^{-1} + NIS (0.125%)	25 b	1.6 b	33 b	32.7 ab	17.9 a	336 a	11013 ab
ANOVA *P*-value	0.0001	<0.0001	<0.0001	<0.0001	0.0297	0.0460	0.0001
LSD ($P = 0.05$)[W]	17.6	0.92	18.4	3.86	0.68	15.4	1451

[V] Postemergence fungicide applications were made on June 16 using 10 gallons of water/A in a 7-inch band except where noted as broadcast; 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; plots were inoculated again on June 16 (after fungicide applications) by applying *R. solani*-infested ground barley inoculum (23 g/25 ft of row) over each of the center four rows by hand, followed by cultivation and hand-raking to move some soil into the crowns.

[W] For each column, numbers followed by the same letter are not significantly different according to Fisher's Protected Least Significant Difference (LSD); NS = not significantly different

[X] Percent stand loss = percent of stand present at the time of inoculation that died by harvest;

[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

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