POSTEMERGENCE FUNGICIDES FOR CONTROL OF RHIZOCTONIA ON SUGARBEET

Jason R. Brantner and Carol E. Windels

Research Fellow and Professor, respectively
University of Minnesota, Northwest Research and Outreach Center
Crookston, MN 56716

Rhizoctonia damping-off and crown and root rot (RCRR) caused by *Rhizoctonia solani* AG 2-2 are common on sugarbeet in Minnesota and North Dakota. This soil-borne fungal pathogen can cause disease throughout the growing season and reduces stands and sucrose yield and quality. Several control options, when combined, help to reduce disease and include: planting partially resistant varieties, cultural practices (e.g., early planting, rotation with cereal crops, improved soil drainage), and application of fungicides.

OBJECTIVES

A field trial was established to compare application of postemergence fungicides for 1) control of RCRR and 2) effects on yield and quality of sugarbeet.

MATERIALS AND METHODS

A trial was established at the University of Minnesota, Northwest Research and Outreach Center, Crookston and fertilized for optimal yield and quality. Sugarbeet seed of a susceptible variety (rating = 4.4) was sown (2.4-inch spacing) on May 17. Counter 20G (6.8 lb $A^{-1)}$ and starter fertilizer (10-34-0, 3 gallon A^{-1}) were applied at planting. Glyphosate (4.5 lb product ae/gallon) was applied on June 9 and 16 and July 1 (22 oz A^{-1}) for control of weeds. Plots were thinned to approximately 175 plants/100 ft of row on June 20. When plants reached the 8-leaf stage (July 5), treatments were assigned to plots (6 rows wide, 30 ft long) arranged in a randomized block design with four replicates. Fungicides included two rates each of two different novel products (referred to as Fungicide 1 and Fungicide 2), two non-registered products from DuPont (Aproach and Vertisan), and two registered products, Quadris and Proline at labeled rates (Table 1). Fungicides were applied in a 7-inch band in the four center rows of plots. Later in the day, *R. solani*-infested ground barley inoculum (28 g/30 ft row) was deposited in sugarbeet crowns with a Gandy granule applicator. Plots then were cultivated to throw soil into crowns and cover inoculum. Two controls were included: non-inoculated and *Rhizoctonia*-inoculated plots, both with no fungicides.

Cercospora leaf spot was controlled by Inspire XT (7 oz) Super Tin 80WP + Topsin M 4.5F (5 oz + 10 fl oz) and Headline (9 oz) in 20 gallons of water A^{-1} with a tractor-mounted sprayer with TeeJet 8002 flat fan nozzles at 100 psi on July 29, August 18 and September 7, respectively. The two center rows of plots were harvested on September 27 and 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).

Table 1. Product names, active ingredients, and rates for fungicides applied in a 7-inch band for control of *Rhizoctonia solani*.

Fungicide	Active ingredient	Active ing. rate g a.i./A	Product rate fl oz/1000 ft row	Product rate fl oz/A	Induce NIS[z]
Aproach	Picoxystrobin	225	1.3	31	none
Fungicide 1	?	20 & 40	0.29 & 0.58	6.9 & 13.8	0.063% v/v
Fungicide 2	?	20 & 40	0.14 & 0.29	3.4 & 6.8	0.063% v/v
Proline	Prothioconazole	80	0.24	5.7	0.125% v/v
Quadris	Azoxystrobin	70	0.4	9.5	none
Vertisan	Penthiopyrad	225	1.6	38	none

[z] Induce NIS is a non-ionic surfactant requested for certain product applications

Table 2. Efficacy of fungicides applied in a 7-inch band at the 8-leaf stage and then inoculated with *Rhizoctonia solani* for control of crown and root rot and effect on sugarbeet yield and quality compared to two controls (non-inoculated, no fungicide and inoculated, no fungicide).

Treatment and rate (Allegiance on all seed)	RCRR (0-7)[z]	No. harv. root/100 ft[z]	Yield T/A[z]	Sucrose[z] %	Sucrose[z] lb/ton	Sucrose[z] lb recov./A
Non-inoculated, no fung. control	1.0 d	153 a	24.1 a	18.3	339	8170 ab
R. solani-inoculated						
No fungicide control	5.1 a	103 c	14.3 d	17.2	314	4598 e
Aproach	1.9 cd	149 a	23.2 a	18.2	338	7830 ab
Fungicide 1 @ 0.045 lb a.i./A	1.3 d	164 a	24.5 a	18.3	339	8320 ab
Fungicide 1 @ 0.089 lb a.i./A	1.2 d	163 a	24.8 a	18.5	345	8546 a
Fungicide 2 @ 0.045 lb a.i./A	4.9 a	109 c	15.4 cd	17.3	315	4808 de
Fungicide 2 @ 0.089 lb a.i./A	4.6 a	122 bc	17.2 bcd	17.0	309	5462 cde
Proline @ 5.7 fl oz/A	3.4 b	141 ab	20.6 abc	17.0	313	6444 bcd
Quadris @ 9.5 fl oz/A	1.2 d	160 a	25.5 a	18.3	339	8613 a
Vertisan @ 38 fl oz/A	2.8 bc	153 a	22.6 ab	17.2	316	7098 abc
ANOVA p-value	<0.0001	0.0001	0.0006	0.075	0.053	0.0001
LSD ($P = 0.05$)[z]	1.1	26.8	5.4	NS	NS	1834

[z] For each column, numbers followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD, $P = 0.05$); NS = not significantly different.

Data were subjected to analysis of variance (General Linear Model) and if significantly different ($P = 0.05$), means were separated by Fisher's protected Least Significant Difference (LSD).

RESULTS

At harvest, ratings for RCRR were significantly lowest ($P = 0.05$) in the non-inoculated, no fungicide control and plots treated with Quadris, both rates of Fungicide 1, and Aproach compared to other fungicides and the inoculated, no fungicide control (Table 2). The inoculated, no fungicide control averaged a rating of 5.1 (50 to 75% of the root surface rotted) which was statistically the same as both rates of Fungicide 2 (4.9 and 4.6, (Table 2). Proline and Vertisan resulted in RCRR ratings of 3.4 and 2.8, respectively, which were significantly better than the *Rhizoctonia*-inoculated, no fungicide control, but worse than Quadris and both rates of Fungicide 1 (Table 2).

Number of harvested roots was significantly ($P = 0.05$) highest for both rates of Fungicide 1, Quadris, the non-inoculated control, Vertisan, and Aproach compared to other fungicides and the *Rhizoctonia*-inoculated, no fungicide control (Table 2). The inoculated, no fungicide control and low rate of Fungicide 2 had the lowest number of harvested roots, while the high rate of Fungicide 2 and Proline were intermediate (Table 2). Similarly, root yields were highest for Quadris, both rates of Fungicide 1, the non-inoculated control, Aproach, Vertisan, and Proline; intermediate for Fungicide 2; and lowest for the *Rhizoctonia*-inoculated, no fungicide control. Percent sugar and pounds of recoverable sugar per ton were not significantly different among treatments. Pounds of recoverable sugar per acre were highest for Quadris, both rates of Fungicide 1, the non-inoculated control, Aproach, and Vertisan; intermediate for Proline; and lowest for both rates of Fungicide 2 and the inoculated, no fungicide control (Table 2).

DISCUSSION AND CONCLUSION

Of the two band-applied novel products tested for control of RCRR on sugarbeet, only Fungicide 1, compared very favorably with the two registered fungicides. Fungicide 1 performed similarly to the 9.5 fl oz A^{-1} rate of Quadris and outperformed Proline. Both rates of Fungicide 1 were statistically equal, but there was a tendency for the higher rate to be slightly better for recoverable sugar per acre. Results warrant further testing for Fungicide 1, but not for Fungicide 2.

Both band-applied DuPont products (Aproach and Vertisan) tested for control of RCRR on sugarbeet compared very favorably with two registered fungicides. Aproach and Vertisan performed similarly, but not quite as well as the 9.5 fl oz/A rate of Quadris. Aproach and Vertisan, however, outperformed Proline. Aproach and Vertisan were statistically equal, but there was a tendency for the Aproach to be slightly better for RCRR rating, percent sugar, and recoverable sugar per acre. Results warrant further testing for Aproach and Vertisan.

Quadris performed quite well, as it has in previous tests, especially considering the rate was its lowest labeled rate. Quadris is labeled for up to 14.5 fl oz A^{-1}. Proline was not as good as Quadris in this trial. Results of Proline in previous trials have been inconsistent, sometimes performing similar to Quadris, but often not as well.

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