APPLICATION METHOD AND RATE OF QUADRIS FOR CONTROL OF RHIZOCTONIA CROWN AND ROOT ROT

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Rhizoctonia crown and root rot (RCRR) of sugarbeet, caused by the soilborne fungus *Rhizoctonia solani* AG 2-2, is increasing in prevalence and severity in Minnesota and North Dakota. This increase is caused by a buildup of pathogen populations over many years of growing sugarbeet and susceptible rotation crops, as well as occurrence of warm and wet weather favorable for disease development. There is a need for effective and economical control methods. Current control methods include planting partially resistant varieties, cultural practices (i.e., non-host crops in the rotation), and band application of fungicides in-furrow or post-emergence.

The fungicide Quadris (azoxystrobin, Syngenta Crop Protection, Inc.) controls RCRR when applied before infections occur. The product is expensive and growers often are confused about when to apply the fungicide for maximum disease control. Labeled rates of Quadris for control of *Rhizoctonia* (in 22-inch rows) are from 0.4 to 0.7 fl oz product per 1,000 ft of row in a 7-inch band (= 9.5 to 16.6 fl oz product A^{-1}). At a current price tag of around $320 per gallon, cost for Quadris is from $23.75 to $41.50 A^{-1}. Product rebates sometimes decrease the cost per gallon. Questions have arisen about the possibility of reducing rates of Quadris in band applications (amount of product and/or band width) - and for growers without band sprayers, about the effectiveness of broadcast applications.

OBJECTIVES

A field trial was established to evaluate Quadris in 5- and 7-inch band widths and broadcast applications at four rates for 1) control of RCRR and 2) effects 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 site naturally infested with low population densities of *R. solani*. The trial was sown with a susceptible variety (2-year RCRR rating = 4.4) in six-row plots (22-inch row spacing) on May 11 at a 2.4-inch seed spacing. Counter 20G (6.8 lb A^{-1}) was applied at planting for control of root maggot and glyphosate (4.5 lb product ae/gallon) was applied on June 9 and 16 and July 1 (22 oz A^{-1}, respectively) for control of weeds. Quadris treatments included 5- and 7-inch bands and broadcast applications at four rates (0.2, 0.3, 0.4, and 0.6 fl oz product per 1,000 ft of row (= 5, 7.5, 10, and 14.5 fl oz product A^{-1}). Note: For fields with 22-inch rows, broadcast applications at 5, 7.5, 10, and 14.5 fl oz product per acre equal **one-third** of a 7-inch band application; at the above rates, a 7-in band would equal 1.7, 2.5, 3.3, and 4.8 fl oz product per acre. A no fungicide control also was included. Treatments were arranged in a randomized block design with four replicates. Cercospora leaf spot was controlled by Inspire XT (7 oz product), Super Tin 80WP + Topsin M 4.5F (5 oz + 10 fl oz product) and Headline (9 oz product) 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.

Plots were thinned to the equivalent of 175 plants per 100 ft of row on June 8. Quadris applications were made on June 9 when plants were in the 4-leaf stage and the 4-inch soil temperature maximum was 59.7 °F, but had reached its highest temperature of 64.5 °F just 3 days earlier. Stand counts were taken after thinning and at 8 days after Quadris application. The center two rows of plots were harvested 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. Effect of various rates and application methods of Quadris (azoxystrobin) applied at the 4-leaf stage on Rhizoctonia crown and root rot (RCRR) at harvest and on sugarbeet yield and quality compared to a no fungicide control in a field that was naturally infested with a low population density of *Rhizoctonia solani*.

Treatment	No. harvested roots/100 ft	RCRR (0-7)	Yield (T/A)	Sucrose %	Sucrose lb/ton	Sucrose lb recov./A	Revenue ($/A)
Control (no fungicide)	165	1.4	23.5	18.3	342	8018	1436
Application method							
5-inch band	167	1.5	24.4	18.6	347	8466	1536
7-inch band	168	1.4	25.3	18.3	341	8616	1540
Broadcast	168	1.4	24.6	18.2	337	8290	1464
Broadcast vs. band[z]	NS	NS	NS	NS	NS	NS	NS
5-inch vs. 7-inch band[z]	NS	NS	NS	NS	NS	NS	NS
Application rate							
5.0 fl oz product/A	171	1.5	24.9	18.4	342	8505	1525
7.5 fl oz product/A	166	1.4	24.4	18.5	345	8428	1522
10.0 fl oz product/A	169	1.3	25.1	18.4	342	8554	1530
14.5 fl oz product/A	166	1.5	24.7	18.2	337	8344	1476
Rate linear[z]	NS	NS	NS	NS	NS	NS	NS
Rate quadratic[z]	NS	NS	NS	NS	NS	NS	NS
Method x rate linear[z]	NS	NS	NS	NS	NS	NS	NS
Method x rate quadratic[z]	NS	NS	NS	NS	NS	NS	NS

[z] * signifies significant contrast at $P = 0.05$, ** = significant at $P = 0.01$, *** = significant at $P = 0.001$; NS = not significant.

Statistical analysis. Data were subjected to orthogonal contrasts ($P = 0.05$) for comparison of application methods and linear and quadratic responses to rate of Quadris using SAS Proc Mixed (SAS Institute, Cary, NC).

RESULTS

Data for the no fungicide control are shown for comparison (Table 1), but are not included in the statistical analysis to have balance for orthogonal contrasts. There were no significant interactions for application method by rate of Quadris (Table 1), so main effects (application method and rate of Quadris) will be discussed separately.

Disease pressure was very low and there were no statistical differences between broadcast and band or between 5- and 7-inch band applications for number of roots harvested, RCRR, root yield, sucrose (percent, pounds per ton, pounds recoverable A^{-1}) or revenue.

There were no significant ($P = 0.05$) effects (linear or quadratic) of Quadris rate on any of the harvest parameters (Table 1). All rates increased revenue over the no fungicide control enough to pay for the cost of the product but the high rate barely covered the cost of the product (Table 2).

Table 2. Revenue summary for Quadris treatment rates minus product cost in a field that was naturally infested with a low population density of *Rhizoctonia solani*.

Quadris rate (fl oz product/A)	Revenue ($/A)	Product cost ($/A)	Benefit over no fungicide[z] ($/A)
Control (no fungicide)	1436	-	-
5.0	1525	12.50	76
7.5	1522	18.75	67
10.0	1530	25.00	69
14.5	1476	36.25	4

[z] Product cost subtracted, but does not account for other costs associated with application.

DISCUSSION

Because of low disease pressure there were no significant effects of Quadris application method or rate on any of the harvest parameters. Disease pressure was extremely low at this site in 2011. Average RCRR rating for the no fungicide control was 1.4 (0-7 scale). The average for treatment with Quadris was 1.3 to 1.5. At this rating, there are only scattered, superficial, non-active lesions that don't affect yield or quality.

Although rate of Quadris did not significantly affect harvest parameters, increase in revenue with all rates of Quadris was more than enough to pay for the product (Table 2). This contrasts with results from 2010 where only the 10 and 14.5 fl oz product A^{-1} resulted in enough revenue increase to cover the cost of the product at the low disease pressure site. For growers who apply Quadris broadcast, they should note that an application rate of 14.5 fl oz product per acre (in 22-inch row fields) equals about one-third the amount applied in a 7-inch band (or equals 4.8 fl oz product per acre applied in a 7-inch band).

The most significant factor in controlling RCRR is to apply Quadris **before** plants become infected by *R. solani*. It is difficult to time application of fungicides before *Rhizoctonia* infects roots or crowns; however, applying Quadris when soil temperatures reach 65 °F at the 4-inch depth is a helpful tool. While Quadris protects roots from infections originating in the crown, which is most common, its effect on infections that occur lower in the soil is questionable. Further research under more severe natural inoculum conditions where infections occur at the crown and/or lower in the soil, as well as at different timings, is warranted to clarify efficacy of different application methods and rates of Quadris.

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