USE OF QUADRIS TO CONTROL NATURAL INFESTATIONS OF RHIZOCTONIA CROWN AND ROOT ROT IN MICHIGAN

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Introduction

Rhizoctonia crown and root rot, caused by *Rhizoctonia solani* (Kuhn) AG-2-2, is an economically important disease of sugarbeets in Michigan. Above-ground symptoms are usually not apparent until late June, and disease development continues through July and August, the month of maximum soil temperatures. Although R. solani has the potential to be an aggressive seedling pathogen, it is thought that low soil temperatures in the early season limit it to diseases of more mature plants. Until recently, no chemical controls were available, and disease reduction efforts focused on the development of resistant germplasm and cultural practices such as appropriate crop rotations, reduced cultivation and early planting.

Recently, however, the fungicide Quadris (azoxystrobin) was approved in Michigan for use against *Cercospora beticola*; it has also shown efficacy against a wide range of fungal and fungal-like pathogens of sugarbeets such as *Aphanomyces cochlioides*, *Pythium* spp. and *Alternaria* spp.. Several recent studies have shown Quadris to provide significant control of Rhizoctonia crown and root rot in artificially-inoculated disease nurseries (i.e. 2,3). These studies, while showing that Quadris could control Rhizoctonia, leave open the question of whether Quadris will work in natural situations, or if the control shown is simply a product of the inoculation and spray procedures employed.

Because Quadris is relatively expensive, the proper timing of application(s) for natural epidemics is also an important issue; to maximize control of the disease, as well as potentially lowering costs by combining application(s) with other spray regimes such as herbicide applications or control of Cercospora leaf spot (noting the potential of Quadris to control Cercospora).

Thus, we were interested in two questions. First, and most importantly, was whether Quadris is an effective control agent for Rhizoctonia crown and root rot for natural infections. Secondly, the question of the proper timing of Quadris applications was initially addressed by asking whether an early application at the 6-8 leaf stage (which could be combined with herbicide applications) was as effective as a later application at row closure, which usually coincides with the onset of above-ground symptoms.

Materials and Methods.

Four fields were chosen in 2001 near Bay City, MI: Meylan, Helmrich, Stockmeyer, and Wadsworth (labeled after the cooperating grower) with a history of high Rhizoctonia infestation. Approximately half of one field (Helmrich) was planted with corn the previous year, and half with soybeans; since there was some anecdotal evidence that Rhizoctonia disease was more severe following soybeans, we planted a test in each half of the field at this location.

Four treatments were applied at each location: an early spray at the 6-8 leaf stage; a late spray at row closure; sprayed at both times; and an unsprayed check. The amount of Quadris sprayed (early: 10.5 oz/A in a ten inch band; late: 9.2 oz/A broadcast) varied according to the label recommendations for in-furrow and broadcast applications. While the rate was approximately the same at both times, the amounts of Quadris per unit of surface area of foliar or crown tissue and the amount of Quadris incorporated into the soil was less at the later application. All treatments were replicated 5 times in a Randomized Complete Block design at each location. At Meylan, Helmrich and Stockmeyer locations, ACH 555 (a variety susceptible to Rhizoctonia crown and root rot) was planted. At Wadsworth, two varieties were planted, E17 (susceptible) and B-5736 (resistant): all spray treatments were applied to each variety for a total of 8 treatments per block. Each plot was 6 rows wide and 300-800 m long depending on the location.

Beets were planted and maintained with standard farming practises. Early spraying treatments were applied on 5/30 at the Meylan location and 5/24 at the Helmrich location at the 6-8 leaf stage. Late treatments were applied on 6/26 at both locations. The Stockmeyer and Wentworth locations were sprayed at similar times.

Disease was monitored during the season by counting the number of beets (i.e Disease Incidence) with above-ground symptoms characteristic (heavy wilting, crown and petiole blackening, death) of Rhizoctonia crown and root rot. Other diseases such as Aphanomyces root rot which can have similar above-ground symptoms were not present at these sites. Beets were counted once at each location in late July-early August. The four center rows in each plot were assessed.

All six rows were included in each plot for final yields at harvest. Two samples of 10 beets each were sampled from each plot at arbitrary locations and percent sugar and sugar purity were determined by standard methods. Results were statistically analyzed by proc Mixed of SAS V.8.2 (SAS Institute, Cary, NC).

Results

Both tests (following corn; following soybeans) at the Helmrich location had high incidence of Rhizoctonia disease; the following-soybean test had twice the crown and root rot of the following-corn test. The other three locations had low or moderate disease incidences (Table I). At most locations, the lowest incidence was with both early and late spray, but this was not significantly different (at the 95% confidence level) than a single, early spray. A single late spray reduced disease incidence, but in all cases not significantly from the untreated check.

Quadris treatments had a significant effect on yield only on the Helmrich farm (with a high disease pressure). On the following-Corn test, Early or Early/Late applications of Quadris gave a 0.7 ton/A or 1.1 ton/A increase in yield respectively, over the untreated check. In the following-Soybean test, with a very high disease incidence, the increases in yield over the check were more dramatic; 6.3 T/A with both sprays, 4.5 T/A for the early spray. A substantial (2.8 T/A) yield benefit was seen with the late spray in this trial (Table 1). A single early spray or combined spray had a significantly higher yield than the single late spray in both tests at this location.

In general, sugar percentage and purity were not affected by treatment, although the combined spray at the Meylan farm had a significantly higher sugar percentage and purity than the check (Table I). Differences between treatments for Recoverable white sugar per ton (RWST) and recoverable white sugar per acre (RWSA), derived variables based on yield, percent sugar and purity parameters, reflected the differences in the constituent quantities.

Discussion

Quadris reduced the incidence of disease at all locations, but the difference between treatments at locations with low to moderate disease pressure was non-significant likely due to the low level of disease at these locations. Quadris applications may not be economically beneficial in fields with a low disease pressure. Methods to provide foreknowledge of the amount of inoculum present in the soil before planting would increase the efficacy of spray programs.

In cases of high disease pressure, as seen at the Helmrich farm, Quadris boosted yields dramatically. Interestingly, the early spray, before above-ground symptoms of Rhizoctonia symptoms are visible, had the greatest benefit per unit cost, although an additional late spray gave roughly a two tons/A benefit (early vs. early/late sprays; late spray vs. unsprayed check) in the very heavily diseased following-Soybean test. Since above-ground symptoms of Rhizoctonia crown and root rot are not usually present at the time of the early spray, its efficacy likely indicates that *R. solani* AG 2-2 is active in soils earlier than previously thought. This early-season activity may be very important to yield losses and visible disease incidences later in the growing season. Although *R. solani* AG 2-2 in inactive at cool temperatures (~60°F); sugarbeets tend to be more resistant to Rhizoctonia diseases in general as they age (1). Thus, visible symptoms of disease may be the end product of early, chronic disease initiated when temperature are not as conducive to disease development, but when tissues are more susceptible.

Since timing of an early spray is not based on above-ground symptoms, improved knowledge of the epidemiology of Rhizoctonia crown and root rot could help time this spray most effectively. Late sprays showed some efficacy against *R. solani* at the Helmrich location, and it is unknown whether increasing the concentration or spray pattern, to concentrate more fungicide into the crowns, for instance, would have been more effective. It is evident that additional research is needed on the epidemiology of *R. solani AG 2-2*, as well as the timing, concentration and type of spray required to optimize Quadris use for growers.

Literature Cited

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Table I: Quadris Test 2001. Disease incidence (DI) and Yield (Tons/Acre) for each location. Means with different letters are signifigantly different at 95% confidence level. S.E = standard error. * - Stockmeyer yields are expressed as raw lbs. per plot.

Location	Var	Trt	DI / 100 m row		s.e.	Yield (T/A)		s.e.
Helmrich		Check	48.2	A	4.8	18.9	A	0.15
(Corn)		Late	35.7	A	4.8	18.5	A	0.15
		E+L	3.4	B	4.8	20.2	B	0.15
		Early	5.3	B	4.8	19.6	B	0.15
		Average	23.2			19.3		
Helmrich		Check	120.7	A	7.3	14.2	A	0.54
(Soybean)		Late	89.9	A	7.3	17.0	B	0.54
		E+L	5.5	B	7.3	22.5	C	0.54
		Early	9.6	B	7.3	20.7	C	0.54
		Average	56.4			18.6		
Meylan		Check	17.7	A	2.3	15.5	A	0.64
		Late	10.8	A	2.3	16.9	A	0.64
		E+L	1.1	B	2.3	16.9	A	0.64
		Early	2.1	B	2.3	16.3	A	0.64
		Average	7.9			16.4		
Stockmeyer		Check	6.9	A	1.4	12253.3*	A	-
		Early	1.1	A	1.4	12126.7	A	-
		Late	3.2	A	1.4	12653.3	A	-
		E+L	3.3	A	1.4	12780.0	A	-
		Average	3.6			12453.3		
Wentworth		Check	13.0	A	2.3	29.5	a	0.41
		Early	3.4	B	2.3	30.2	a	0.41
		Late	8.1	AB	2.3	29.5	a	0.41
		E+L	2.4	B	2.3	29.4	a	0.41
	E-17		10.3	A	1.6	29.3	a	0.29
	B-5736		3.1	B	1.6	30.0	a	0.29
		Average	6.7			29.7		

Table I: continued. Pct. Sugar = Percent sugar per beet; % CJP = clear juice purity; RWST= Raw White Sugar per Ton ; RWSA = Raw White Sugar per Acre; s.e = standard error. Means with different letters are signifigant letters at the 95% level.

Location	Var	Trt	Pct. sugar		se	% CJP		Se	RWST		se	RWSA		se
Helmrich		Check	17.35	a	0.16	93.70	a	0.46	248.53	a	6.00	4692.3	a	115.4
(Corn)		Late	17.68	a	0.16	94.10	a	0.46	256.94	a	6.00	4753.7	ab	115.4
		E+L	17.77	a	0.16	94.52	a	0.46	260.08	a	6.00	5250.5	c	115.4
		Early	17.72	a	0.16	94.03	a	0.46	256.42	a	6.00	5029.2	bc	115.4
			17.63			94.09			255.49			4931.4		
Helmrich		Check	17.32	a	0.15	92.38	a	0.28	234.32	a	6.58	3337.8	a	198.9
(Soybean)		Late	17.16	a	0.15	92.55	a	0.28	233.95	a	6.58	3960.7	a	198.9
		E+L	17.62	a	0.15	93.31	a	0.28	254.51	a	6.58	5706.0	b	198.9
		Early	17.33	a	0.15	92.96	a	0.28	246.88	a	6.58	5115.0	b	198.9
			17.36			92.80			242.41			4529.9		
Meylan		Check	14.57	a	0.13	91.14	a	0.28	191.38	a	4.04	2956.9	a	158.7
		Late	14.97	ab	0.13	91.67	ab	0.28	204.73	ab	4.04	3461.1	ab	158.7
		E+L	15.61	b	0.13	92.63	b	0.28	219.04	b	4.04	3708.2	b	158.7
		Early	15.10	ab	0.13	92.07	ab	0.28	207.56	ab	4.04	3387.7	ab	158.7
			15.06			91.88			205.68			3378.5		
Stockmeyer		Check												
		Early												
		Late												
		E+L												
Wadsworth		Check	18.88	a	0.21	94.06	a	0.19	274.56	a	4.00	8094.2	a	126.1
		Early	18.73	a	0.21	93.89	a	0.19	271.30	a	4.00	8178.5	a	126.1
		Late	18.78	a	0.24	93.76	a	0.22	271.23	a	4.54	8086.8	a	143.0
		E+L	18.94	a	0.21	94.10	a	0.19	275.69	a	4.00	8102.2	a	126.1
	E-17		18.97	a	0.15	94.23	a	0.14	276.87	a	2.83	8103.3	a	89.2
	B-5736		18.70	a	0.16	93.68	b	0.15	269.52	a	3.03	8127.6	a	95.3
			18.83			93.95			273.20			8115.44		