THE TIMING AND EFFICACY OF BANDED FUNGICIDE APPLICATIONS FOR RHIZOCTONIA ROOT AND CROWN ROT MANAGEMENT IN SUGARBEET

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ABSTRACT

Strobilurin class fungicides are effective for suppressing Rhizoctonia root and crown rot (RRCR) of sugarbeet. Our objectives were to determine the optimal timing of fungicide applications relative to tillage operations that introduce inoculum onto sugarbeet crowns and to determine the relative efficacy of several fungicides. A total of three field trials were conducted in 2001 and 2002 at the University of Wyoming Research and Extension Center at Torrington, WY. All fungicide treatments were made as a banded (7-inch width) application. Plots were cultivated and *Rhizoctonia solani* (AG2-2) inoculum was applied to the crown of each plant. Rhizoctonia crown rot incidence was rated mid to late season and beet root yields were determined at harvest. In the 2001 timing study, the most effective strobilurin fungicide treatments were those made at the time of inoculation or when a half-rate split application of fungicide was made at inoculation plus 2 weeks later. Disease incidence decreased 41-82% and root yields increased 294-398% compared to the nontreated control. In 2002, similar strobilurin timings resulted in 92% disease reductions and root yield increases of 1886% compared to the nontreated control. In 2001, the two best azoxystrobin treatments were 60% more effective than the two best trifloxystrobin treatments on average for reducing disease incidence (linear contrast, *P*• 0.05). However, trifloxystrobin treatments applied at the time of inoculation in 2001 or as a half-rate split application in 2002 were statistically equivalent to the best azoxystrobin treatments (*P*• 0.05). Pyraclostrobin was not always as effective as azoxystrobin or trifloxystrobin for RRCR suppression but final yields were equivalent to azoxystrobin and trifloxystrobin. At the rates tested, thiophanate methyl was not as effective as the strobilurins for season-long RRCR management (*P*• 0.05).

INTRODUCTION

Rhizoctonia root and crown rot (RRCR) of sugarbeet is caused by the soil-borne fungus *Rhizoctonia solani* AG 2 (Schneider & Whitney, 1986). A survey of the Western United States sugarbeet production areas revealed that RRCR was identified as a problem on 42% and 30% of the sugar beet crop in 1998 and 1999, respectively (Jacobsen *et al.*, 2001). In addition to crown and root rot of maturing sugarbeet plants, *R. solani* causes post-emergence damping-off in young seedlings. Crown rot infection is favored by temperatures of 25 to 28 C and moist soils (Parmeter, 1970). Crown rot infection results when Rhizoctonia infested soil is deposited in beet crowns during cultivation (Schneider *et al.*, 1982).

The development of fungicides that effectively suppress RRCR development offers growers an additional technique for disease management. Effective fungicides also would be an important component of integrated pest management programs that include host plant resistance and other cultural practices for RRCR suppression. The strobilurin fungicide chemistry class (azoxystrobin, Quadris®, SYNGENTA; trifloxystrobin, Gem®, BAYER; pyraclostrobin, Headline®, BASF), is effective against a wide range of fungi, including *R. solani*. The primary objective of this study was to determine the optimal time to apply a strobilurin class fungicide to sugarbeet for RRCR disease management in relation to the introduction of inoculum. A secondary objective was to determine the relative efficacy of various strobilurin fungicides for RRCR suppression. Additionally, thiophanate methyl (Topsin M®, CEREXAGRI) was explored as a low-cost alternative fungicide for RRCR management.

MATERIAL AND METHODS

A total of three experiments were conducted in 2001 and 2002 and were located at the University of Wyoming Research and Extension Center in Torrington, WY. All experiments were planted with Monohikari, a local variety that is categorized as susceptible to *R. solani* infection. Treatment plots measured 20 ft long by four rows wide (30-inch row centers) with a 5-foot in-row buffer. All treatments were made to, and all data were collected from, the center two rows. Fungicide treatments were applied in a foliar band (7-inch width) with the aid of a backpack sprayer in a total volume of 22 gal/A at 50 psi boom pressure. The boom was equipped with a single-nozzle (8002 flat fan tip). To simulate disease development resulting from tillage operations that introduce contaminated soil onto the crown of sugarbeet plants, *R. solani* (AG2-2) inoculum was applied to the crown of each plant then covered with soil in a final cultivation pass. Fungicide application timings ranged from 2 weeks before inoculation to 3 weeks after inoculation. Half-rate split fungicide applications also were made at inoculation plus 2 weeks later. Plots were rated for mid to late-season crown rot incidence and sugarbeet root yields.

RESULTS

The effects of fungicide timings on RRCR management during 2001 and 2002 are summarized in Tables 1 and 2, respectfully. Application timings of azoxystrobin or trifloxystrobin that coincided with the time of inoculation or half-rate applications split between the time of inoculation plus 2 weeks later, generally were the most effective for the management of RRCR (Table 1). Disease incidence decreased 41% to 82% and root yields increased 294% to 398% compared to the nontreated control (*P*• 0.05). Similar results with azoxystrobin and pyraclostrobin were found in 2002. Disease incidence decreased an average of 92% and root yields increased on average 1886% for the at inoculation and the half-rate split application made at the time of inoculation plus 2 weeks later (*P*• 0.05). Results for pyraclostrobin treatments reveal that most disease suppression resulted from fungicide applied at the time of inoculation and that fungicide applied 2 weeks later contributed very little to disease suppression (*P*• 0.05).

Effects of fungicide efficacy on RRCR management are summarized in Tables 3 and 4. In 2001, the azoxystrobin at inoculation and half-rate split application timings had on average 60% less disease incidence than the average of the corresponding trifloxystrobin timings (Table 3, linear contrast, *P*• 0.05). However, trifloxystrobin applied at the time of inoculation in 2001 (Table 1) or as a half-rate split application in 2002, provided statistically equivalent disease suppression and total root yields (Table 4, *P*• 0.05). Pyraclostrobin was not always as effective as the other strobilurins for disease suppression but final yields were equivalent to azoxystrobin and trifloxystrobin (*P*• 0.05). Thiophanate methyl half-rate split application was not as effective as the half-rate split applications of strobilurin (*P*• 0.05). Initially, thiophanate methyl application resulted in a 55% decrease in disease incidence but, by harvest yields were equivalent to the nontreated control (*P*• 0.05).

Table 1. Effects of azoxystrobin and trifloxystrobin application timings on RRCR management and sugarbeet root yields, 2001.

[a] All applications were made in a 7-in. banded spray in 22 gal/A @ 50 psi boom pressure. Plants were inoculated with Rhizoctonia solani AG2-2 on 13 Jun, 2001 immediately after the 13 Jun fungicide application and tillage. NA= not applicable.

[b] Treatment means followed by different letters differ significantly (Fisher's protected LSD, $P \leq 0.05$).

Treatment	Timing and Application rate (oz ai/1000 row ft) [a]	RRCR incidence (per 20 row ft) 21 Aug	Beet yield (T/A)
Nontreated	NA	28.8 ab [b]	4.7 de
Azoxystrobin	2 weeks before inoculation (0.15)	26.8 abc	3.4 e
Azoxystrobin	1 weeks before inoculation (0.15)	24.8 a-d	14.9 a-d
Azoxystrobin	at inoculation (0.15)	6.5 fg	22.0 a
Azoxystrobin	1 week after inoculation (0.15)	15.3 d-g	24.3 a
Azoxystrobin	2 weeks after inoculation (0.15)	17.8 b-e	20.2 a
Azoxystrobin	3 weeks after inoculation (0.15)	17.8 b-e	17.7 abc
Azoxystrobin	at inoculation (0.075) plus 2 weeks after inoculation (0.075)	5.3 g	23.4 a
Trifloxystrobin	2 weeks before inoculation (0.15)	26.0 a-d	0.0 e
Trifloxystrobin	1 weeks before inoculation (0.15)	32.3 a	8.0 b-e
Trifloxystrobin	at inoculation (0.15)	12.8 efg	18.5 ab
Trifloxystrobin	1 week after inoculation (0.15)	24.0 a-d	8.8 b-e
Trifloxystrobin	2 weeks after inoculation (0.15)	18.8 b-e	7.1 cde
Trifloxystrobin	3 weeks after inoculation (0.15)	19.5 b-e	4.0 e
Trifloxystrobin	at inoculation (0.075) plus 2 weeks after inoculation (0.075)	17.0 c-f	21.9 a

Table 2. Effects of azoxystrobin and pyraclostrobin application timing on RRCR management and sugarbeet root yields, 2002.

[a] All applications were made in a 7-in. banded spray in 22 gal/A @ 50 psi boom pressure. Plants were inoculated with Rhizoctonia solani AG2-2 on 21 Jun, 2002 immediately after the 21 Jun fungicide application and tillage. NA= not applicable.

[b] Treatment means followed by different letters differ significantly (Fisher's protected LSD, P≤0.05).

Treatment	Timing and Application rate (oz ai/1000 row ft) [a]	RRCR incidence (per 20 row ft) 16 Jul	Beet yield (T/A)
Nontreated	NA	39.6 a [b]	0.3 b
Azoxystrobin	at inoculation (0.075) plus 2 weeks after inoculation (0.075)	2.5 b	23.3 a
Azoxystrobin	at inoculation (0.15)	2.1 b	22.6 a
Pyraclostrobin	at inoculation (0.075) plus 2 weeks after inoculation (0.075)	5.8 b	18.7 a
Pyraclostrobin	at inoculation (0.15)	2.8 b	18.8 a
Pyraclostrobin	2 weeks after inoculation (0.15)	36.1 a	1.8 b

Table 3. Relative efficacy of azoxystrobin and trifloxystrobin fungicides on RRCR incidence and sugarbeet root yields, linear contrast results, 2001.

[a] All applications were made in a 7-in. banded spray in 22 gal/A @ 50 psi boom pressure. Plants were inoculated with Rhizoctonia solani AG2-2 on 13 Jun, 2001 immediately after the 13 Jun fungicide application and tillage. NA= not applicable.

[b] Treatment means followed by different letters differ significantly (Linear contrasts, P≤0.05).

Treatment (avg over the at inoculation and split timings) [a]	RRCR incidence (per 20 row ft) 21 Aug	Beet yield (T/A)
Nontreated	28.8 a [b]	4.7 a
Azoxystrobin	5.9 c	22.7 b
Trifloxystrobin	14.9 b	20.2 b

Table 4. Efficacy of half-rate split applications of fungicides on RRCR incidence and sugarbeet root yields, 2001-2002.

[a] All applications were made in a 7-in. banded spray in 22 gal/A @ 50 psi boom pressure. First number was the rate tested in 2001, second number was the rate tested 2002. Thiophanate methyl was tested during 2002.

[b] Treatment means followed by different letters differ significantly (Fisher's protected LSD, P•0.05).

Treatment	Timing and Application rate (oz ai/1000 row ft) [a]	2001		2002	
		RRCR incidence (per 20 row ft) 21 Aug	Beet yield (T/A)	RRCR incidence (per 20 row ft) 16 Jul	Beet yield (T/A)
Nontreated	NA	27.8 a [b]	5.4 b	39.6 a	0.3 b
Azoxystrobin	at inoculation (0.19)/ (0.075) plus 2 weeks after inoculation (0.19)/ (0.075)	3.8 c	23.7 a	2.5 c	23.3 a
Trifloxystrobin	at inoculation (0.21)/ (0.075) plus 2 weeks after inoculation (0.21)/ (0.075)	4.0 c	25.2 a	3.3 c	19.0 a
Pyraclostrobin	at inoculation (0.19)/ (0.075) plus 2 weeks after inoculation (0.19)/ (0.075)	15.8 b	22.9 a	5.8 c	18.7 a
Thiophanate methyl	at inoculation (0.2345) plus 2 weeks after inoculation (0.2345)	NA	NA	17.8 b	5.0 b

CONCLUSION

The most effective timing of strobilurin class fungicide treatment application was at the time of inoculation or when a half-rate split application of fungicide was made at inoculation plus 2 weeks later. Efficacy rankings of strobilurins for RRCR suppression revealed azoxystrobin>trifloxystrobin>pyraclostrobin although differences were not always significant (*P*•0.05). At the rates tested, thiophanate methyl was not as effective as the strobilurin fungicides for season-long RRCR management (*P*•0.05).

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