

NOVEL SEED TREATMENT FUNGICIDES FOR CONTROL OF RHIZOCTONIA

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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 causes disease throughout the growing season and reduces stands and sucrose yield and quality. Rhizoctonia diseases are managed through planting partially resistant varieties, cultural practices (e.g., early planting, rotation with cereal crops, good soil drainage), and application of fungicides. Currently, commercially sold seed is treated with fungicides that provide only moderate control of Rhizoctonia damping-off, so screening for more effective seed fungicides continues.

OBJECTIVES

A field trial was established to compare performance of two non-registered seed treatment products compared to standard seed treatment products for: 1) control of Rhizoctonia diseases and 2) effect on sugarbeet yield and quality. The same seed treatments also were evaluated in a controlled environment growth chamber trial where field soil was infested with *R. solani* to compare protection of stand against Rhizoctonia damping-off.

MATERIALS AND METHODS

Field trial. A trial was established at the University of Minnesota, Northwest Research and Outreach Center, Crookston. Plots were fertilized to ensure optimal sugarbeet yield and quality. Soil was infested with *R. solani* (grown on whole barley grains) at 35 kg ha⁻¹ and incorporated into the top 4 inches with a Melrow multiweeder followed by a Rau harrow with rolling baskets. Then, the trial was sown with sugarbeet seed (VDH 46519) at a 4.7-inch spacing on May 17, 2011. Seed treatments included an untreated control, fludioxonil (Maxim 4FS @ 0.04 oz a.i./cwt), Thiram (8 fl oz/cwt), Fungicide 1 (two rates: 0.05 g a.i./unit and 0.10 g a.i./unit) and Fungicide 2 (two rates: 0.05 g a.i./unit and 0.10 g a.i./unit). All seed, including the controls, were treated with Allegiance (0.15 g a.i./unit of seed) to prevent Pythium seed rot. Non-inoculated control plots were sown with seed treated with Allegiance + Thiram to establish baseline of disease pressure for comparison to *Rhizoctonia*-inoculated plots. Seed treatments and the control were planted in the four middle rows of six-row plots (rows 22 inches apart, 30 ft long) and replicated four times. Counter 20G was applied at planting at 6.8 lb of product A⁻¹ to control sugarbeet root maggot. Starter fertilizer (10-34-0, 3 gallons A⁻¹) was applied at planting. Weeds were controlled with microrate herbicides (0.5-0.7 pt Betamix + 1/8 oz UpBeet + 50 ml Stinger + 10 oz Select + 1-2 pt MSO A⁻¹) on June 6, 9, 20 (no Stinger), and July 1. Cercospora leaf spot was controlled with Inspire XT (7 oz product A⁻¹ on July 29) Super Tin 80WP + Topsin M 4.5F (5 oz + 10 fl oz product A⁻¹ on August 18) and Headline (9 oz product A⁻¹ on September 7) in 20 gallons of water using a tractor-mounted sprayer with TeeJet 8002 flat fan nozzles at 100 psi.

Stand counts were made in the two center rows of each treatment at 15, 17, 20, 27, 31, 34, and 43 days after planting. The two center rows 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).

Growth chamber trial. Seed treated with the same fungicides evaluated in the field trial were sown (16 seed/10 x 10 x 10 cm pot, 2-cm depth) in natural field soil infested with *R. solani* AG 2-2 intraspecific group IIIB at a rate of 10 kg ground infested barley/ha (~10 mg/600 cc soil/pot). Soil was watered thoroughly and pots were incubated at ~77 °F for 4 weeks.

Emergent seedlings were counted three times weekly. Dying seedlings were removed and assayed in the laboratory to determine cause of death. Necrotic portions of hypocotyls and roots were rinsed in 0.5% sodium hypochlorite,

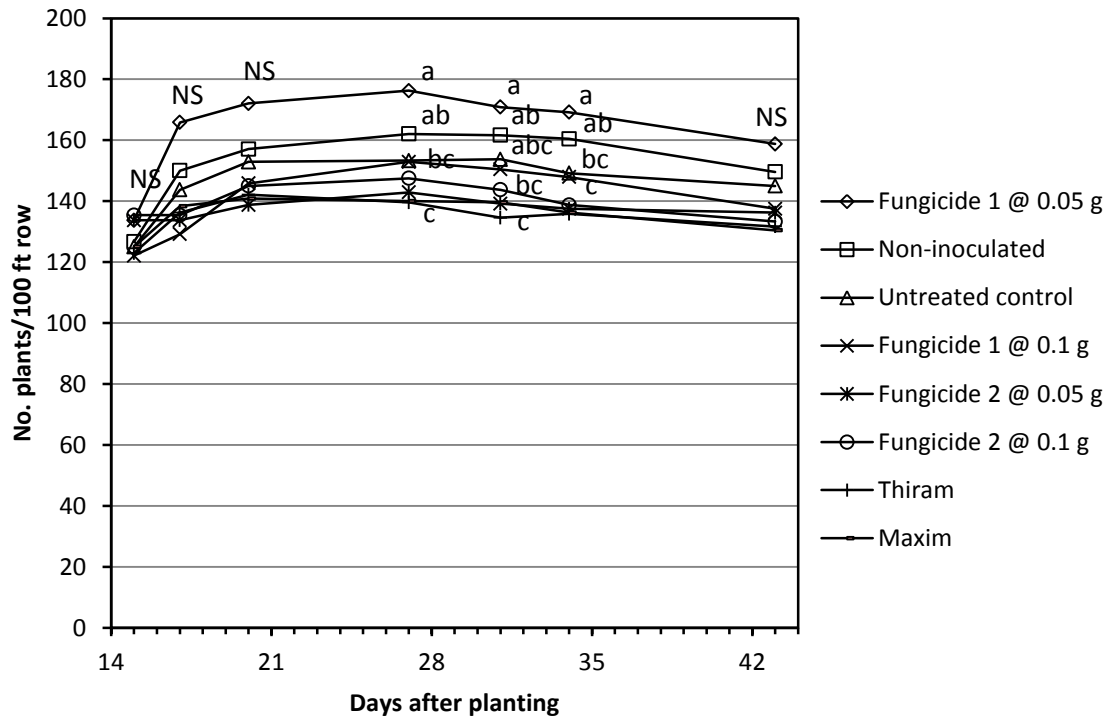


Fig. 1. Stand of sugarbeet seedlings in a field inoculated with *Rhizoctonia solani* and sown with seed treated with various fungicides compared to a non-treated control; all seed also was treated with Allegiance (0.15 g a.i. per unit of seed). Each data point is an average of four replicates; at each stand count date, treatments followed by the same letter are not significantly different ($P = 0.05$), NS = not significantly different at $P = 0.05$.

rinsed twice with deionized water, and placed in quad-portioned petri dishes with ~5 ml deionized ultra-filtered water. Hypocotyls were microscopically examined after 48 hr to verify presence of *R. solani* or other soilborne pathogens.

After 4 weeks, remaining plants were gently removed from soil, washed, and rated on a 0 to 3 scale where 0 = no disease and 3 = dead seedling. The number of plants that died during the 4 week assay and root rot ratings were used to calculate a root rot index (0-100 scale; 0 = no disease, 100 = all plants died during the assay).

Data for both field and growth chamber trials were subjected to analysis of variance and if significantly different ($P = 0.05$), means were separated by Fisher's Protected Least Significant Difference.

RESULTS

Field trial. Emergence was somewhat low and equal (~130 plants/100 ft ~50% emergence) for all seed treatments and the controls at about 14 days after planting and increased to 140 to 170 plants per 100 ft by 21 days after planting (Fig. 1). *Rhizoctonia* damping-off did not start to occur until 28 days after planting and stands from seed treated with the low rate of Fungicide 1 were significantly higher than all other seed treatments; stand in the non-inoculated control was intermediate. By 43 days after planting, stands were statistically the same among all fungicide seed treatments and the controls (Fig. 1). Rate of stand loss after 28 days was similar for inoculated and non-inoculated controls, so disease pressure was very low at this time.

At harvest, stands were statistically equal for all treatments (Table 1). *Rhizoctonia* crown and root rot (RCRR) was low across all treatments in *Rhizoctonia*-inoculated soil and was lowest in the non-inoculated control (Table 1). A significantly lower rating for RCRR occurred on roots from the non-inoculated control (Table 1) compared to the *Rhizoctonia*-inoculated untreated control. Numbers of harvested roots and root and sucrose yields, however, were statistically the same for roots of all seed treatments and the controls (Table 1).

Table 1. Efficacy of sugarbeet seed treatments sown into a field inoculated with *Rhizoctonia solani* before planting for effects on *Rhizoctonia* crown and root rot (RCRR) and on sugarbeet yield and quality compared to two controls (inoculated with *R. solani* and non-inoculated).

Treatment and rate (Allegiance on all seed)	RCRR (0-7) ^z	No. harv. root/100 ft ²	Yield T/A ^z	Sucrose ^z		
				%	lb/ton	lb recov./A
Non-inoculated control (Thiram)	1.3 c	128	24.5	18.4	339	8297
<i>R. solani</i> -inoculated						
Untreated control	2.1 a	128	23.4	17.9	332	7761
Maxim 4FS (Fludioxonil)	1.9 ab	120	23.2	17.7	328	7610
Thiram	1.6 bc	123	24.1	17.6	321	7737
Fungicide 1 @ 0.05 g a.i./unit	1.8 abc	139	23.9	17.8	329	7846
Fungicide 1 @ 0.1 g a.i./unit	1.9 ab	118	22.0	17.8	329	7241
Fungicide 2 @ 0.05 g a.i./unit	1.9 ab	121	24.3	17.6	324	7887
Fungicide 2 @ 0.10 g a.i./unit	2.1 a	120	23.3	18.1	336	7848
LSD (<i>P</i> = 0.05)	0.43	NS	NS	NS	NS	NS

^y Allegiance (0.15 g a.i./unit) was on all seed and provides control of *Pythium*.

^z Each data value is an average of four replicates; numbers in each column followed by the same letter are not significantly different (*P* = 0.05), NS = not significantly different.

Growth chamber trial. Emergence of seedlings for all seed treatments was good in the growth chamber at 77 °F. By 6 days after planting, stand was 75-85% and statistically equal for all treatments (Fig. 2). Plants began damping-off from *R. solani* by 7-8 days after planting for all treatments except the two rates of Fungicide 1, which continued increasing in percent stand (Fig. 2). By 4 weeks after planting, all seedlings had died except seedlings from seed treated with Fungicide 1. Seedlings began dying for both rates of Fungicide 1 around 16 days after planting, but at a slower rate for the higher rate of Fungicide 1. By 4 weeks after planting, final stands were 40 and 74% for the low and high rate of Fungicide 1, respectively (Fig. 2). Root rot indices were statistically equal (98-100) for all treatments other than Fungicide 1 (data not shown). Root rot indices were 76, and 54 for the low and high rates of Fungicide 1, respectively, which were significantly different from each other and other treatments (data not shown).

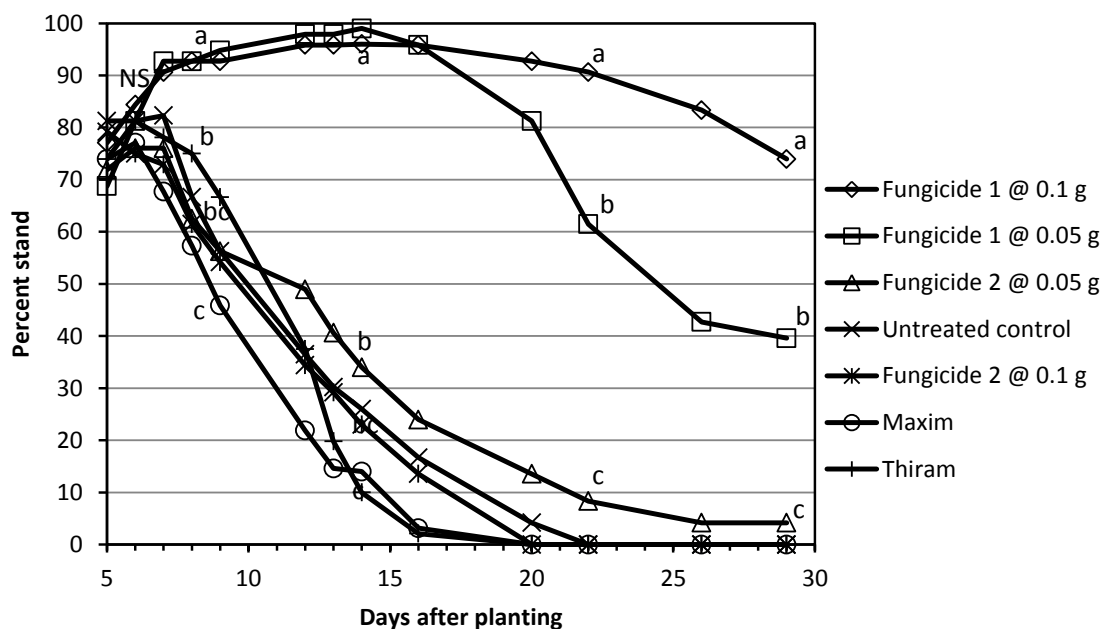


Fig. 2. Stand of sugarbeet seedlings in natural field soil infested with *Rhizoctonia solani* and sown with seed treated with various fungicides compared to an untreated control; all seed also was treated with Allegiance (0.15 g a.i. per unit of seed). Each data point is an average of four replicates; at each stand count date, treatments followed by the same letter are not significantly different (*P* = 0.05), NS = not significantly different at *P* = 0.05.

DISCUSSION AND CONCLUSIONS

In the field trial, disease pressure was too low to discern differences among seed treatment fungicides for control of *Rhizoctonia* damping-off and crown and root rot on sugarbeet. *Rhizoctonia* crown and root rot ratings at harvest were ≤ 2.1 (0-7 scale) for all treatments. A rating of 2 means presence of a shallow, dry rot canker or active lateral lesions affecting $\leq 5\%$ of the root. Seed treatment fungicides decompose within 4 weeks after planting, so they do not typically affect later-season infections of crowns and roots by *R. solani*. There was a trend for the non-inoculated control to have lower RCRR ratings and higher recoverable sugar A⁻¹ than *Rhizoctonia*-inoculated treatments, which experienced low disease pressure throughout the growing season.

In the growth chamber trial, environmental conditions were controlled to favor development of *Rhizoctonia* damping-off of seedlings (77 °F and high soil moisture), so efficacy of seed treatment fungicides could be determined. Fungicide 1 had excellent activity against *R. solani* and the higher rate was better than the lower rate. Based on our previous experience, activity of the higher rate of Fungicide 1 was on par with some of the better seed treatments we have tested, although direct comparison is not possible since soil assays often vary, even when conducted under similar conditions. Results suggest that the active ingredient in Fungicide 1 should be further tested in trials that include other products showing good potential for control of *Rhizoctonia* on sugarbeet.

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