Mitigation of Summer Stress of Roughstalk Bluegrass with Strobilurin Fungicides

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BACKGROUND

Rough bluegrass (RBG, *Poa trivialis* L.) is a problematic weed in tall fescue (*Festuca arundinacea* Schreb.) and Kentucky bluegrass (*Poa pratensis* L.) lawns and roughs, as well as creeping bentgrass (*Agrostis stolonifera* L.) fairways. Rough bluegrass can be a contaminant included under the "other crop" category on seed labels, and is often unknowingly planted with desirable species as a result. Rough bluegrass enters a stress-induced dormancy during summer months leaving behind brown patches that are easily mistaken for disease. Recently, researchers observed the mitigation of summer decline of RBG with application of strobilurin fungicides (Figure 1) and postulated that summer diseases may influence RBG decline (Weisenberger and Reicher, 2007).

Figure 1. Lack of RBG decline in West Lafayette, IN after treatment with Heritage 50 WDG followed by heat stress.

OBJECTIVES

- Determine the effects of several strobilurin fungicides on measures of RBG health.
- Determine if root or foliar pathogens contribute to summer RBG decline.

MATERIALS AND METHODS

- Randomized complete block design with four replications. Individual plots were 0.9 m × 0.9 m. The study was conducted in Manhattan, KS in 2011. In 2012, the study was conducted in Manhattan, KS and Lincoln, NE.

- Fungicides:
  - ***Heritage 50 WDG*** and ***Heritage TL*** (azoxystrobin; Syngenta Crop Protection, Greensboro, NC) at **610 g a.i. ha^{-1}**
  - ***Insignia 20 WG*** and ***Insignia SC*** (pyraclostrobin; BASF Corporation, Research Triangle Park, NC) at **556 g a.i. ha^{-1}**
  - Water carrier: 815.6 L ha^{-1}

  Fungicides were applied at a 2-week interval from 21 May to 23 August in 2011. In 2012, fungicides were applied from 23 April to 30 August in Manhattan, KS and from 4 May to 30 August in Lincoln, NE.

- *Percent cover*, *turfgrass quality*, and *gross photosynthesis (Pg)* were monitored weekly.
  - *Percent cover* data were taken as a visual estimate of each plot covered by RBG.
  - *Turfgrass quality* was taken considering color, density, and uniformity on a 1 to 9 scale (1=completely brown, 6=minimum acceptable quality, 9=optimum color, density, and uniformity).
  - *Pg* was estimated by monitoring carbon dioxide concentrations using a non-steady state chamber that was developed at Kansas State University and configured with a closed path infrared gas analyzer (LI-840, Li-Cor Industries, Lincoln, NE).

- Several rooting parameters were measured in 2012 in Manhattan and Lincoln. Plugs (5 cm diameter × 17.5 cm deep) were removed from each plot, washed, and analyzed with WinRHIZO (version 2003 b, Regent Instruments, Quebec City, Canada) to determine:
  - *Root length density (RLD)*
  - *Surface area*
  - *Average root diameter*

  After analysis, roots were dried at 60°C for 2 days and then weighed to determine *Root Biomass.*

- *Disease sampling*: Plots were sampled for the presence of root and foliar pathogens on 24 May and 11 July in 2011. In 2012, plots were sampled on 11 June and 7 August in Manhattan only.

RESULTS

- ***Gross photosynthesis*:**
  - Heritage TL and Insignia SC averaged greater Pg than untreated plots on 2 of 10 dates each in 2011 (Table 1).
  - In 2012, Heritage 50 WDG, Heritage TL, Insignia 20 WG, and Insignia SC averaged greater Pg than untreated plots on 5, 5, 3, and 4 dates out of 14, respectively, in Manhattan. In Lincoln, Heritage 50 WDG and Insignia SC averaged greater Pg than untreated on 1 of 4 dates each.
  - Fungicides did not have an effect on Pg until RBG was exposed to extended periods of heat stress.

- ***Rough bluegrass quality:***
  - Heritage 50 WDG and Heritage TL improved quality over untreated plots in 2011 (Table 2).
  - In 2012, all fungicides increased quality over the untreated in Manhattan and Lincoln.

- ***Rough bluegrass cover:***
  - Heritage 50 WDG and Heritage TL increased RBG cover compared to untreated in 2011 (Table 3; Figure 2).
  - In 2012, all fungicides increased RBG cover compared to untreated in Manhattan and Lincoln.

- ***Rooting parameters:***
  - Compared to untreated in late summer of 2012, Heritage 50 WDG resulted in greater **RLD** (11.1 cm cm^{-3} vs. 6.7 cm cm^{-3}), **surface area** (175.2 cm^2 vs. 92.1 cm^2), **average root diameter** (0.15 mm vs. 0.13 mm), and **total root biomass** (0.15 g vs. 0.07 g) in Manhattan, KS. There were no differences in rooting in Lincoln, NE.

- ***Pathogenic contribution to decline:***
  - A small amount of dollar spot (*Sclerotinia homoeocarpa*) was observed in untreated plots in Manhattan and Lincoln in 2012. Incidence was very low, and dollar spot was not a major contributor to the summer decline of RBG.
  - There were no other known or unknown foliar or root pathogens consistently detected in 2011 or 2012.

RESULTS CONTINUED

Table 1. Effect of fungicide treatments on gross photosynthesis in 2011 in Manhattan, KS and in 2012 in Manhattan, KS and Lincoln, NE.

	Pg (µmol CO_2 m^{-2} s^{-1})†									
	2011			2012						
	Manhattan, KS			Manhattan, KS						Lincoln, NE
Treatment	15 June	28 June	16 Aug.	24 July	31 July	8 Aug.	15 Aug.	21 Aug.	30 Aug.	28 June
Untreated‡	12.8	14.4	0.1	12.7	9.1	6.2	5.9	6.7	5.9	10.7
Heritage 50 WDG	12.8	14.9	2.7	**17.3**	11.6	**12.7**	**16.9**	**17.1**	**18.8**	**18.1**
Heritage TL	**17.4**	16.2	**2.8**	15.5	**14.6**	**11.3**	**14.0**	**18.5**	**14.1**	12.7
Insignia 20 WG	15.3	13.2	1.3	16.3	**15.1**	**13.1**	10.2	13.6	**17.4**	14.5
Insignia SC	**17.0**	**17.5**	1.8	15.8	11.1	**15.3**	**15.9**	**15.1**	**18.2**	**16.6**

†Gross photosynthesis measurements were taken weekly from 31 May to 8 Sept. in 2011, and from 4 June to 6 Sept. in 2012 in Manhattan. In 2012, measurements were also taken monthly in Lincoln from June to Sept. Only means from significant rating dates are shown.

‡A set of single degree of freedom contrasts were used to compare fungicide treatments to the untreated control. Means highlighted in red are significantly different from untreated ($P < 0.05$).

Table 2. Effect of fungicide treatments on RBG quality in 2011 in Manhattan, KS and in 2012 in Manhattan, KS and Lincoln, NE.

	2011		2012			
	Manhattan, KS		Manhattan, KS		Lincoln, NE	
Treatment	Quality†	DBU‡	Quality	DBU	Quality	DBU
Untreated	3.5	*N/A*	6.6	*N/A*	6.0	*N/A*
Heritage 50 WDG	**4.2**	14	**7.7**	9	**7.0**	8
Heritage TL	**4.6**	18	**8.1**	13	**6.7**	7
Insignia 20 WG	4.0	4	**7.8**	10	**6.5**	4
Insignia SC	3.9	2	**7.7**	9	**6.7**	5

†Means represent season-long quality estimates. Single degree of freedom contrasts were used to compare fungicides to untreated. Means highlighted in red are significantly different from untreated ($P < 0.05$).

‡Days better than untreated (DBU), out of 25, 22, and 11 total dates in 2011, 2012-Manhattan, and 2012-Lincoln, respectively.

Table 3. Effect of fungicide treatments on RBG cover in 2011 in Manhattan, KS and in 2012 in Manhattan, KS and Lincoln, NE.

	Turfgrass Cover†									
	2011			2012						
	Manhattan, KS			Manhattan, KS			Lincoln, NE			
Treatment	28 Aug.	28 Sept.	30 May 12‡	27 July	30 Aug.	26 Sept.	29 June	31 July	30 Aug.	28 Sept.
Untreated§	0.8	0.3	30.0	77.5	73.8	78.3	67.5	58.8	62.5	71.3
Heritage 50 WDG	**16.8**	**7.5**	**87.8**	85.5	**95.3**	**95.8**	**81.3**	**78.8**	**82.5**	**80.0**
Heritage TL	**21.3**	**7.8**	**91.0**	**95.8**	**98.0**	**99.3**	**76.3**	**70.0**	**83.8**	**80.0**
Insignia 20 WG	8.3	2.0	63.8	**93.0**	**93.8**	**96.5**	**78.8**	**72.5**	**76.3**	76.3
Insignia SC	7.5	1.0	**63.8**	88.3	**88.5**	**92.5**	**78.8**	**76.3**	**80.0**	76.3

†Turfgrass cover data were visually estimated. Cover data were subject to an *arcsine* (*y*) transformation prior to analysis and back transformed for presentation; selected dates on which significant differences occurred are shown.

‡Data on 30 May 2012 represent recovery of the 2011 study the following spring.

§A set of single degree of freedom contrasts were used to compare fungicide treatments to the untreated control. Means highlighted in red are significantly different from untreated ($P < 0.05$).

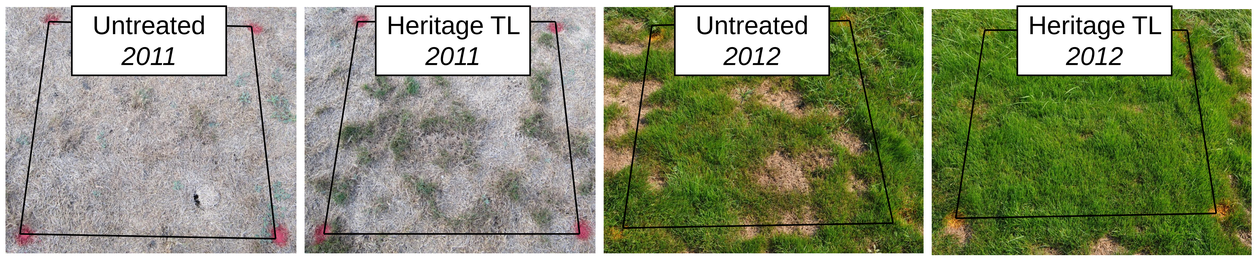

Figure 2. Untreated plots, and plots treated with Heritage TL in Manhattan, KS on 1 September 2011 (*left*) and 28 August 2012 (*right*). Other fungicides yielded similar results.

CONCLUSIONS

Like Weisenberger and Reicher (2007), we observed that treatment with strobilurin fungicides increased RBG quality and cover during periods of high temperature stress. The products also resulted in higher RBG photosynthetic rates during stressful periods, though it is likely that increased metabolic activity is secondary, and results from delayed leaf senescence (Brosnan et al., 2010). Increased RBG rooting was observed with applications of Heritage 50 WDG, though this response was variable. No foliar or root pathogen was associated with the summer decline of RBG.

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