Seasonal nitrogen fertilization programs and plant growth regulator effects on anthracnose severity of annual bluegrass putting green turf

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INTRODUCTION

- Anthracnose (caused by *Colletotrichum cereale sensu* lato Crouch, Clarke, and Hillman) is a detrimental disease of annual bluegrass (ABG; *Poa annua* L.) putting green turf.
- Nitrogen applied every 7-d at 4.9 kg ha^{-1} during the summer has been demonstrated to reduce anthracnose severity on ABG (Inguagiato et.al., 2008). However, the influence of seasonal N programming on the ability of plant growth regulators to reduce anthracnose is not well understood.
- Ethephon (ET) inhibits seedhead growth of ABG. Controlling seedheads could enable ABG to reallocate carbohydrates to tillers and roots (Ong et.al., 1975) helping to increase stress tolerance.
- Trinexapac-ethyl (TE) is known to suppress shoot growth, and increase turf density. However, the efficacy of TE decreases with greater temperatures. A new growing degree day model (GDD200; base 0°C) can improve consistency of growth suppression and reduce N removal from creeping bentgrass turf (Kreuser et.al., 2011, 2012).
- ET and TE have been shown to reduce anthracnose; however reductions have been inconsistent. It has been speculated that the efficacy of ET and TE is dependent on increased spring N fertilization (Inguagiato et.al., 2009, 2010). Further research is needed to determine if PGR programs can be optimized for enhanced anthracnose suppression.

OBJECTIVES

- To evaluate potential interactions between seasonal nitrogen fertilization programs, ethephon, and trinexapac-ethyl application interval on anthracnose severity of ABG putting green turf.

MATERIALS & METHODS

- A two year field study was established in April 2013 on ABG maintained at 3.2 mm in Storrs, CT.
- The study was conducted as a randomized complete block design with 4 replications. Seasonal N programs, ET and TE interval were studied in a 3 x 2 x 3 factorial arrangement.
- Seasonal N programs included spring or fall applications of 48.8 kg ha^{-1}, or a split application of 12.2 and 36.6 kg ha^{-1} applied spring and fall respectively. N was applied uniformly to all plots at 4.9 kg ha^{-1} as urea every 14-d from May to August.
- Ethephon was applied at 0 or 3.8 kg a.i. ha^{-1} twice in April once 110-167 GDD base 0°C had accumulated
- Trinexapac-ethyl intervals consisted of none, every 14-d, or every 200 GDD base 0°C from mid-Apr through July 2013 and August 2014, applied at 0.05 kg a.i. ha^{-1}.
- Anthracnose severity was rated as percent plot area blighted by using a line-intercept grid count method every 7-d.
- Percent seedhead cover was visually assessed every 7-d during May and June.
- Clippings were collected every 14-d from May through August, dried, cleaned and weighed.
- Clipping total N concentration was determined as a percentage of tissue dry wt. by combustion analysis (LECO TruMac CN analyzer).
- Area under the curve values of seedhead production, clipping N concentration and clipping yield were calculated to assess treatment effects throughout the growing season.
- Data were subjected to an analysis of variance and means were separated using Fisher's protected least significant difference test (α = 0.05).

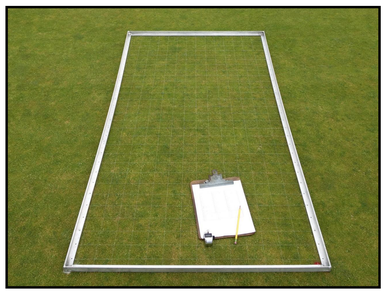

Fig. 1. Line-intercept grid

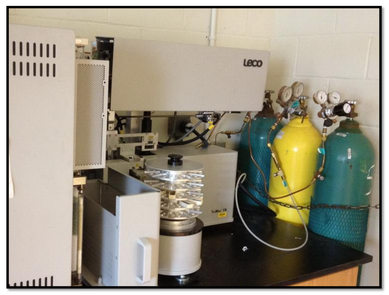

Fig. 2. LECO TruMac CN analyzer

RESULTS

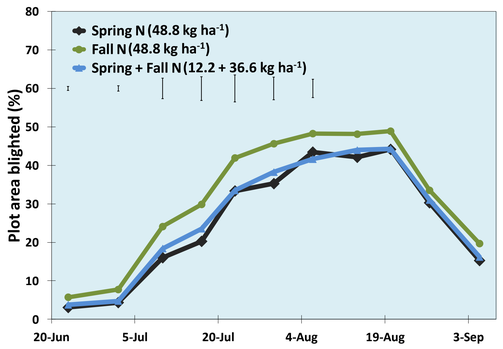

Fig. 3. Seasonal nitrogen effect on anthracnose severity of annual bluegrass in 2014.

- Both spring N programs reduced anthracnose severity 2 to 10% from Jun through early Aug compared to fall N only program.
- By late summer, N programs had no effect on anthracnose.

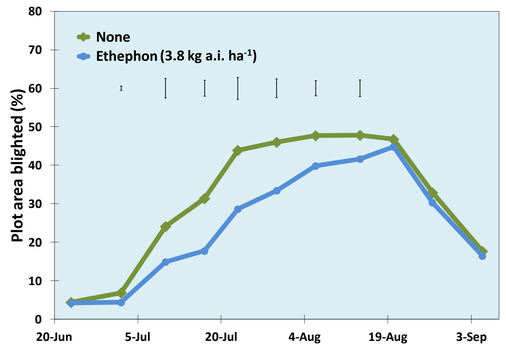

Fig. 4. Ethephon effect on anthracnose severity of annual bluegrass in 2014.

- Ethephon reduced anthracnose 2 to 16% compared to no ET from Jun through mid-Aug.
- However, it had no effect as disease recovered 19 weeks after the initial application.

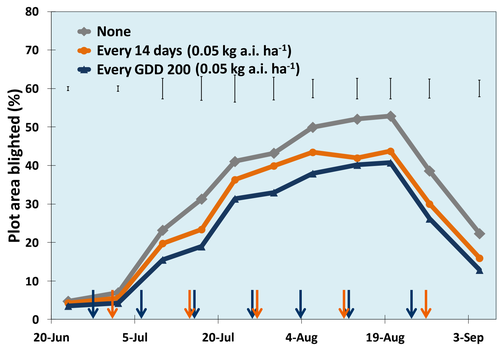

Fig. 5. Trinexapac-ethyl treatment interval effect on anthracnose severity of annual bluegrass in 2014.

- Trinexapac-ethyl reduced anthracnose severity throughout the growing season, regardless of application interval.
- Application based on GDD200 reduced disease severity compared to a 14-d interval in mid-summer when higher temperatures resulted in more frequent applications.

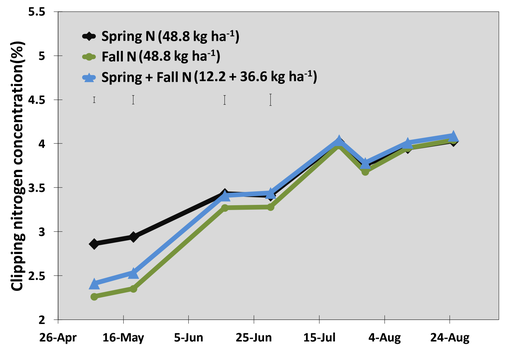

Fig. 6. Seasonal nitrogen effect on clipping total nitrogen concentration of annual bluegrass in 2014.

- Clipping N conc. was increased 1.3 fold by spring only N program during May (4 WAT) and 1.1 fold in Jun (8 WAT) compared to the fall only N program.
- Similarly, the spring + fall program also increased clipping N conc. compared to fall only program; although less than the spring only program particularly in May.
- Seasonal N programs had no effect on N conc. in Jul and Aug when all plots were fertilized uniformly.

Table 1. Area under seedhead production, clipping nitrogen concentration, and clipping yield curve means and ANOVA results of main effects during 2014.

	Area under the curve		
Main effect	Seedhead production	Clipping N concentration	Clipping yield
Seasonal Nitrogen Program			
Spring	1392.9 a	388.7 a	553.0 a
Fall	1269.1 b	368.7 b	466.8 b
Spring + Fall	1257.1 b	381.8 a	495.4 b
p-value	*0.0060*	*0.0002*	*0.0002*
Ethephon			
0.0 kg a.i. ha^{-1}	1840.5 a	376.8	471.5 b
3.8 kg a.i. ha^{-1}	772.3 b	382.7	538.6 a
p-value	*< 0.0001*	*0.1194*	*< 0.0001*
Trinexapac-ethyl Application Interval			
None	1373.6 a	371.5 b	545.2 a
14-d	1273.4 b	381.0 a	495.0 b
GDD 200	1272.1 b	386.7 a	475.0 b
p-value	*0.0417*	*0.0057*	*0.0021*

- Seedheads were increased by the spring only N program and decreased by ET and TE.
- However, a N x ET interaction indicated that when ET was applied, the spring N only program, had fewer seedheads than other seasonal N programs (data not shown).
- Spring only N program increased clipping N conc. and clipping yield; whereas the fall only N program had the lowest clipping N conc. and clipping yield. Clipping N conc. of spring + fall N program was comparable to spring only, although clipping yield was similar to the fall only N program.
- Trinexapac-ethyl increased clipping N conc. and reduced clipping yield regardless of application interval compared to no TE.
- Ethephon had no effect on clipping N conc. and increased clipping yield.

SUMMARY

- Nitrogen applied in spring reduced anthracnose severity in early and mid-summer likely due to increasing N conc. of ABG. However, it had no effect on disease severity or clipping N conc. by late summer.
- Trinexapac-ethyl consistently reduced anthracnose severity through Aug. This may have been due in part to improved nitrogen use efficiency suggested by increases in season long clipping N conc. and reduced clipping yield. The GDD200 schedule was slightly more effective at reducing anthracnose during late-Jul and early Aug than the14-d interval. Based on the GDD200 model, application interval during Jul and Aug had decreased to 8 – 11-d which may have enhanced beneficial effects of TE.
- Ethephon reduced anthracnose severity in early- and mid-summer. It also decreased ABG seedhead production, as expected, which may have resulted in the reallocation of resources toward shoot and root growth, thus improving abiotic and biotic stress tolerance.
- Counter to our hypothesis, no consistent interactions between seasonal N programming and PGRs have been observed. However, results to date indicate that emphasizing spring N fertilization and using PGRs all reduce anthracnose severity. Moreover, the effect of these factors on anthracnose appears to be additive; whereby disease severity is decreased incrementally by each additional main effect.

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