Nitrogen Fertility, Mowing Height, and Topdressing Effects on Anthracnose and Playability of Annual Bluegrass

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INTRODUCTION

Anthracnose, caused by the fungus *Colletotrichum cereale* Manns sensu lato Crouch, Clarke, and Hillman, is a destructive disease of annual bluegrass [ABG; *Poa annua* L. forma *reptans* (Hausskn.) T Koyama] putting green turf.

Previous research has identified N fertility, mowing height, and sand topdressing as best management practices (BMPs) that can be used to reduce anthracnose severity of ABG.

However, questions remain about how combinations of these BMPs may interact to affect disease severity and playability [ball roll distance (BRD; Stimpmeter) and turf quality] of ABG turf.

OBJECTIVE

To evaluate the effects of mowing height, N fertility, and sand topdressing on anthracnose severity and playability of ABG turf.

MATERIALS AND METHODS

Experimental and Treatment Design

- 2 x 2 x 2 factorial arranged in split-split-plot design with four reps
- The three factors were:
  - Mowing Height (2.3 and 3.2 mm; 6 d wk^{-1} from Apr. to Oct.)
  - Nitrogen Fertility (Table 1)
  - Sand Topdressing (Table 2)

Field Maintenance

- Irrigation applied to maintain moderately-dry conditions
- Light-weight rolling performed 3 times wk^{-1}
- Soil pH, P and K managed based on soil test results
- Other pests controlled using pesticides that had no effect on anthracnose isolates at the research location

Data Collection and Analysis

- Anthracnose severity was evaluated approximately every 14-d. Disease severity data were transformed to area under disease progress curve values (AUDPC). Turf quality was also evaluated.
- Ball roll distance was measured in sub-subplots one to three times per week using a Stimpmeter (USGA, Far Hills, NJ).
- Data were subjected to ANOVA using the General Linear Model procedure (PROC GLM) in SAS (SAS Institute, Cary, NC).

Table 1. Application timing and N rates for low and high N treatments on annual bluegrass turf

Application Date	Low N (non-BMP)	High N (BMP)
	kg N ha^{-1} yr^{-1}	
Mid-Mar.†	18.3	18.3
Early-Apr.†	0	18.3
Apr. to Oct. (26 wk)‡	4.9 every 2-wk	4.9 every 1-wk
Early-Oct.†	18.3	18.3
Late-Oct.†	0	18.3
Annual	**100.1**	**200.2**

† Fertilizer comprised of water-soluble (9.8 kg N ha^{-1}) and slow-release (8.5 kg N ha^{-1}) nitrogen.
‡ N was applied as urea.

Table 2. Application timing, number of applications, and sand rates for low and high sand treatments on annual bluegrass turf

Application Period	Number of Applications	Low Sand† (non-BMP)	High Sand† (BMP)
		Mg ha^{-1} yr^{-1}‡	
Late-Mar.	1	19.5 (9.8)§	19.5 (9.8)§
April	2	-	9.8 (7.3)§
May	1	4.9	4.9
Late-May to June	3 (2)§	-	4.9
Late-June/Early-July to Mid-Sept.	6 (7)§	-	2.4
Late-Sept.	1	2.4	2.4
Mid-Oct.	1	-	2.4
Late-Oct.	1	19.5	19.5
Annual		**46.4 (36.6)§**	**97.6 (80.6)§**

†The low topdressing treatment emulated the sand rates and application frequency of a minimal program in the northeastern U.S. The high sand topdressing treatment applied sand every 14 d using sand rates that matched growth of the turf (thatch accumulation).
‡ Mg denotes megagram (metric tonne). 4.9 Mg ha^{-1} is equivalent to 0.3 L m^{-2} dry sand.
§The number and rate of applications were modified during 2013. Values in parentheses represent the number and rate of applications used during 2013 and 2014..

RESULTS AND DISCUSSION

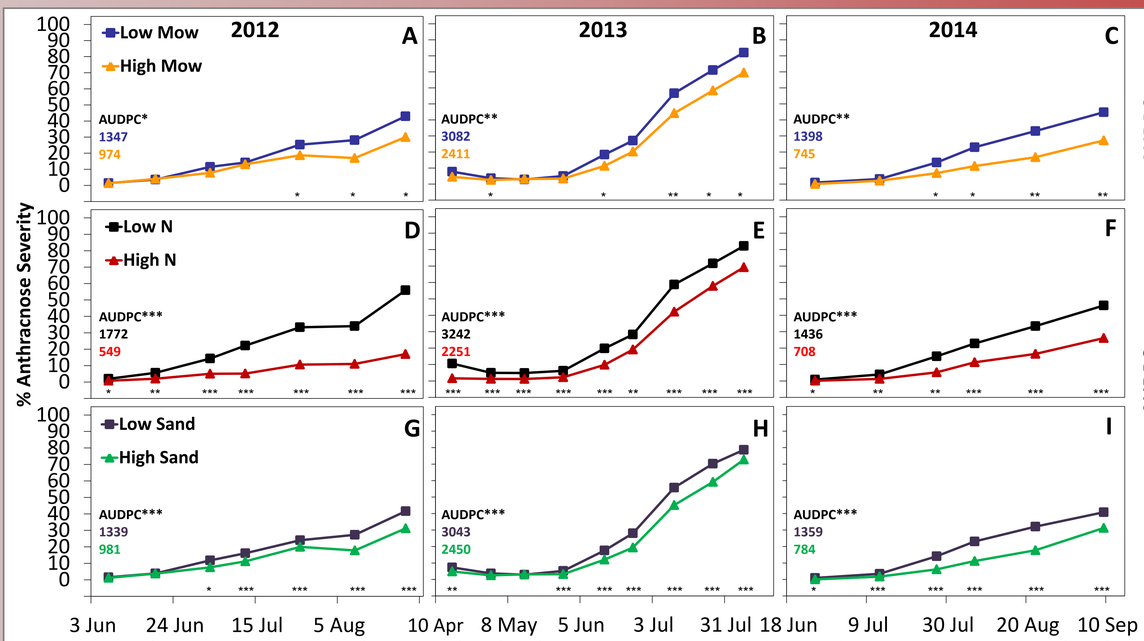

Figure 1. Anthracnose severity and area under the disease progress curve (AUDPC) response to mowing height (A, B, C), N fertility (D, E, F), and sand topdressing (G, H, I) during 2012, 2013, and 2014. *, **, and *** denote significance at the 0.05, 0.01 and 0.001 probability levels, respectively.

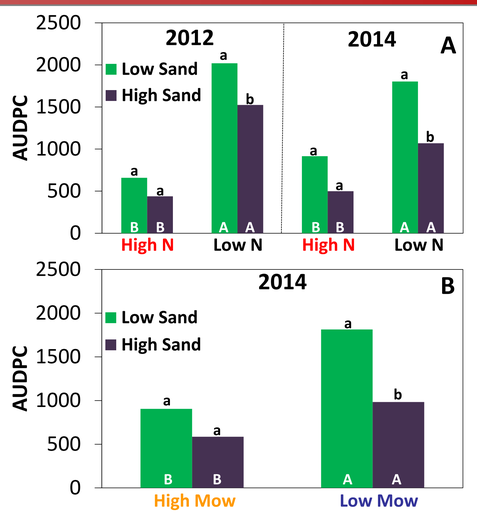

Figure 2. Area under the disease progress curve (AUDPC) response to sand topdressing interacting with N fertility (A) and mowing height (B). Means separation among sand topdressing levels are designated by lower case letters, N and mowing heights effects are designated by upper case letters.

Anthracnose Severity and Area Under the Disease Progress Curve

- As expected, greater mowing height (Fig. 1A, 1B, 1C), N fertility (Fig. 1D, 1E, and 1F), and sand topdressing (Fig. 1G, 1H, and 1I) reduced anthracnose severity and AUDPC during 2012, 2013, and 2014.
- Nitrogen fertility accounted for 34 to 82% of the variation in the AUDPC data; whereas, mowing height accounted for 8 to 27% and sand topdressing accounted for 7 to 21% (data not shown).
- AUDPC interaction data from 2012 and 2014 suggest that sand topdressing may become a more important practice for disease suppression when ABG is managed at a lower N fertility rate (Fig 2A) and lower mowing height (Fig 2B).
- During recovery periods, higher mowing and frequent topdressing improved the healing of residual anthracnose damage more than greater N fertility (data not shown).

Ball Roll Distance and Turf Quality

- As expected, high mowing negatively affected BRD (Table 3)
- Any changes in BRD caused by N fertility and sand topdressing were not likely to be detectable by golfers since BRD differences were typically 0.2 m or less (Table 3).
- Across all treatments, the occurrence of an acceptable BRD (≥ 2.9-3.2 m) ranged from 56 to 96% of 71 evaluation dates during 2012, 2013, and 2014.
- Frequent rain and high humidity during early summer 2013 led to a abnormally low frequency of acceptable BRD, especially at the high mowing height.
- The relative importance of management factors for BRD differed from that observed with disease severity responses. Mowing height accounted for 62 to 73% of the BRD response, respectively, and N fertility accounted for slightly more of the BRD response than the sand topdressing factor (data not shown).
- Turf quality was improved by greater mowing height, N fertility, and sand topdressing due to these practices reducing disease severity.

Table 3. Frequency distribution (n = 71) of ball roll distances for combinations of mowing height, N fertility, and sand topdressing during 2012, 2013, and 2014.

Mowing Height	N Fertility	Topdressing Sand	Ball Roll Distance Ranges (m) 2.0-2.3	2.3-2.6	2.6-2.9	2.9-3.2	3.2-3.5	3.5-3.8	> 3.8	**≥ 2.9-3.2¶**	**MEAN#**
			% (of observations)								meters
Low	Low	Low	0	1	6	16	35	35	7	93	**3.4**
Low	Low	High	0	0	4	11	27	43	14	96	**3.5**
Low	High	Low	0	2	7	20	40	25	6	91	**3.3**
Low	High	High	0	1	7	17	35	33	7	92	**3.4**
High	Low	Low	1	7	24	42	23	3	0	68	**3.0**
High	Low	High	0	6	19	39	31	3	0	74	**3.1**
High	High	Low	2	13	29	46	9	1	0	56	**2.9**
High	High	High	1	11	26	42	19	1	0	62	**3.0**

¶The minimally acceptable ball roll distance is 2.9-3.2 meters.
#Mean ball roll distance of 71 observations made during 2012, 2013, and 2014 for each treatment combination.

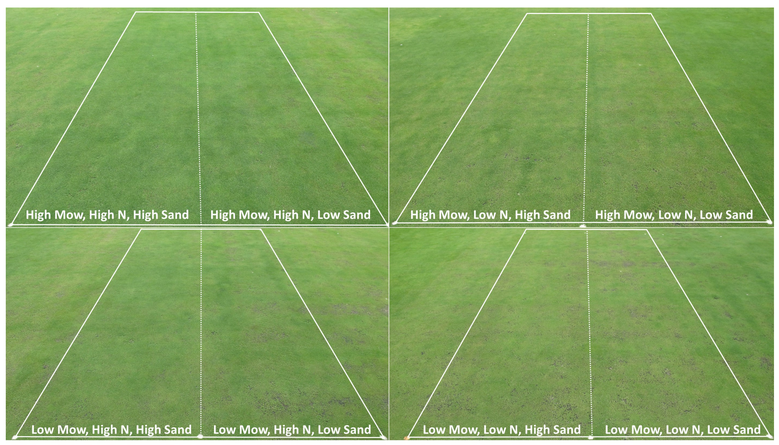

Figure 3. Residual anthracnose damage on annual bluegrass plots. Photo taken on 3 Oct. 2013.

CONCLUSIONS

These findings show that:

1. Increased N produced greater reductions in disease severity compared to higher mowing or greater sand topdressing.
2. Nitrogen fertility and sand topdressing had minimal effects on BRD.
3. Higher mowing had a substantial negative impact on BRD.

Thus, priority should be given to lowering mowing height rather than reducing N fertility or sand topdressing rates when adjusting BMPs to improve playability (BRD; green speed) without greatly increasing the risk for anthracnose.

ACKNOWLEDGEMENTS and CONTACT

EIFG Environmental Institute for Golf
GCSAA Golf Course Superintendents Association of America
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