Effect of Humic Acids on Golf Putting Green Performance

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Golf course putting greens are maintained under extremely stressful conditions including high traffic and low mowing heights. Golf course managers are constantly seeking ways to improve stress tolerance and turfgrass responses. Humic acids have been identified as having the potential to improve turfgrass health, yet little information exists regarding the performance of individual humic acid products and their responses on root zone of varying carbon contents. This study was designed to investigate the agronomic effects of organic amendments on golf putting greens varying in total and bioactive soil carbon content.

Methods and Materials:

The study was initiated on May 8, 2012 at the O.J. Noer Turfgrass Research Facility. The treatments included two liquid humic acid products , ANO12011 and KOH extracted Humic Acid (KOHA) both from AMCOL International Corporation, and Humic DG, a granular product from The Anderson's. Treatments were applied on May 8, June 6, July 3, and August 7. Liquid treatments were applied using a CO2 pressurized backpack sprayer calibrated to deliver 2 gallons of water per 1000 sq. ft. The ANO12011 was applied at 3.8 fl. oz. per 1000 sq. ft., KOHA was applied at 12 oz. per 1000 sq. ft., and Humic DG was applied at 2 lbs. per 1000 sq. ft.

The treatments were arrayed in a randomized complete block design with four replications. Individual plots measured five feet by five feet. The study was replicated on three sand based root zones constructed according to USGA specifications. The oldest root zone was constructed in 2000 and planted to 'L-93' creeping bentgrass, the middle-aged root zone was constructed in 2005 and planted to 'Memorial' creeping bentgrass. The youngest root zone was constructed in 2008 and planted to 'A4' creeping bentgrass. The age distribution of the root zones ensured a range in soil organic matter content and quality (Table 1).

Table 1. Characterization of soil carbon and organic matter in the three root zones.

Putting Green ID	Age	Bioactive C	Total Organic Matter
	yrs	mg/L	%
Youngest	4	8.8	0.4
Middle-Aged	7	32.5	1.2
Oldest	12	24.3	1.2

Figure 1. The youngest root zone profile is shown on the left, and the oldest root zone profile on the right. Positive responses to humic acid were only found on the youngest root zone, likely because of its lower organic matter content.

Putting greens were maintained typical to high quality putting greens in the Upper Midwest. Turf was mowed six days per week using a walk behind mower set to a cutting height of 0.125 inches. Light topdressing was applied approximately weekly. Nitrogen fertilizer (as urea) was applied every other week at 0.2 lbs. N/1000 sq.ft. Irrigation was applied three times each week to replace 70% of reference ET as measured from an on-site weather station

Impact of the treatments was quantified by assessing the visual quality, turfgrass color, and clipping weight. Turfgrass quality was assessed weekly on a 1 to 9 scale, where 9 represents perfect turfgrass quality and 6 represents the minimally acceptable quality. Turfgrass color was measured weekly using a hand held reflectometer from Spectrum Technologies (CM-1000). Turfgrass clipping weight was measured approximately monthly. Statistical differences were calculated using JMP software, means were separated using Fisher's LSD at alpha=0.10, where appropriate.

Results and Discussion:

Over the duration of the season no significant differences in clipping yield, turfgrass color, or quality were observed on the middle-aged and oldest root zones (Table 2). On the youngest root zone, no significant differences in clipping yield or turfgrass color were observed, however the KOHA and ANO12011 treatments had significantly greater turfgrass quality that the Humic DG and the non-treated control.

The turfgrass quality over the season for the youngest root zone is shown in Figure 1. The KOHA and ANO12011 treatments generally were generally 0.5 to 1.0 turfgrass quality units greater than the Humic DG and Non-treated control for much of June, July, and early August. This suggests that the KOHA and ANO12011 were improving summer stress tolerance of the bentgrass. However, it is unusual that no significant differences in turfgrass color or clipping yield were observed during this time, as grass exhibiting greater stress tolerance usually show increases in these two parameters as well.

Conclusions:

1. ANO12011 and KOHA have potential to improve turfgrass quality on sand-based putting greens with low total and/or bioactive soil carbon content.
2. There were no advantages of applying humic acid products on sand putting greens with higher soil organic matter and bioactive carbon.
3. Humic DG did not improve turfgrass response compared to the non-treated control, even on the low organic matter content root zone.
4. More work is required done to confirm, and better understand the nature of the summer stress response of turfgrass to ANO12011 and KOHA.

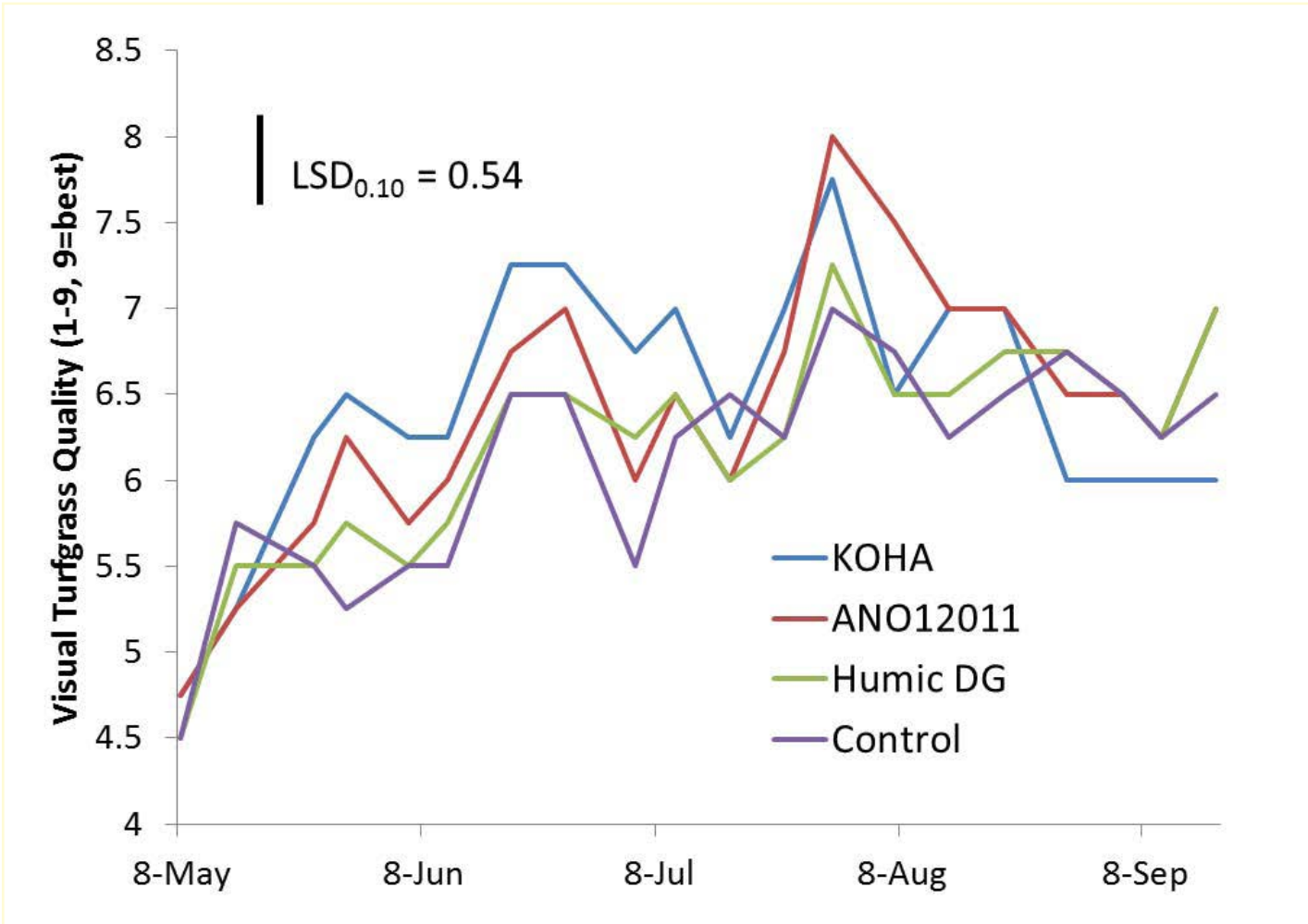

Figure 2. Visual turfgrass quality during the season on the youngest root zone (low organic matter). This was the only root zone for which a significant response was observed. Differences between treatments greater or equal to 0.54 are considered statistically significant according to Fisher's LSD at alpha=0.10.

Table 2: Average growth and visual responses for the treatments on the (a) oldest root zone, (b) middle-aged root zone, and (c) youngest root zone. Treatment means were separated using Fisher's LSD at alpha=0.10.

(a) Oldest Root Zone

Treatment	Clipping Yield	Turfgrass Color	Turfgrass Quality
	$g/m^2/day$	0-999, 999=best	1-9, 9=best
KOHA	3.07 A	259 A	5.50 A
ANO12011	2.51 A	257 A	5.54 A
Humic DG	2.52 A	264 A	5.66 A
Non-Treated Control	2.50 A	263 A	5.61 A

(b) Middle-Aged Root Zone

Treatment	Clipping Yield	Turfgrass Color	Turfgrass Quality
	$g/m^2/day$	0-999, 999=best	1-9, 9=best
KOHA	2.20 A	276 A	6.21 A
ANO12011	2.23 A	278 A	6.31 A
Humic DG	1.99 A	280 A	6.35 A
Non-Treated Control	2.14 A	277 A	6.21 A

(c) Youngest Root Zone

Treatment	Clipping Yield	Turfgrass Color	Turfgrass Quality
	$g/m^2/day$	0-999, 999=best	1-9, 9=best
KOHA	1.71 A	271 A	6.45 A
ANO12011	1.92 A	266 A	6.43 A
Humic DG	1.96 A	271 A	6.20 B
Non-Treated Control	1.99 A	264 A	6.10 B