

Humic Substances Do Not Increase Water Holding Capacity and Phosphorus Uptake in Putting Greens



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Objective

Determine the effect organic acids, namely humic substances, had on moisture retention and phosphorus uptake of golf course putting greens.

Methods

Greenhouse experiment

- Three organic acids (citric, tannic, humic) applied as irrigation treatments to a simulated USGA putting green (Figure 1). Treatments normalized at 250 ppm carbon.
- Irrigation occurred when volumetric water content of soil was less than 10 percent as measured by soil moisture sensors.

Field experiments

- Three organic acids (citric, tannic, humic) and four commercial humic products (*H-85*, *Focus*, *Launch*, *Fulvic acid*) applied at label rates to golf course putting greens.
- TDR device used to periodically measure volumetric water content of the soil from June through August (Figure 2).
- At one site, irrigation levels of 80, 70 and 60 percent ETo were also imposed.



Figure 1. Greenhouse experiment design and irrigation system. Four treatments were replicated three times.



Figure 2. TDR device and datalogger used for measurement and storage of volumetric water content data of the field sites.

Additional Methods

Greenhouse experiment

- SR1019 and SR1020 creeping bentgrass was grown in a tub that simulated a USGA putting green profile with calcareous sand.
- Volumetric water content was constantly measured with 20 cm Echo probes connected to a multiplexer. The multiplexer was connected to a CR10X datalogger.
- When the volumetric water content dried to less than 10% the CR10X triggered an irrigation event through an SDM relay controller.

Field experiment

- Four field sites including three golf course and one research putting green with creeping bentgrass and calcareous sand profiles.
- Irrigation levels at the research putting green were determined by weather data broadcast from an onsite weather station to an ET controller.
- A CM1000 chlorophyll meter was used to measure a color index of the turf.

Greenhouse Experiment Results

- Irrigation frequency was lower for the control compared to all organic acid treatments. The humic acid treatment irrigated most frequently (Figure 3).
- Organic acids did not affect total biomass, root mass and water content after irrigation (Figure 4).
- No differences were observed for uptake of phosphorus, however K, S, Ca, Cu, Zn, Mo, Mn, Ni and Na were affected (Table 1).
- The humic acid treatment produced longer roots compared to the control.

Field Experiment Results

- No differences in volumetric water content for any treatment, regardless of irrigation level were observed. Humic acid was consistently lower compared to the control (Figure 5).
- Turfgrass color was not different for treatment or irrigation level (Figure 6), and no differences in phosphorus uptake were observed.

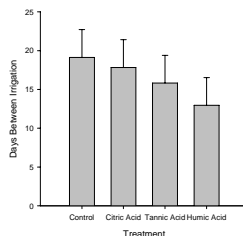


Figure 3. Days between irrigation for the greenhouse experiment treatments.

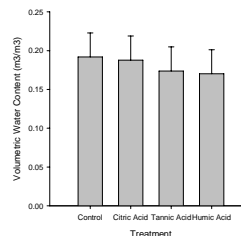


Figure 4. Maximum soil moisture content after irrigation for the greenhouse experiment treatments.

Table 1. Greenhouse experiment treatment effect on tissue concentration of elements.

Treatment	%					mg/kg						
	P	Ca	Mg	K	S	Fe	Cu	Zn	Mo	Mn	Ni	Na
Control	0.47 a	0.64 a	0.30 a	3.18 a	0.38 ab	210 a	14 c	37 b	27 c	48 b	0.7 c	56 b
Citric Acid	0.47 a	0.67 a	0.30 a	3.02 ab	0.36 ab	396 a	17 ab	46 a	35 b	72 b	2.7 b	59 b
Tannic Acid	0.39 a	0.63 a	0.27 a	2.55 c	0.33 b	291 a	19 a	49 a	39 a	410 a	4.1 a	46 b
Humic Acid	0.48 a	0.49 b	0.28 a	2.68 bc	0.42 a	226 a	16 bc	40 b	31 bc	45 b	1.0 c	249 a a

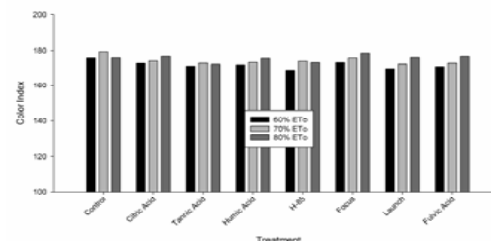


Figure 6. Color index of field treatments for each irrigation level. Color was measured by a CM1000 chlorophyll meter.

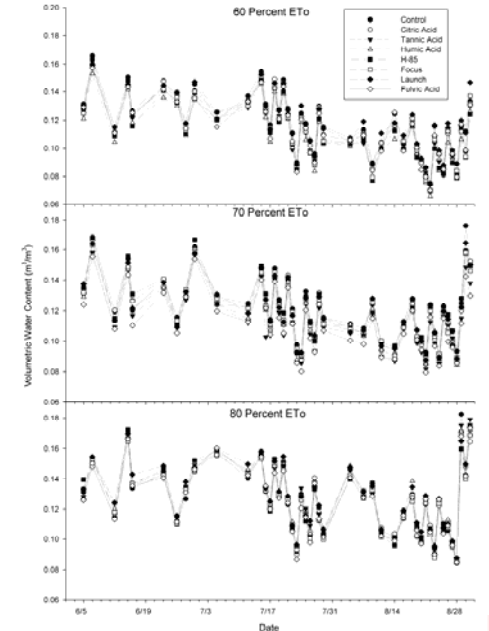


Figure 5. Volumetric water content of field treatments for each irrigation level.

Discussion

- This study is a work in progress. The greenhouse experiment will have two more trials, and the field experiment with irrigation levels will be run again in the summer of 2007.
- Humic substances may decrease soil water holding capacity due to the hydrophobic tendencies of these molecules.
- Phosphorus uptake was not improved by humic substances.
- Humic acid increased root depth. However, it is not known if this was a treatment effect or a physiologic response to decreased water.
- At the recommended application rates, humic substances do not appear to affect soil moisture. The lack of response to uptake of phosphorus may not be worth the cost of these materials.

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