Influence of Humic Substances on Moisture Retention and Phosphorus Uptake of Putting Greens

Can superintendents reduce water and fertilizer applications with these natural organic products?

BY ADAM VAN DYKE AND PAUL G. JOHNSON

Humic substance products are now widely available in the turf industry, and many of them have been reported to reduce water and fertilizer use by increasing soil moisture and nutrient availability. Humic acid is the most common humic substance studied, but research results on its effectiveness has been highly variable. Many times, the response of humic acid on turf is difficult to interpret due to confounding effects of nutrients and other ingredients often included in humic substance products.

This study tested a pure humic acid along with commercial humic substance products in both a controlled greenhouse study and a field experiment under golf course conditions. The studies had two objectives: 1) determine if humic substances increase water retention in sand putting greens, and 2) evaluate the ability of humic substances to improve phosphorus uptake in creeping bentgrass grown on calcareous sand.

In the greenhouse, creeping bentgrass sod was grown on calcareous sand on top of gravel to simulate a USGA putting green.

GREENHOUSE EXPERIMENT

In a greenhouse, creeping bentgrass (*Agrostis palustris* L.) sod was grown in tubs of calcareous sand, simulating a USGA putting green. Three organic acids were applied to the turf, delivered through an automated irrigation system and evaluated against a control treatment of water. The organics consisted of a pure leonardite humic acid (Sigma-Aldrich), a tannic acid (J. T. Baker Chemical Co.), and citric acid (Mallinckrodt Chemicals) applied at normalized carbon rates of 250 mg C L^{-1} (carbon per liter) during each irrigation.

Detection probes (Decagon Devices) were buried five inches in the soil and constantly measured the volumetric water content (VWC) of each tub. Data from the probes was used to automate the irrigation system with a datalogger and a relay controller. The soil was allowed to dry to 10% VWC before irrigation.

Turf management included mowing at approximately 0.156 inch with weekly applications of nitrogen (KNO_3) as a drench at 0.1 lb. N/1,000 sq. ft. No additional phosphorus was applied to the turf during the experiment.

None of the organic acids increased the water-holding capacity of the soil. The addition of humic acid had an opposite effect and decreased soil moisture by exhibiting hydrophobic properties that required more frequent irrigation than the control. No differences in plant tissue levels of phosphorus were observed, but humic acid did increase root length over the control in this study.

FIELD EXPERIMENT

This experiment was conducted on established putting greens constructed with calcareous sand and creeping bentgrass at three golf courses along the Wasatch Front in Utah and at a

The field experiment was conducted on established creeping bentgrass putting greens at three golf courses. Individual plots were treated with the same organic materials used in the greenhouse study in addition to four humic substance products available to turf managers.

research green at Utah State University. Individual plots (5 ft. × 5 ft.) were treated with the same organics used in the greenhouse study as well as four additional humic substance products available to turf managers. The commercial products included Focus (PBI Gordon Corp.), Launch (PBI Gordon Corp.), H-85 (Redox Chemicals Inc.), and a fulvic acid (Horizon Ag Products). Treatments were applied at label rates every 30 days during the summer with a CO_2 backpack sprayer and evaluated against a control of water only.

Turf management differed at each golf course site, but each included irrigation to drought stress the turf at the superintendents' discretion. At the Utah State University site, management included mowing at 0.125 inch with weekly applications of a foliar fertilizer at 0.1 lb. N/1,000 sq. ft. Three different irrigation levels of 80%, 70%, and 60% ETo were also imposed on the treatments at the USU site only.

The volumetric water content (VWC) of each plot was measured at weekly intervals throughout the summer, from June 1 to August 30 in 2006 at the golf courses, and in 2006 and 2007 at the Utah State site, with a hand-held TDR probe. Turf color was measured using a CM-1000 chlorophyll meter (Spectrum Technologies) the same days VWC was measured.

In the field, few differences in VWC were observed. Some differences occurred on individual days, but overall the humic substances did not change soil moisture-holding capacity. Tissue phosphorus of the humic acid-treated plots (0.41%) was actually slightly lower than the control plots (0.43%), and chlorophyll content was not different for any treatment.

SUMMARY POINTS

Humic substances did not increase water-holding capacity in sand putting greens.

Humic substances displayed hydrophobic properties, resulting in more frequent irrigation than pure water.

Phosphorus uptake by creeping bentgrass was not increased by humic substances.

Humic acid increased root depth of creeping bentgrass.

No visual differences of turf appearance or color were observed with the use of humic substances.

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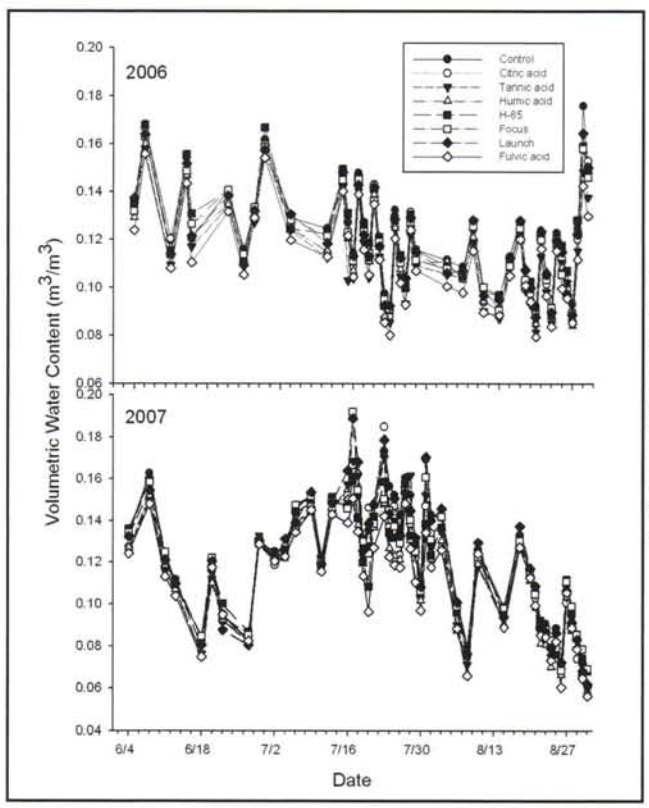

Volumetric water content (VWC) for each treatment in the field experiment was measured at the Utah State University site for the 70% ET irrigation level. In the field work, few differences in VWC were observed.