Golfdom's PRACTICAL RESEARCH DIGEST FOR TURF MANAGERS

TURFGRASS TRENDS

SOIL AMENDMENTS

Do Humic Substances Bolster Water and Nutrient Availability?

By Adam Van Dyke and Paul G. Johnson

Increasingly, products containing humic substances are appearing in the turf industry market claiming to reduce water and fertilizer use by increasing soil moisture and nutrient availability. Humic acid is the most common humic substance that has been studied, but results have been highly variable (Cooper et al., 1998). The response of humic acid is difficult to interpret due to confounding effects of nutrients and other ingredients often included in humic substance products (Karnok, 2000).

This study tested a pure humic acid along with commercial humic substance products in both a greenhouse and field experiment. The greenhouse portion of the study used a controlled environment to evaluate the effects of the pure product while the field portion evaluated commercial humic substance products under golf course conditions. Our objective was to determine if humic substances 1) can increase water retention in sand putting greens, and 2) improve uptake of phosphorus.

The greenhouse experiment consisted of creeping bentgrass (*Agrostis palustris L.*) sod grown in 24 centimeters x 36 cm x 30 cm tubs with calcareous sand. The tubs had drainage holes in the bottom and were placed in larger tubs on top of 4 cm of gravel. This setup simulated a USGA putting green (Photo 1).

Three organic acids were applied to the turf as watering solutions delivered through an irrigation system. The organic acids 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 milligrams per liter. The amount of material applied is about 100 times higher than rates used in the field. The organics were evaluated against

Continued on page 52

PHOTO 1

This greenhouse experiment with creeping bentgrass sod grown in calcareous sand on gravel beds simulates a USGA putting green.

ALL PHOTOS BY: ADAM VAN DYKE AND PAUL G. JOHNSON

IN THIS ISSUE

Continued from page 51

a control treatment of water and replicated three times.

Turf management included mowing with hand shears at 0.156 inches with weekly applications of nitrogen as a drench at 0.1 pound nitrogen per 1,000 square feet. No additional phosphorus was applied to the turf during the three-month experiment.

Echo probes (Decagon Devices) that constantly measured volumetric water content (VWC) of each tub were buried 13 cm in the soil. The echo probe data was used to automate the irrigation system with a datalogger and a relay controller based on the soil moisture measured by the probes. The soil was allowed to dry down to 10 percent VWC before irrigation. This was an adequate moisture level that did not stress the turf.

The VWC data was stored in the datalogger and analyzed for differences and number of days between irrigations. Tissue was collected during mowing and combined for analysis of total biomass production at the end of the experiment. Tissue was also collected and analyzed in a lab for elemental content, most notably for phosphorus.

Field experiment

Three golf courses along the Wasatch front and a research green at Utah State University served as sites for this experiment. The study was conducted on established putting greens constructed with calcareous sand and creeping bentgrass (Photo 2).

Individual plots (5 feet x 5 feet) were treated with the organics used in the greenhouse as well as four additional humic substance products, which allowed for the evaluation of commercial products available to turf managers.

The application of the organics consisted of 3 ounces per 1,000 square feet of the humic acid, 3.2 ounces per 1,000 square feet of tannic acid and 5 ounces per 1,000 square feet of citric acid.

A fulvic acid at 40 ounces per 1,000 square feet was also used, and the products were applied three times during the summer of 2006 at one-month intervals. Application was done with a carbon dioxide backpack sprayer at label rates and evaluated against a control of water only. For statistical analysis, the treatments were replicated three times.

Management of turf was different at each golf course site. At the USU site, management included mowing at 0.140-inches to 0.156-inches with light, frequent fertilizer applications at 0.1 pounds nitrogen per 1,000 square feet. Trace amounts of phosphorus were applied during fertilization, and irrigation was approximately 70 percent of reference (or potential) evapotranspiration (ETo). However, three different irrigation levels of 80, 70 and 60 percent ETo were imposed on the treatments. This allowed for the evaluation of different irrigation intervals on the humic substances.

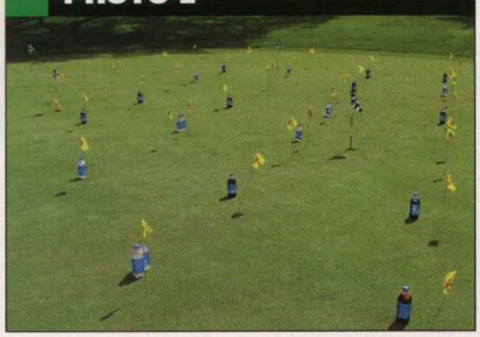
The VWC was measured with a hand-held TDR probe at weekly intervals throughout the summer from June 1 to Aug. 30. Measurements at the USU site were performed daily for two weeks at the end of July and August. Turf color was measured using a CM-1000 chlorophyll meter (Spectrum Technologies) the same days VWC was measured.

The VWC data was analyzed for differences throughout the summer. Tissue was collected at the USU site and analyzed in a lab for elemental content, most notably for phosphorus. Color data also was analyzed for differences throughout the summer.

Results

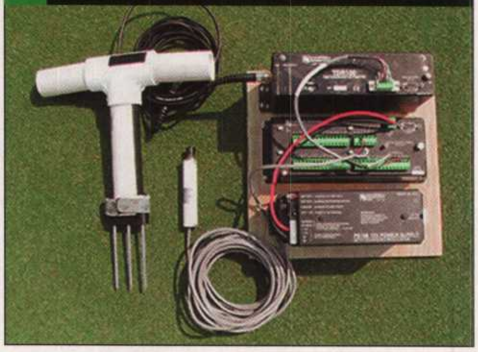
In the greenhouse experiment, the addition of pure humic acid resulted in a decrease in the water-holding capacity of the soil and thus more frequent irrigations than the control. The humic acid treatment was irrigated

PHOTO 2



A field experiment putting green with individual plots features established bentgrass and USGA-style construction.

PHOTO 3



Portable hand-held TDR probe used to measure volumetric water content of the field experiment sites.

every 13 days compared to 19 days for the control.

All the treatments amended with organic acids were irrigated more frequently than the control and demonstrated hydrophobic properties that repelled water. In the field, few differences in VWC were observed. There were some differences on individual days but overall the humic substances did not alter soil moisture holding capacity.

Tissue analysis in both experiments showed no differences in the uptake of phosphorus. However, other minerals were affected, most notably the high amount of sodium on the pure humic acid treatment. Biomass production was not different among the treatments. Additionally, there were no differences in the amount of root mass produced by the turf. This suggests that the organic acids do not provide a growth stimulus. However, the humic acid did increase length of the roots. Roots measured 22 cm for the humic acid treatment compared to the control, which had 16-cm-long roots.

After one year of data, no visual differences were observed in either experiment, suggesting humic substances do not increase turf quality in this time frame. This study showed that the humic substances used in these experiments do not increase water-holding capacity in sand putting greens. In fact, the humic substances contributed to lower moisture retention than pure water.

This resulted in more frequent irrigations rather than a reduction because humic substances can decrease the amount of water in soil by hydrophobic properties, thus reducing the amount of water available to the roots. The use of wetting agents together with the organics is a potential way to deal with this problem. The uptake of phosphorus was not increased in either experiment. Creeping bentgrass is already capable of obtaining adequate amounts of phosphorous even at low levels (Johnson et al., 2003).

High sodium levels were observed in plant tissue treated with pure humic acid. The excess sodium might contribute to other soil structure and nutrient problems such as poor infiltration of water and inhibition of other cations from being absorbed by the plant (Carrow and Duncan, 1998). High soil sodium levels might require applications of gypsum or similar materials. Humic acid did increase root depth in the greenhouse experiment, which might have been in response to the decreased water in the profile rather than an effect of the humic acid treatment.

Although not an original objective, one significant finding of this study was the potential to irrigate creeping bentgrass at 60 percent ETo during the summer months in the Intermountain West with no reduction in quality. Turf managers looking to conserve water and reduce phosphorus fertilization may not be best served by using humic substance products. These products might offer other benefits, but in terms of water conservation and reducing phosphorus fertilization, why bother?

Adam Van Dyke (avandyke@cc.usu.edu) is a research associate in the Department of Plants, Soils and Biometeorology at Utah State University and a master's candidate in plant science.
Paul G. Johnson, Ph.D., (paul.johnson@usu.edu) is an associate professor in the Department of Plants, Soils and Biometeorology at Utah State.

REFERENCES

Carrow, R.N., and R.R. Duncan. 1998. Salt-Affected Turfgrass Sites: Assessment and Management. Ann Arbor Press, Michigan.

Cooper R.J., C. Liu, and D.S. Fisher. 1998. Influence of humic substances on rooting and nutrient content of creeping bentgrass. Crop Science. 38(6):1639-1644.

Johnson, P.G., R.T. Koenig, and K.L. Kopp. 2003. Nitrogen, Phosphorus, and Potassium Responses and Requirements in Calcareous Sand Greens. Agronomy Journal. 95:697-702.

Karnok, Keith J. 2000. Promises, promises: Can biostimulants deliver? Golf Course Management. 68(8): 67-71.