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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

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PHOTO 1

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

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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.

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Velvet Offers A Low-Input Option To Creeping Bent

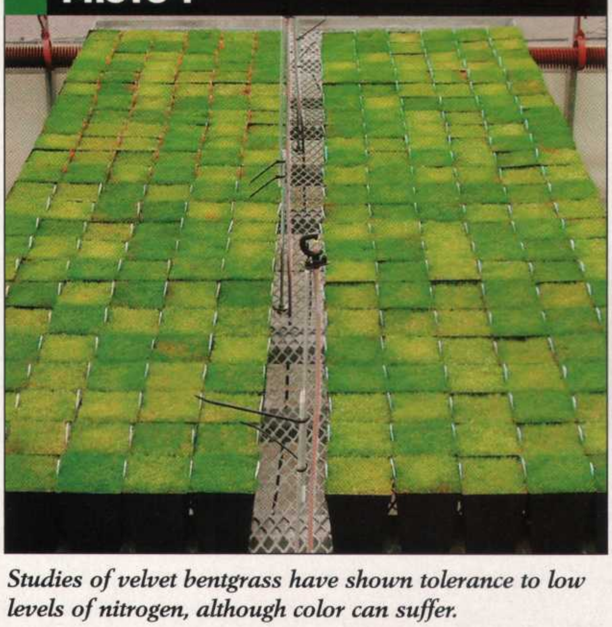
By John Watson and Katerina Jordan

Golf course putting greens are commonly seeded with creeping bentgrass (*Agrostis stolonifera, L.*) primarily due to its history as a high-performance turfgrass that can withstand low cutting heights. Establishment practices are well-documented for creeping bentgrass (CBG), as are management practices such as cultivation and fertility level (Beard, 1973).

Creeping bentgrass is popular with many superintendents for the aforementioned reasons, and is widely used for putting surfaces in temperate climates (Beard, 2002). However, particularly with new cultivars, CBG requires regular applications of nitrogen and fungicides after establishment to maintain acceptable putting turf quality, and therefore can be considered a high-input turfgrass (Dernoeden, 2002). Due to growing concerns over chemical fertilizer and pesticide use on turfgrass and increasing regulation of these inputs, there is rising interest in the use of alternate, low-input turfgrasses for putting greens.

Some golf courses, putting greens in particular, are targeted often by the public for their high chemical and water inputs, but some level of maintenance is necessary to achieve the quality demanded by the end-users. Velvet bentgrass (VBG) has the potential to be an excellent lower input alternative to CBG.

PHOTO 1



Studies of velvet bentgrass have shown tolerance to low levels of nitrogen, although color can suffer.

It is a dense, fine-textured turfgrass that was introduced in the early 1900s to North America from Europe in a seed mixture of bentgrasses containing creeping, velvet, colonial and redtop called South German bentgrass (Brilman and Meyer, 2000). Velvet bentgrass was used on golf courses until the 1950s when turfgrass management leaned toward increased inputs, especially with respect to pesticides and inorganic fertilizers.

As VBG showed a greater tolerance to low levels of nitrogen fertilizer, high-input management favored CBG (Torello and Lynch, Undated). However, with increased pressure from government agencies to reduce the negative impact of crop production on the environment, a reversion to lower input management of turfgrasses may be necessary.

Another reason that VBG can be a viable alternative to creeping bentgrass greens is that recent research suggests that VBG has good resistance to the fungal disease dollar spot (Chakraborty et al. 2006). This disease is of particular concern to golf courses as it is a very common problem on putting greens and in the United States. Dollar spot is the most costly disease to control when compared with the many other diseases that can affect turf (Vargas, 1994). Research also suggests that in addition to requiring reduced pesticide inputs, velvet bentgrass can perform well under reduced nitrogen fertility (Grant and Rossi, 2004). Recent research data suggests that good-quality VBG turf can be achieved with 0.48 to 1.46 kilos per 100 square meters per year on fine-textured soils (Boesch and Mitkowski, 2007). However, establishment practices for VBG are not extensively documented, and research on longer-term management including cultivation and fertility is limited, especially in Canada.

The purpose of this study is to gather information on VBG establishment by testing different establishment variables that could be altered at putting green construction or renovation, for example. The variables tested included: rootzone media type, seeding rate, phosphorus rates and nitrogen rates. The project was completed in a controlled greenhouse environment. This study is part of a large-scale project to determine the ideal establishment and management of fertility levels for velvet bentgrass, both in the greenhouse and the field.

Materials and methods

The research was conducted as a greenhouse study during a nine-week period in 2006 at the University of Guelph

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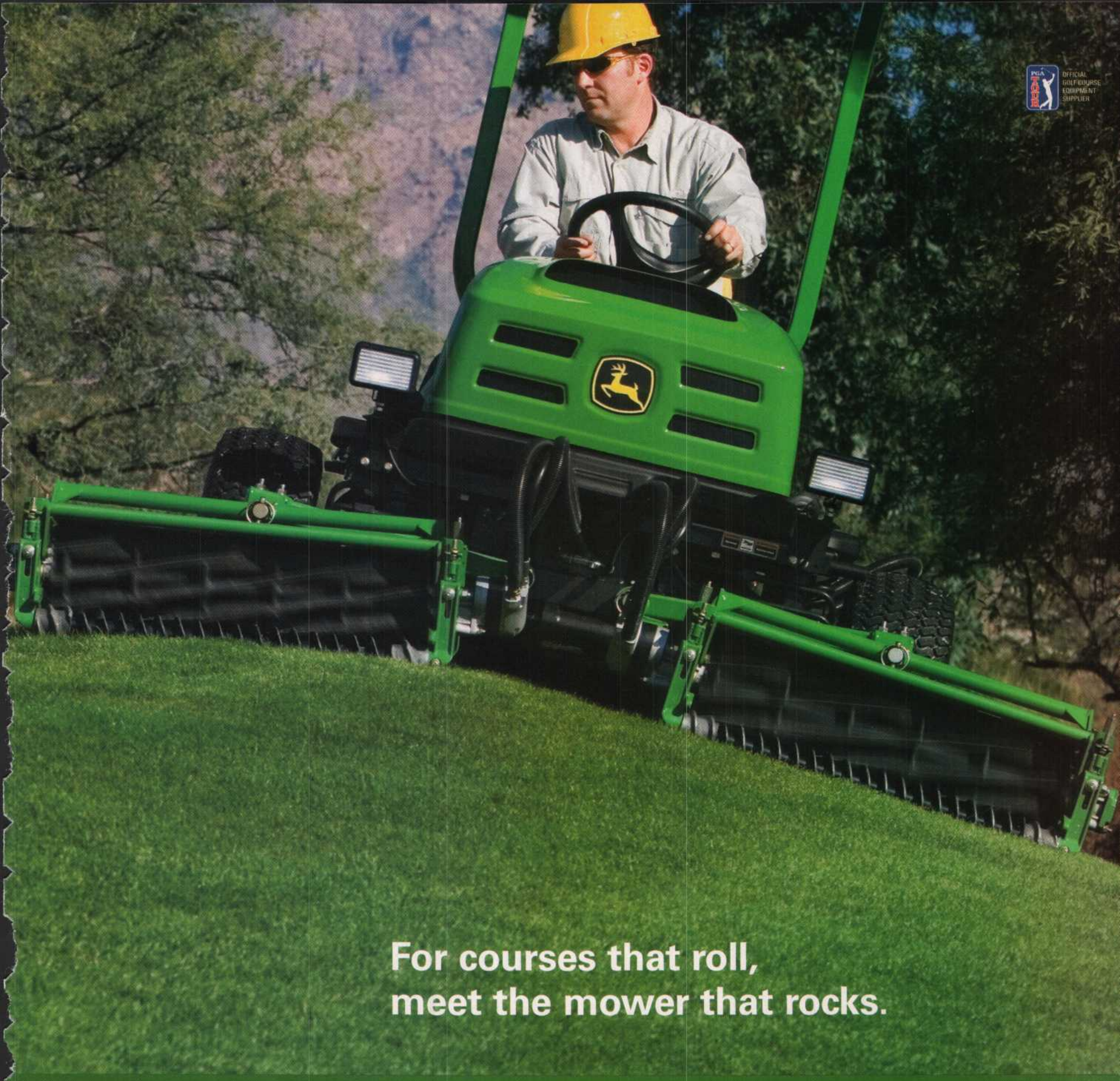

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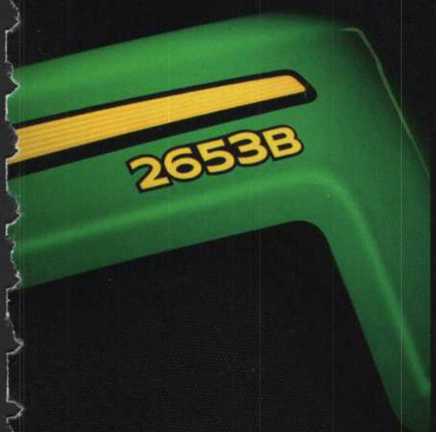

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(Ontario, Canada). Treatments applied at project inception consisted of four rootzone media types (100/0, 95/5, 80/20, 70/30 Sand/Peat, by volume), three seeding rates (0.5, 1.0, 1.5 kilos per 100 square meters), three phosphorus rates (0.25, 0.75, 1.25 kilos per 100 square meters), and two nitrogen rates (0.5, 1.0 kilos per 100 square meters). Treatment parameters were examined in a full factorial randomized complete block design using 100-square-centimeter pots seeded with a specific velvet variety.

The study had two stages: establishment (weeks 1 to 4) and early fertility (weeks 5 to 9). Establishment measurements were taken at the end of week 4 and included initial clipping dry weight (DW) and estimated percent turf cover (TC). Early fertility treatments consisted of weekly liquid fertilizer applications to each treatment group at rates of 0, 0.01875, and 0.0375 kilos per 100 square meters for phosphorus, and 0.025 and 0.075 kilos per 100 square meters for nitrogen to simulate a spoon-feeding program.

Clippings (DW) and turf quality (TQ) ratings were collected weekly during this phase of the study. Initial clipping DW and TC (weeks 1-4) were analyzed using SAS Version 9.1.3 with the mixed procedure; DW and TQ (weeks 5-9) were analyzed as repeated measures, also using the mixed procedure (SAS Institute, Cary, N.C.).

Results

Dry weight during the establishment phase was greatest in the 70/30 rootzone mix (Table 1), while for weeks 5-9 both 70/30 and 80/20 yielded higher DW values than 100/0 or 95/5.

However, the 95/5 and 100/0 rootzones scored significantly higher in TQ compared with the higher peat rootzones (Table 1). Seeding rate significantly affected both DW and TC for weeks 1-4 with the 1.5 kilos per 100 square meters rate being the highest in both cases (data not shown). Over time, however, seeding rate had no effect on DW through weeks 5-9 although quality ratings were consistently highest for the 1.5 kilos per 100 square meters seeding rate (data not shown).

Phosphorous rate had minimal impact on TQ, but DW was lowest during both phases of the study at the lowest phosphorous rates (data not shown). Nitrogen level initially had no significant effect on DW and TC (data not shown), but over time became a significant contributor to both variables measured. The most striking treatment effect was based on the color component of TQ.

Based on the data collected, we concluded that seeding rate is largely related to turf quality, but not dry weight over time. This is likely due to the fact that the highest seeding rate produced the most dense turf with the finest leaf texture (both components of TQ). It is also clear that nitrogen does not have an initial effect (weeks 1-4) on either parameter, but over time it becomes an important factor in determining turf quality and dry weight accumulation.

Our preliminary results suggest that the variety performed best with our high nitrogen treatment, perhaps indicating that velvet prefers a higher amount of N at establishment. A future greenhouse and field project will evaluate both higher and lower nitrogen levels than those used

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TABLE 1

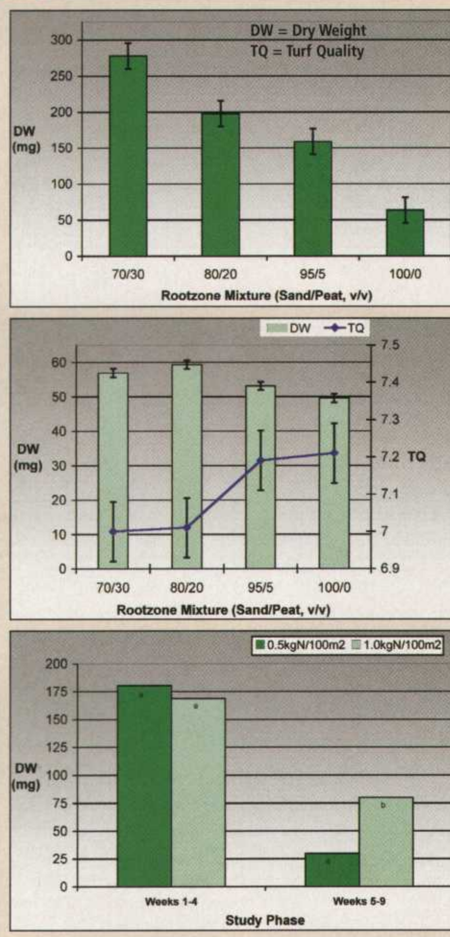

PHOTO 2

Velvet bentgrass performed best with high nitrogen treatment, perhaps indicating that velvet prefers a higher amount of N at establishment.

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in this experiment, and more specific nitrogen requirements of SR7200 will be determined. The 70/30 and 80/20 rootzone mixtures, perhaps due to higher nutrient and water retention ability, were able to foster more desirable conditions for early establishment (weeks 1-4).

However, over time (weeks 5-9), the 95/5 and 100/0 mixtures produced similar DW accumulations to the 70/30 and 80/20 mixtures, and had higher quality ratings. This might indicate that higher peat content becomes less important as the turf develops. Overall, our greenhouse study has provided some insight as to what factors may have an effect on VBG establishment, and what practices may be applicable for VBG establishment in the field.

John Watson has a bachelor's degree in agriculture from the University of Guelph. He is pursuing his master's degree in turfgrass science studying the fertility requirements of velvet and creeping bentgrass cultivars. The aim of the research is to provide better insight as to the exact fertility needs of velvet bentgrass in comparison to creeping bentgrass putting green turf.
Dr. Katerina Jordan is an assistant professor of turfgrass science at the University of Guelph. She earned her Ph.D. in plant sciences from the University of Rhode Island. Her research focuses on low-input management practices of golf course turf. She also oversees the Guelph Turfgrass Diagnostic Lab.

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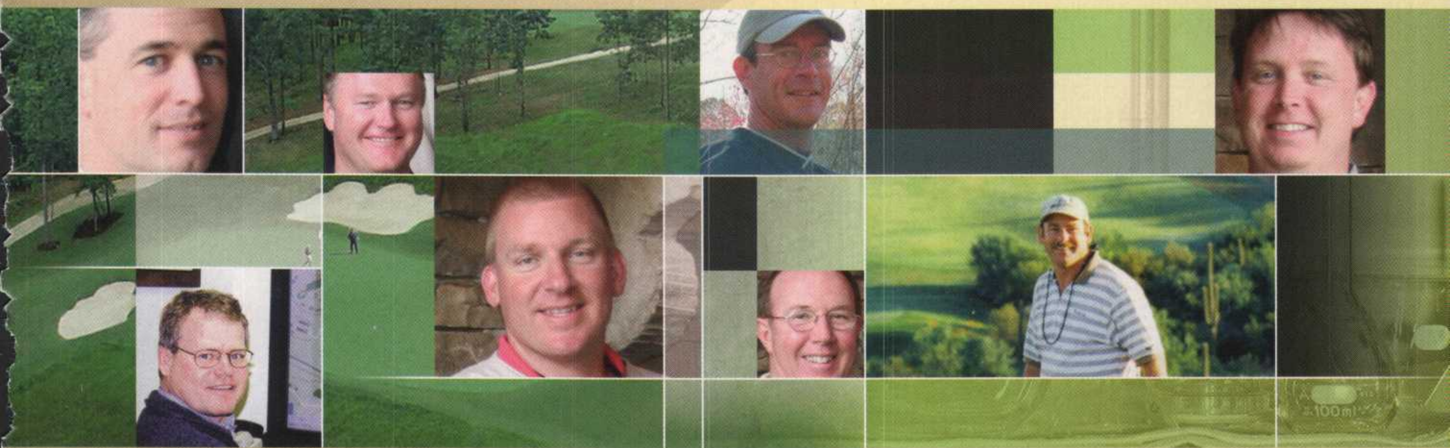

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