For example, a low-revenue New Zealand course located on sandy soils next to the Tasman Sea had undulating fairways that were very patchy. The course could not afford the fairway irrigation equipment or labor force to keep all the bumps and mounds adequately irrigated for the turf to remain uniformly green.

Patchiness does not indicate playability. For example, one of the greater than $700,000 revenue courses had 50 percent distinct patches in its greens, but the greens had excellent playability because their speed was 10 feet and their surface was classified as very smooth. In this case, the patchiness was because of one of the green's creeping bentgrass varieties turning dark purple during cool weather.

Conversely, a less than $70,000 revenue course had only 15 percent distinct patches in its greens but the greens had poor playability because their speed was 7 feet and their surface was classified as bumpy.

It was surprising to find that the less than $70,000 courses had the faintest patches in approaches, surrounds, fairways and roughs. These courses were very low maintenance. After speaking with the course superintendents, they mentioned that the approaches, surrounds, fairways and roughs were all maintained exactly the same using sheep as mowers. Although these courses had only faint patches in the sheep-grazed areas, the playability was usually not as good as higher revenue courses because the turf was bumpy, thin, weedy and had a variable height (Linde, 2004).

The NZSTI now has a technique to measure turfgrass uniformity and a database of uniformity data for golf courses that they can use to more appropriately advise superintendents and course officials.

In addition, turf managers that are concerned about turf uniformity can use the technique to monitor whether their management program is influencing turf uniformity and if standards are being met.

FIGURE 5

Average patch contrast per turf area sorted by annual revenue of golf courses in New Zealand.

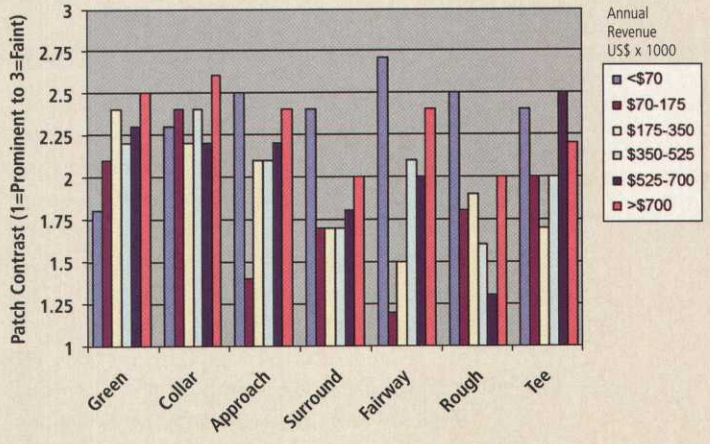
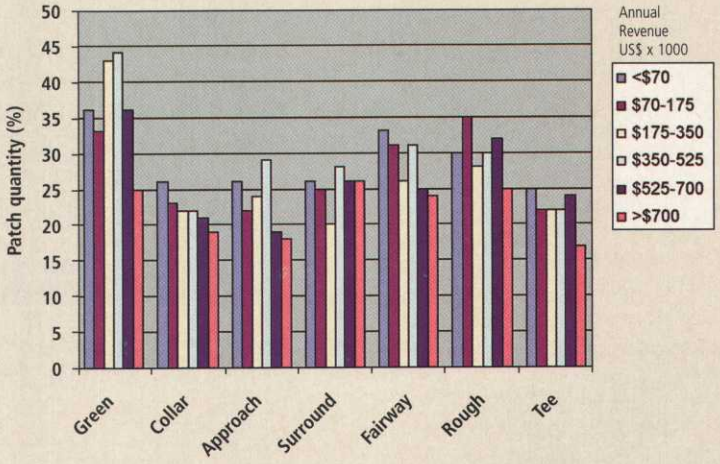


FIGURE 6

Average patch quantity per turf area sorted by annual revenue of golf courses in New Zealand.



Douglas T. Linde, Ph.D., is an associate professor of agronomy and heads the turf management program at Delaware Valley College in Doylestown, Pa. He is also the college's head golf coach. He can be reached at linded@devalcol.edu.

REFERENCES

Linde, D. 2004. "Benchmarking golf course conditions in New Zealand." *New Zealand Turf Management Journal.* Vol 19, No. 4, p. 13-15.

Schoeneberger, P.J., D.A. Wysocki, E.C. Benham, and W.D. Broderson. 1998. "Field book for describing and sampling soils." Natural Resources Conservation Service, USDA, National Soil Survey Center, Lincoln, Neb.

Foy, J. 2002. "Course presentation: Playability vs. aesthetics: Can expectations of American golfers be met in the future?" *USGA Green Section Record.* Vol. 40, No. 2, March/April, p. 23-24.

Brady, N.C. and R.R. Weil. 2000. "Elements of the nature and properties of soils." Prentice-Hall, Inc. Upper Saddle River, N.J.

Morris, Kevin. 2005. "A guide to NTEP turfgrass ratings." www.ntep.org/reports/ratings.htm (verified Jan. 20, 2005).

To Air Is Human When It Comes to Anaerobic Greens

By Chong, S.-K., R. Boniak, S. Indorante, C.-H. Ok and D. Buschschulte

Management of anaerobic golf greens has always been a dilemma to golf course superintendents and turf researchers (Bunnell and McCarthy, 1999; Chong et al., 2000). Anaerobic soils limit the amount of free oxygen available in the rootzone and therefore will impede root development and restrain nutrient availability for turf growth.

Since soil air content in the rootzone depends very much upon the aeration rate with the atmosphere, respiration rate of microorganism and plant roots and solubility of gases in water, it's important to further understand the influences of soil air on turf growth. The objective of this study was to examine the influence of carbion dioxide (CO_2) content in golf green rhizosphere on turf quality.

The study was conducted on the existing greens at the Hickory Ridge Golf Center in Carbondale, Ill. The 18-hole golf course was constructed in 1993 and opened in 1994. The greens were constructed in California-style without a layer of gravel between rootzone mix and the native soil.

Nine greens were randomly selected. On each green, five 1-meter diameter circular plots were randomly selected for measurement. The first measurement was made on Aug. 29, 1998.

Data collected from each plot included water content, CO_2 content, turf quality index and soil physical and chemical properties. In order to be consistent and to minimize the climatic influence on CO_2 content, all experiments were conducted between 6 a.m and 10 a.m.

The greens were cultivated using the hollow tine (1.2-centimeter (cm) diameter, 5 x 5-cm spacing and 7.5-cm deep) in the first week of April and the last week of August in1998. In 1999 the cultivation was performed again in the first week of April. In mid-June, the green was water-injection cultivated once using a Hydroject (Murphy and Rieke, 1994). No other cultivation was conducted until the end of the experiment.

Water content (from 0-20 cm) was detected

FIGURE 1

Mean variation in rootzone CO_2 content between August 1998 and September 1999 in golf green at Hickory Ridge Golf Center, Carbondale, Ill.

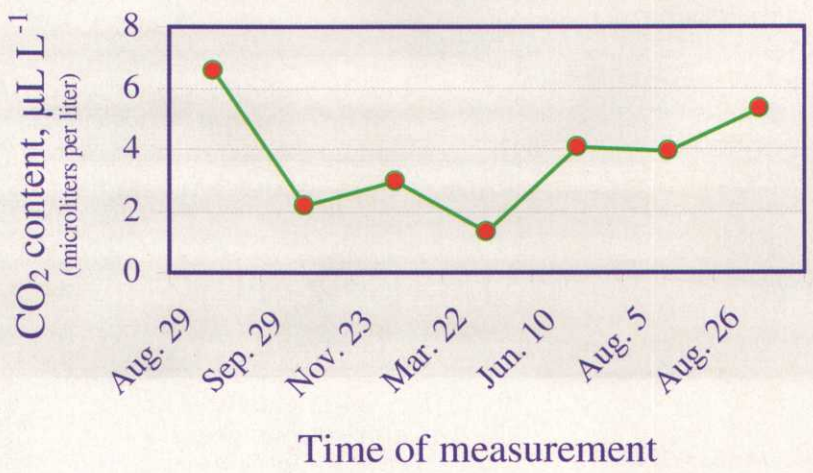
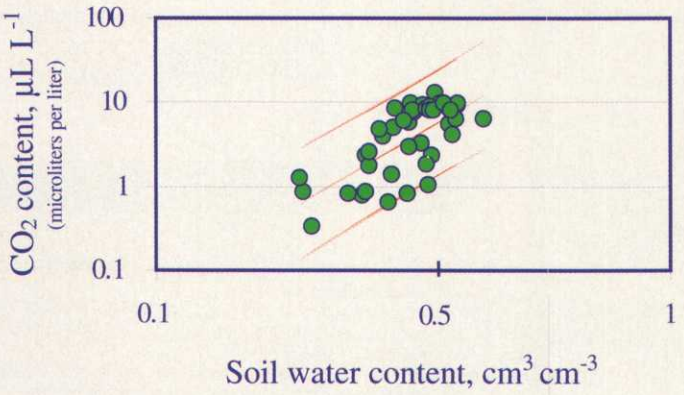


FIGURE 2

CO_2 content increased when water content in the golf green rootzone increased.



by time domain reflectrometry (TDR, by Soil moisture Equipment, Santa Barbara, Calif.). The *in situ* CO_2 content in the rootzone was measured using a gas analyzer (Subair, Inc., Deep River, Conn.). In the measurement, a 16-cm (depth) hole was prepared using a 1.2-cm diameter auger. Right after pulling the auger out from the green, a small Plexiglas tube (8 cm long, with 3.2 and 6.35-millimeter (mm) inside and outside diameters, respectively) was immediately inserted into the hole for extracting CO_2. The inlet of the tube was inserted into the hole and held at 8 cm below the green surface. The outflow of the tube was connected to a gas analyzer through a rubber stopper. The rubber stopper was used as a plug for the hole in the green to prevent soil air contamination by the surrounding atmospheric air.

Soil air was withdrawn directly from the profile and CO_2 content was detected as the soil air passed through the gas analyzer. The reading of CO_2 content started from zero and gradually increased to a higher value and finally it decreased because of infiltration of atmospheric air into the profile. The highest reading was recorded for analysis. Turf quality was scored at the same time when CO_2 was measured using the method described by Chong et al., 2000.

The CO_2 was measured seven times for the entire study from August 1998 to August 1999. Infiltration was measured only once using a single-ring (12.7 cm in diameter) infiltrometer.

Results and discussion

Large variations in rootzone CO_2 content were found both spatially and temporarily (see Figure 1) in a golf green.

In general, CO_2 content in the golf green rhizosphere was low during the dormant season. But, it increased to as high as 13 microliters per liter (µL L^{-1}) during the late summer. A curve linear relationship (see Figure 2) was found between soil moisture and CO_2 content.

Continued on page 64

FIGURE 3

CO_2 content decreased as infiltration rate of golf green increased.

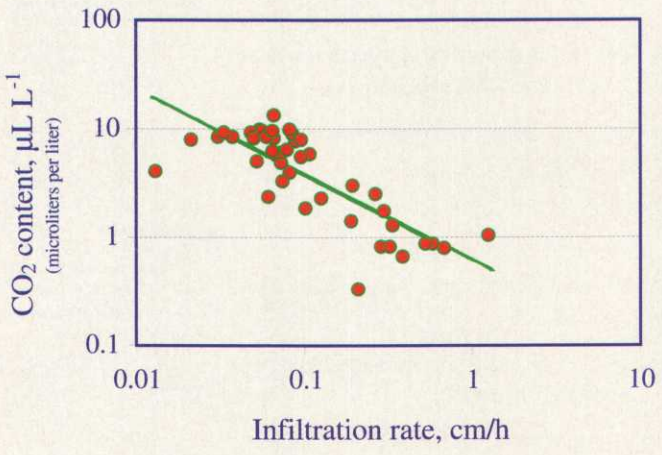
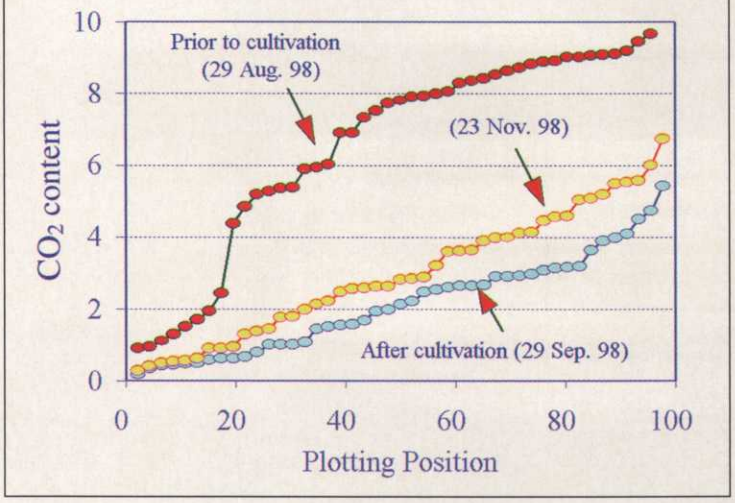


FIGURE 4

CO_2 vs. probability (before and after cultivation)



Continued from page 63

As water content increased, CO_2 content in the rootzone increased, but CO_2 content decreased as water infiltration rate of the rootzone increased (Figure 3). When CO_2 content in the rootzone accumulated higher than 5 microliters per liter, turf quality drastically declined.

Undoubtedly, cultivation of the green can reduce CO_2 content in the root zone but the benefit of cultivation decreased with time (Figure 4). Green cultivation generally runs in the early or late growing seasons. Unfortunately, CO_2 content in rootzone could accumulate over 9 microliters per liter, particularly in the middle and late summer.

At the time aeration is needed, other concerns such as causing turf injury, disturbing golf green and losing playability time has prevented superintendents from aerifying. Therefore, nontraditional cultivation methods such as water injection and sub-airing should be applied to alleviate anaerobic condition to enhance turf growth.

REFERENCES

Bunnell, T. and B. McCarthy. 1999. "Gas underground." *Golf Course Management.* 67(10): 65-69.

Chong, S.-K., S. Indorante, D. Buschschulte and R. Boniak. 2000. "Is your turfgrass suffocating." *Golf Course Management.* 68 (7):72-75.

Chong, S.-K., Richard Boniak, S. Indorante, C.-H. Ok and D. Buschschulte. 2003. "CO_2 Content in Golf Green Rhizosphere." *Crop Science* (In press).

Murphy, J.A and P.E. Rieke. 1994. "High pressure water injection and core cultivation of a compacted putting green." *Agronomy J.* 86 (4) 719724.

She-Kong Chong, Ph.D., is a professor of soil physics and turf soil management at Southern Illinois University Carbondale; Richard Boniak is a Ph.D. candidate at SIUC; Chang-Ho Ok was a graduate student at SIUC; Sam Indorante, Ph.D., is a soil scientist with the USDA-Natural Resources Conservation Service in Carbondale and adjunct professor at SIUC. D. Buschschulte is the superintendent at Belk Park Golf Course in Wood River, Ill.

TEST EQUIPMENT FOR YOUR COURSE ON OUR COURSE.

With over 60% of America's public and private golf courses within a day's drive of Louisville, it makes perfect sense to attend the International Lawn, Garden & Power Equipment Exposition, October 14-16, 2005.

A superintendent attending EXPO in 2004 said, "Besides equipment, there's so much more – parts, attachments, utility carts. I even found a better source for trimmer line." And this year, all exhibitors will be under one roof in the new Exhibit Building and Conference Center.

EXPO 2005 offers you a chance to:

- Try out equipment in the 20-acre Outdoor Demo Area all 3 days
- See new products and technologies
- Network with suppliers
- Swap success stories with other superintendents
- Attend Saturday seminars sponsored by Golfdom Magazine
- Enjoy Saturday's Free EXPOFest starring Charlie Daniels
- Dine at the new 4th Street Live entertainment district
- Visit Caesar's Riverboat Casino and more

Louisville is at the center of the golf industry.

Get a jump on next year's season. Get to EXPO 2005.

October 14-16, 2005

EXPO
The International Lawn, Garden & Power Equipment Exposition
2005

POWER. KNOWLEDGE. GROWTH.

REGISTER TODAY ONLINE AT
expo.mow.org
or call
800-558-8767

SEE CHARLIE DANIELS FREE!

Got Gusto?

Tom Alex does, and he's brought plenty of it to his job as superintendent of Orlando's Grand Cypress Resort

By Anthony Pioppi, Contributing Editor

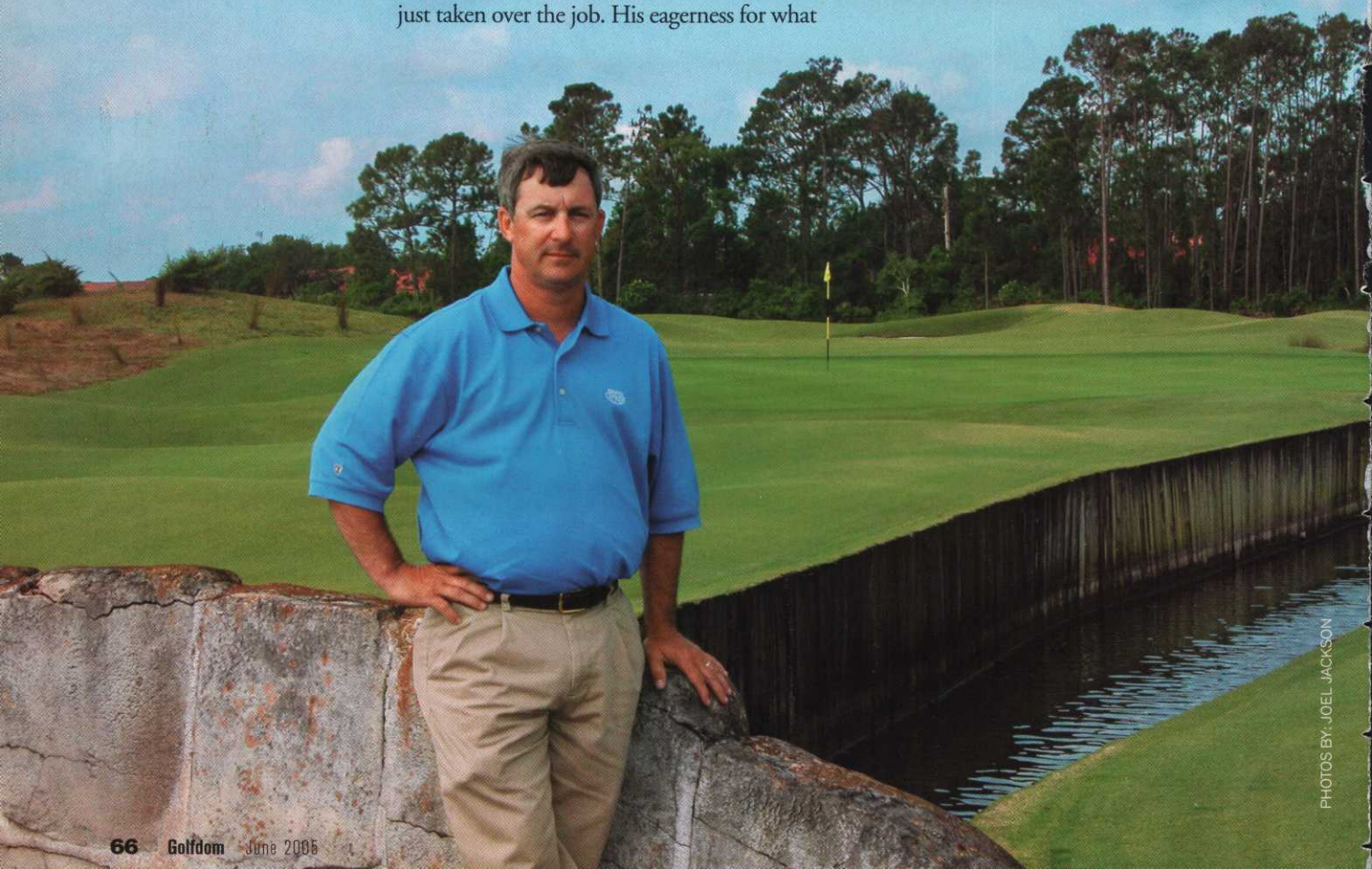
Tom Alex sits behind his desk at Grand Cypress Resort, and it's easy to see he finds great happiness in his position as director of grounds for one of Orlando's most prominent golf resorts.

You would expect his enthusiasm to be a bit tempered; after all, he's had his hands on the Grand Cypress reigns for more than 20 years. But the 44-year-old Alex acts more like he has just taken over the job. His eagerness for what he does is apparently contagious. Nearly 30 of Alex's former employees have gone on to become superintendents, including Mark Michaud, the superintendent at Shinnecock Hills Golf Club.

Alex offers no secret for his longevity.

"I like coming to work every day," he says as he sits relaxed in his small, comfortable office.

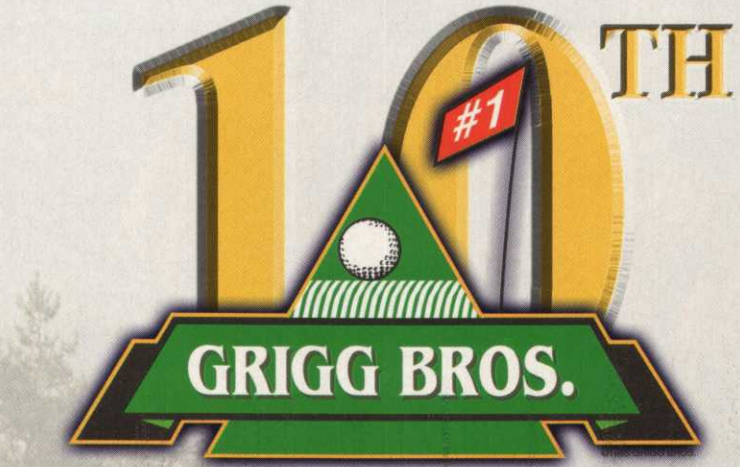
Continued on page 68



PHOTOS BY: JOEL JACKSON

TRUST!

Quality • Performance
Compatibility



10TH
ANNIVERSARY

The most advanced fertilizer technology available today!

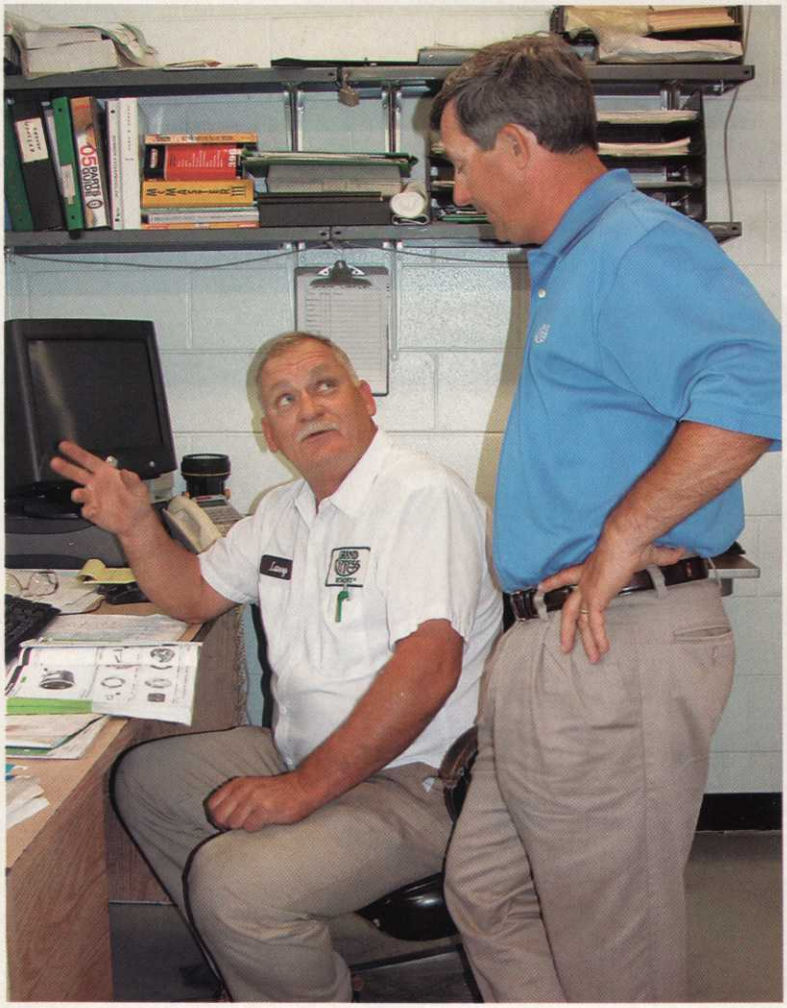
GRIGG BROTHERS
P.O. BOX 128 • ALBION, IDAHO 83311
For a Distributor Near You Call:

1-888-246-8873

or find us on the web at *www.griggbros.com*

ITODA

GCSAA PLATINUM



Alex, who is the only superintendent that Grand Cypress has known, confers with Larry Smith, the club's maintenance shop manager.

Continued from page 66

And this is no cushy private facility job. The 45 holes designed by Jack Nicklaus see plenty of play. "We're busy all the time," Alex says, pointing out that Grand Cypress has a tournament office to book all the outings the club hosts.

On the Grand Cypress property are 144 villas. The nearby Hyatt Regency Grand Cypress has 750 rooms, and its guests have access to the courses.

Although Alex can spend a good part of his day attending meetings, signing purchase orders and the like, he's still out on the course every chance he gets. It's there that he finds his most enjoyment.

Grand Cypress has had only one head superintendent since the first course opened in 1983. Alex grew it in, maintains it and has made occasional renovations to it since arriving from the TPC at Sawgrass in Ponte Vedra Beach, Fla.

The long way around to a career in course maintenance began for Alex in the small northwest Connecticut town of Washington Depot, where he excelled in baseball under the tutelage of his father, who coached the Washington High School team for more than 30 years. During his sophomore year Alex took his first summer job, shagging golf balls at the nine-hole Washington Golf Club. As the club pro gave lessons, Alex picked up balls one at a time and made 50 cents a lesson.

Alex graduated to the grounds crew and spent much of the next two summers pushing a rotary mower. "When they finally put me on equipment, that's when I screwed it up," he says.

After graduating high school Alex had no intention of going into golf course maintenance for a living, nor did he have any intention of going to college, especially with his below-average grades.

However, nearby Hotchkiss School, an exclusive private academy whose students come from money and go on to the Ivy League, needed a shortstop and Alex needed some direction in his life. His father used a connection, made a phone call and Hotchkiss suddenly recognized "my academic potential," Alex says, shaking his head with a wry smile on his lips.

Alex spent a year at Hotchkiss doing nothing but playing baseball, soccer and studying. "You didn't have any extra time, especially when you weren't brilliant," he says.

Although Alex can spend a good part of his day attending meetings, he's still out on the course every chance he gets.

It was during his time at Hotchkiss that he began thinking seriously about college, and the idea of going to turf school appealed to him. While his classmates went off to the likes of Yale, Princeton and Brown, for Alex it was the University of Massachusetts-Stockbridge and a two-year degree in turfgrass science, a major his guidance counselor at Hotchkiss didn't even know existed.

Continued on page 70

EAGLE ONE

"Always On The Right Course" SM

Pull Top Trash

Defibrillator

Outstanding Quality

Embroidered Flags

Screened Flags

Water Cooler
Housing With Clock

Adirondack Chair

Surprisingly Affordable

Custom Signs

Greens-Sweeper

Underground Rake Caddie

1-800-448-4409 **www.eagleonegolf.com** **info@eogp.com**

Alex (center) is most happy when on the golf course. Here he talks with assistant superintendent Erin Galloway (Left) and senior superintendent Pat Gibaratz about a tee addition project.

Continued from page 68

The unexpected twists and turns in Alex's life were far from over.

He excelled in his studies in his first year at UMass and was intending to head back to Washington Golf Course for the summer when he was approached in the midst of final exams by legendary Stockbridge Professor Joe Troll. Troll asked Alex a question that would change his life: "Have you ever been to Florida?"

Alex had not, but he found himself there a few weeks later as an intern working on what would become TPC Sawgrass under grow-in Superintendent Dave Postlethwaite. Alex arrived in north Florida in March and went to work in the swamps as part of the early stages of clearing. His companions were local lumberjacks and snakes — large snakes. But Alex knew he was on to something special.

"The maintenance facility was bigger than the Washington town garage," he says.

The next few months were made up of 90-hour weeks and a severe learning curve, part of which included getting to run heavy equipment for the first time. Alex also estimates he spent part of at least 100 days with course designer Pete Dye.

Often that meant Dye standing there as Alex raked out the final grades on greens. Alex didn't just rake the grades, he also contributed to forming them. He recalls Dye querying him once from off the green as he smoothed out a putting surface, "Hey Tommy, can we put a pin there?" When Alex said, "Yes," they moved on.

Another time Dye couldn't figure how to grade the right side of the 14th fairway. After failing on more than a few occasions to get it right, he climbed off the bulldozer and left with instructions to Alex, "Do something."

Continued on page 72