An outbreak of miniring disease on ultradwarf bermudagrass in midsummer on a microcystin toxin-positive course. The exact cause or causes of miniring aren't clear. Photo: Mike Healy

tests, Sutula felt it might need to look at various options to market the test once it was thoroughly validated. I agreed, but didn't immediately see any applications in my field.

And, as Paul Harvey says, the rest of the story. A year later, in early January 2007, I was called to a municipal golf course in Southern Alabama to look at a live oak problem. Live oak trees, on and adjacent to the course, which had been irrigated by spray, were suffering from leaf blighting – but only as far up as the water came in contact with the leaves.

As it turned out, the blighted leaves fell off eventually, and the new leaves replacing them were unaffected. The superintendent thought sediment removal from the irrigation pond the previous summer must have had something to do with the problem. I didn't find any fungal disease on the symptomatic leaves.

RESERVOIRS IN AUSTRALIA

Then, in early May 2007, I was in Dubai. One evening I had dinner at a Mexican restaurant with several people including Jeff Ferney, an expatriate Australian who came to the United Arab Emirates as manager of the landscape maintenance division of a local company based in Abu Dhabi.

During our dinner, Jeff talked about the serious problem Australia was having with a toxin, produced by blue-green algae, found in reservoirs. This was, potentially, a serious human- and livestock-health problem. I remembered my conversation with Sutula in January 2006 and said I would pass on Agdia's contact information to him.

DISEASED GREENS

The final part of my serendipity took place in mid-May 2007. I visited a golf course where a greens-disease problem began on nine holes in the fall of 2006. The symptoms returned in the spring of 2007. As I rode with the golf course superintendent, he said he was having problems with the greens, tees and fairways on these nine holes, which didn't respond to fertilizer as the turf on the adjacent nine did. Those nine holes had never had any greens-related problems, even though they were maintained identically.

I asked about the source of irrigation water for these two nines, assuming the source was the same for both nines.

"Oh no," replied the superintendent. "The nine with no problems has its own irrigation pond and pump station, as does the nine with all the problems."

I asked if the separate sources of irrigation water had been tested. They had been, and the water quality test results showed no distinct differences. The superintendent also indicated he pulled soil samples for nematode and standard soil fertility testing, and these tests also showed no difference between the good and bad nines.

Could there be a toxin being produced in the irrigation pond serving the bad nine that was affecting turf quality, perhaps making a conventional disease more difficult to control or cure? I called Agdia and spoke with the scientist working on the toxin test. The test was a microcystin toxins immunostrip assay, and Heather Chambers, a scientist at Agdia, provided me with more background informa-

tion about the toxin. Chambers said that while their primary interest in the test was for use in drinking or recreational water testing, articles had been published about its adverse affect on plant growth, even causing root dysfunction.

Agdia agreed to run samples from the good and bad nines, specifically water from each pond, as-irrigated samples from each nine and samples of badly affected turf (in areas with a heavy blue-green algae buildup). The sample test results were startling. The good nine samples all tested negative, while the bad nine samples all tested positive for microcystin toxins. Might microcystin toxins produced by aquatic forms of blue-green algae exist in other golf course irrigation ponds as well?

TESTING THE WATER

During the following months, I requested, and had sent to my laboratory, golf course pond and as-irrigated water samples from 35 golf courses in Florida, Alabama, Georgia, Louisiana and Texas. Microcystin toxin testing of all samples was carried out by Agdia, using its immunostrip assay and, in certain cases, a standard immunoassay. Positive samples came from golf courses in Florida, Alabama, Louisiana and Texas. Four of the courses which tested positive for microcystin toxins had unusual and/or difficult-to-control disease or disease-like problems on their greens. Water samples from more than 50 percent of the ponds tested contained microcystin toxins.

Selected samples archived by freezing were sent to Linda Lawton, Ph.D., at the School of Life Sciences at The Robert Gordon University in Aberdeen, Scotland, for additional testing by conventional analytical techniques. On January 9, 2008, Lawton's lab confirmed the presence of microcystin-LR and microcystin-LA. In addition to analytical capabilities, Lawton is recognized as an expert in the area of microcystin toxins toxicity to plants.

Microcystin toxins are produced by a number of genera of blue-green algae, which almost always grow in an aquatic environment. These toxins are hepatotoxic cyclic heptapeptides. Microcystin-LR is one of the most investigated of these toxins. It has been found in rivers, lakes and ponds throughout much of the world. Factors influencing toxin production and its sometimes immediate production cessation aren't clearly understood.

The major concern about the presence of microcystin toxins is their known mammalian toxicity. Most current water quality standards mandate potable water contains no more than 1 parts per billion and no more than 10 to 20 parts per billion in recreational water. Many countries, along with the World Health Organization, have introduced such standards. Currently, the United States has no microcystin toxins standards, although the U.S. Environmental Protection Agency considers these toxins of interest

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and is headed toward regulatory authority. The impact of these toxins on plant growth is being examined further.

FUTURE PLANS

So where do I go from here? I've made my findings known to several organizations, including the U.S. EPA, with hope of finding sponsorship for a much larger survey. Until then, I'll continue to seek courses that have difficult-to-control disease or disease-like problems and recommend conventional plant disease diagnosis, along with multiple samples of pond water for microcystin toxins testing. Soon, I plan to have a PowerPoint presentation that can be shown remotely. **GCI**

Michael J. Healy is a turfgrass pathologist based in southern Alabama. He can be reached at 251-986-6240, mjhealy@gulftel.com or through his Web site, www.sportsturfdiagnostics.com.

Typical cyanobacterial bloom in an irrigation pond. Blooms are pushed by wind or drawn to the induction point of the operating irrigation pump. Photo: Mike Healy

BY MARGARET HEPP

Wild blue yonder

In a green-obsessed industry, estate manager Scott Resetich has learned there's no green without blue

Pond management is a chore for many golf course superintendents, but for Scott Resetich, estate manager at Rich Harvest Farms in Sugar Grove, Ill., it's become a passion.

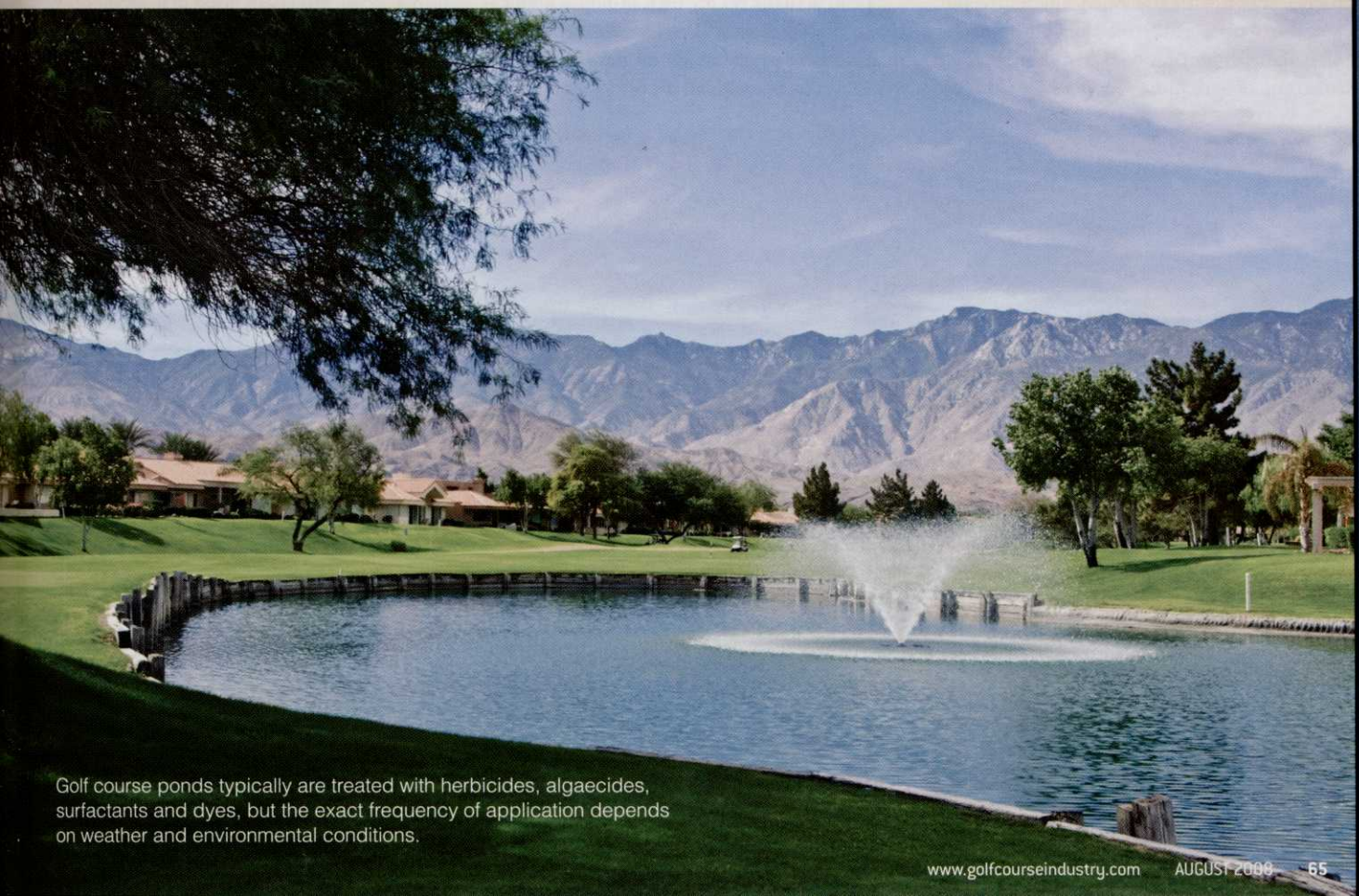
Resetich was in charge of all aspects of course maintenance when he started at ground zero at the 18-hole, 1,820-acre course 20 years ago. Since then, the facility has hired two turf managers, Jason Funderburg and Jeff VerCautren, allowing Resetich, who officially oversees horticulture and grounds activity, to make water quality his priority.

When you're new to pond management, practice makes perfect – and with 7 acres of on-course water under his care, Resetich gets plenty of practice. The course has three treatable lakes: Clyde, Katherine and the course's irrigation source, Rainbow. Resetich treats them about every 10 to 14 days with herbicides, algaecides, surfactants and dye. The exact frequency of application depends on the weather and environmental conditions.

"In 2007, we did quite a few applications throughout the season – the most ever," Resetich says. "It was rainy, and we didn't adjust water levels on two of our lakes."

Resetich sprays approximately equivalent concentrations to the 3.75-acre Lake Clyde and 1-acre Lake Katherine, but the 1.5-acre irrigation lake receives special treatment. For pesticide applications to Lake Rainbow, he reduces the concentration of Reward (diquat dibromide) and restricts other herbicides.

You have to be attentive to maintain a delicate balance, Resetich says, and you can't overdo it with pesticides, es-



Golf course ponds typically are treated with herbicides, algaecides, surfactants and dyes, but the exact frequency of application depends on weather and environmental conditions.

pecially when you're committed to Audubon standards. He stocks a thriving fish population in each pond, including large-mouth bass and trout in Lake Rainbow, plus hybrid bluegill, catfish, walleye, northern pike and muskie, so fish populations are another consideration when it comes to pesticide applications.

Consequently, Resetich has reduced aquatic pesticide quantities, using about 2 pints of the surfactant Aqua-Prep and between 48 and 64 ounces of Reward per lake application.

"Reward is a little more effective from a contact standpoint, and it works well on rooted vegetation," he says.

Curly leaf pondweed mainly affects the waters at Rich Harvest Farms, as do algae varieties hydrodictine, photophora and spirogyra. Cutrine Plus (elemental copper) is systemic and works well to keep algae at bay, Resetich says. He uses an average of 3 gallons of the algaecide per lake application.

After each pesticide application, Resetich sprays Precision Laboratories' True Blue, a dye he switched to from Aqua Shade (acid blue 9, acid yellow 23) almost seven years ago. Resetich was happy with the Aqua Shade dye but wanted to build on his relationship with his water management product distributor, Scott Armstrong of agriculture cooperative Conserv FS in Tinley Park, Ill.

"Scott carries all the other pesticide products, so it was really a matter of convenience," he says. "I can call right now and place an order, and they'll drop it off this afternoon. It's service oriented. I can't beat that."

Precision recommends applying at least a gallon of dye per 4 acre/feet. Resetich applies as much as 2 gallons to Lake Rainbow and another 2 gallons to Lake Katherine. Lake Clyde receives 3 to 4 gallons of dye.

"Sometimes, I have to consider how high the water level is," he says. "I want as much of the shade as possible to ward off that algae growth."

Fluctuating water levels can affect the amount of algae in a lake at any given time, causing it to produce at even double the rate, Resetich says. Usually he can keep up with water management on his own, but when rapid growth requires more time than he can commit, he's able to reach out to a local aquatic management contractor, Marine Biochemists. Based in nearby Elburn, the company has sent a marine biochemist out to the facility for two treatments the past month.

"I can actually do my own in-house applications," Resetich says. "I've been handling pond management pretty much on my own for the last 20 years, but with all my priorities, I've had contractors fill in for me periodically."

With such large lakes, water treatment can be quite an elaborate set-up, Resetich says. He goes out with another crewman in a 14-foot john boat with an 8-horsepower Johnson motor and a 4-horsepower chemical injector.

"It's a good four to six hours by the time you get your logging done and your cleanup finished," he says.

Maintaining the lakes on property is almost a full-time job, so in addition to Resetich and the two turf managers on staff, the facility keeps a 38-man, on-season staff during growing season. Labor is included in the facility's maintenance budget, which is about $1 million.

Water management products also are part of the maintenance budget. The price of Reward increased recently to $136 per gallon. Cutrine Plus costs about $30 per gallon and True Blue is about $39 per gallon.

"I get a small discount on aquatic products," he says. "But service is what's important to me. If I've got to pay a little more to have service at my fingertips, so be it."

Quality, not quantity, then, is Resetich's primary concern about pond management, and it's a mantra that's propelled the course through the Audubon certification process. The facility has one more project to complete before it's a Certified Sanctuary. The estate manager says he'll focus on this during the winter and then prepare for his next big project: hosting the LPGA Solheim Cup in August 2009.

"During tournament prep, aesthetics become so important from a management standpoint," he says. "Medinah Country Club practically had a management team on site waiting to stay on top of algae in lakes, just for appearance, during the PGA Championship in 2006. We might be at the same point just to stay on top of it. Frequency will vary a little bit then. It'll probably stay about the same up until two weeks before, and then we'll watch it a little closer."

Resetich estimates 95 percent of golf courses with any kind of algae problems or vegetation will hire water-quality control out to contractors, and with the amount of effort involved, it's easy to see why. But Resetich only wishes he had more time to devote to his passion.

"If it was my choice, as a grounds manager, I'd prefer to do water quality – from stocking to algae control to overall aeration – over any of the other specialties, turf management or horticulture," he says. **GCI**

Many golf courses with an algae problem or vegetation will hire water-quality control out to contractors.

BY MARGARET HEPP

In limbo on the lakes

Two superintendents at Purgatory Golf Course suffer through scorching heat to keep on-course lakes under control

During the past year, golf course superintendent James Brown and his assistant Larry Wilk have been through hell at Purgatory Golf Course.

Opened in 2000 on 218 acres of land in Noblesville, Ind., the 18-hole facility has 16 total acres of water divided into five lakes. Last July, pond management jumped to the top of their priority list during a serious drought when one of the four major lakes on the course dried up. The trouble wasn't only the lack of water. As the lake depth plummeted, the algae population, thriving in the summer heat and shallow water, multiplied.

"The algae got to be about 8 inches thick," Brown says. "It wasn't pretty, and it smelled like a dead animal."

Fortunately, the lake was built on top of a pipe system. A pump was installed, and Brown and Wilk were able to pump fresh water into the lake at several hundred gallons a minute.

"Without that fresh water supply, it was just a festering wound," Brown says. "But once we put another well in, the lake took care of itself."

This past spring, though, the lake couldn't manage itself. Brown and his crew usually take the month of January off, and when they returned to the course this February, they found one of their lakes entirely overgrown with aquatic weeds, mostly free-floating duckweed and watermilfoil.

"It was just a mess," Brown says. "We were unaware you could even get growth in the winter, but I guess it never stops."

Brown and Wilk consulted with local SePro representatives for crisis management. The course opens around St. Patrick's Day every

This winter, James Brown, left, and his assistant Larry Wilk, dealt with a lake overgrown with aquatic weeds, mostly free-floating duckweed and watermilfoil. Photo: Purgatory Golf Course

year, so with no way of knowing how long it would take to get the weeds under control, there was no time to lose. They purchased aquatic herbicide K-Tea from Advanced Turf Solutions and sprayed it right away.

"We put 5 gallons of K-Tea down, and it knocked the plants down immediately," Brown says. "Two days later, everything was gone. It was impressive."

Luckily for Brown and his crew, this past spring was a wet one, which kept plant growth at bay – but Brown and Wilk feel confident K-Tea will handle any aquatic plant growth. To apply the K-Tea, a two-person crew – one sprayer, one driver – uses a 13-gallon sprayer, which shoots about 8 feet, to target growth spots.

"I'd like to get a boat to be more deliberate," he says. "When you just go around the edges, you don't quite get everything."

Nonetheless, he says, his method of applying the herbicide is more effective than his prior technique.

"We used to get straight copper sulfate in bags and drive around on a Jet Ski to spread it in the water," he says. "There are all kinds of things on the market for lakes, but the K-Tea works best for me."

The crew applies K-Tea as needed, and last summer's drought-afflicted lake – Brown calls it his problem child – is the most frequent recipient, with 2 gallons of herbicide per treatment.

Brown hopes to be able to devote more time and money to his pond management regimen. Purgatory's lakes cost about as much as one fairway to maintain.

"I like the idea of biological chemicals to control water," he says. "It's just a little pricey. I thought it was doable with our budget, but we spent about $20,000 on the pump last summer."

So, for now, the crew applies Pond Champs black onyx dye every few weeks. Brown prefers the natural look of black water to bright blue, he says – plus, it's an effective way to control plant growth.

"If you can see a golf ball in the water, there's not enough dye," he says.

Aside from regular dye and as-needed herbicide applications, the crew's only other water treatment is an annual early spring application of Sonar (fluridone) to the main and irrigation lakes. The crew applies slightly less of the systemic herbicide to the irrigation pond because of its "Caution" label, which is the lowest toxicity category from the U.S. Environmental Protection Agency. It's safe to irrigate with the herbicide in the water, but Brown and Wilk prefer not to.

Thanks to the wet weather, Brown anticipates they'll finish the season without any significant water management issues. The drought last summer was his biggest challenge in his 10 years at Purgatory.

"It was stressful for a lot of people in the area," he says. "Water was in short supply. I wasn't watering the driving range at all, and I had to let the greens on the driving range go."

This year, rounds are fewer than average, not just at Purgatory but throughout the Midwest. It's hard to catch up on what you lose in the spring, Brown says, but he strives to maintain the entire course under budget. With pond management, that means he has to forego some of the methods and applications he'd like to try.

"We're a high-end course with a relatively small budget," he says. "But there's lots of ways to skin the cat." **GCI**

Striving to maintain an entire course under budget, superintendents sometimes have to forego certain pond management applications, such as an herbicide or dye.

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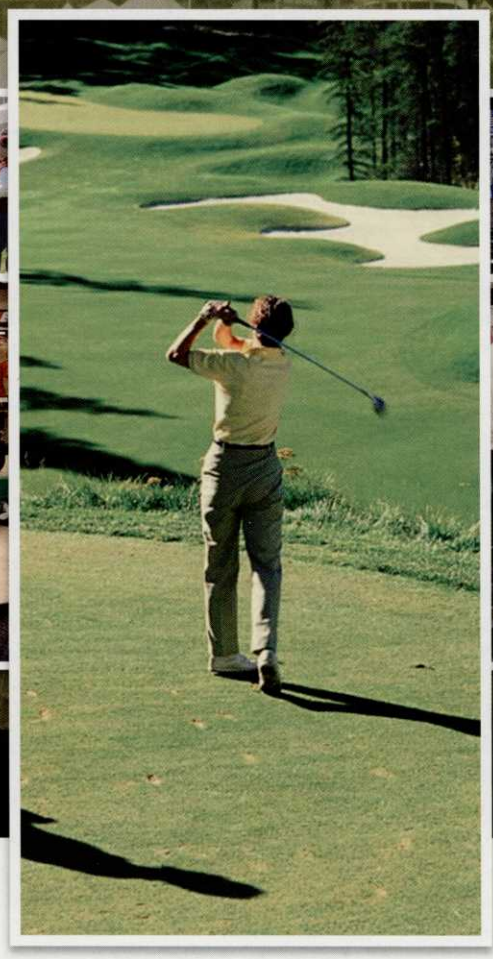

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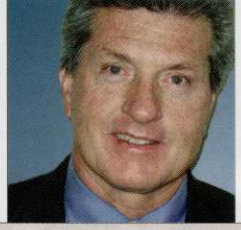

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PREPPING FOR THE MEMORIAL

Q Why would Jack Nicklaus furrow the bunkers at Muirfield Village Golf Club in Dublin, Ohio, to make them so penal?

A Nicklaus believes sand bunker preparations have created a safe haven for players nowadays. They've become the preferred place to be, and it's easy to get in and out of them without much penalty. While playing into a bunker isn't a new philosophy, with today's bunker preparation, players feel extremely confident they can make a sand save without issue.

This era has ended at Muirfield Village, where golf course superintendent Paul B. Latshaw, at Nicklaus' request, reviewed bunker preparations and decided to make bunkers more hazardous. The following ensued:

- First, Latshaw and Nicklaus reviewed bunker sand quality, shape, particle size, firmness, drainage capabilities and depth to see if the sand could be raised and furrowed.
- Next, the crew found an old-fashioned wooden leaf rake with teeth long enough to provide the proper furrow depth. This wasn't an easy task.
- Latshaw and Nicklaus reviewed tooth depth and spacing. Latshaw settled on a 1.25-inch tooth length and a 1.75-inch space between teeth. The goal was to have more sand around the ball to influence the shot.
- They reduced rake-head size and varied the handle lengths to allow workers to reach all portions of the steep-faced bunkers, capes and bays.
- The crew irrigated sand by hand each night so moisture content was proper for the next morning's work. They occasionally applied a soil penetrant to reduce surface tension and allow sand particles to fall together, especially on the steep faces.
- Each morning before play, the raking crew would hand-rake the furrows into the sand slowly. There were front and back nine crews to accomplish this.
- Furrows remained in place until a ball entered, and caddies raked the mark left from an explosion shot.

This process shouldn't be the daily practice at your golf course. The tournament goal of providing an additional penalty for those who miss-hit their approach shots worked during the Memorial and frustrations followed. After all, a bunker is a hazard.

Q How was the golf course preparation work and done so quietly?

A The club is located within a housing development. The first and 10th teeing grounds and the practice green, being located near the clubhouse where traffic volumes were high, required a stealth-like maintenance operation.

Palletized rubber material was used to pave the cart paths around the clubhouse, first and 10th teeing grounds, and practice green. This reduced the noise of the equipment, people, competitors and machinery moved and transported. The rubber material can be mixed similar to concrete so it can be included in the cart path material as well.

When cutting the fairways from teeing ground to putting green approach, the mowing units would return along the cart paths for their next mowing pass, eliminating transport noise.

All metal-on-metal contact was reduced by coating each component with the rubberized material. Even the tool boxes and tools were wrapped with cloth or plastic to eliminate noise.

Finally, the air generator is battery-powered, not gas-powered, to reduce noise.

Q How does the mechanic staff service equipment and help people if there's a breakdown?

A Bill Clayton, the club's equipment manager, has a chase vehicle he uses to traverse the property to check on all people and equipment. The vehicles include:

- An enclosed driver's cab to protect Clayton from the elements and reduce the noise from his conversations with employees via radio transmissions, cell phone calls and text message alerts.
- Extra-wide tires for noise reduction, stability and off-road capabilities.
- An Internet connection for ordering parts, reviewing equipment specifications or locating vendor information.

If you elect to prepare a response unit of this sophistication, consider including the following:

- Two tool boxes containing standard and metric tools for any type of equipment repair.
- A portable air compressor mounted on the unit's bed.
- A small lift capable of fixing flat tires, mower work, reel repair and height of cut adjustments.
- A supply of the most often repaired parts for the most-used pieces of equipment during tournament preparations.
- Lights for early mornings and late nights, and portable lights for repairs or directing crews, mowers and people around the golf course.
- Trailer hitches and able to pull medium-sized turf equipment back to the maintenance facility.

Q Why did the intermediate rough cut extend from each teeing ground in a V-shaped cut to the edge of the fairway? Did this make the tee shots easier?

A Nicklaus fanned the intermediate cut to open up the fairway target from the teeing ground. Having thick, high-cut rough occasionally prevents balls from reaching the fairway on a long carry. This cut eliminates players getting caught in thick rough if they can't reach the fairway, enhances the formal look of the course design and gives direction off the teeing ground.

The shorter cut didn't reduce the labor involved in preparing this area. Mowing increased because of the height of cut, which required more mower adjustment time and additional labor and equipment. In the final analysis, time, labor, fertility, irrigation and pesticide use increased. **GCI**