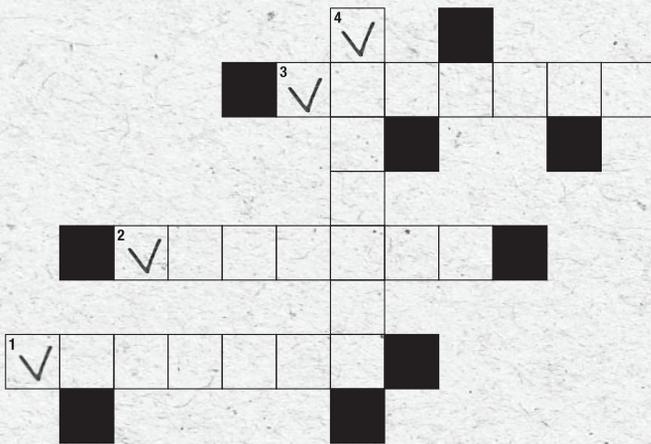


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 U.S. OPEN
PREVIEW
2017

PLUS
Name that nematode
Thinking outside the bunker
Joel Jackson farewell column

MAGIC KINGDOM

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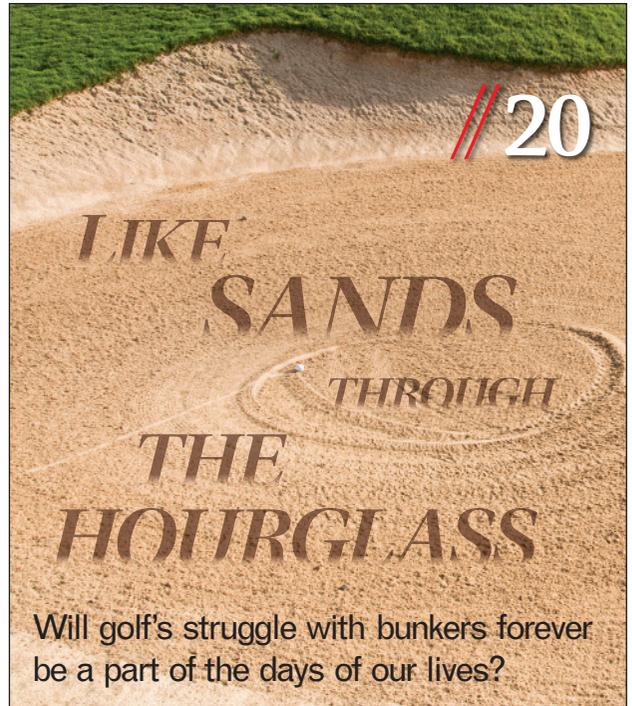


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Beautiful Erin Hills is ready to host Wisconsin's first-ever U.S. Open. But once upon a time, it wasn't the happiest place for turf.



MAGIC KINGDOM // 14



LIKE SANDS THROUGH THE HOURGLASS

Will golf's struggle with bunkers forever be a part of the days of our lives?

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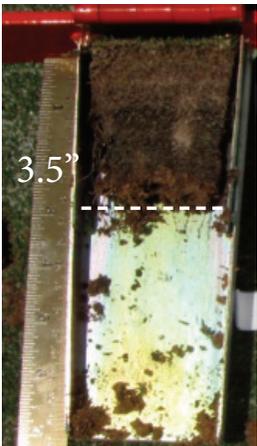
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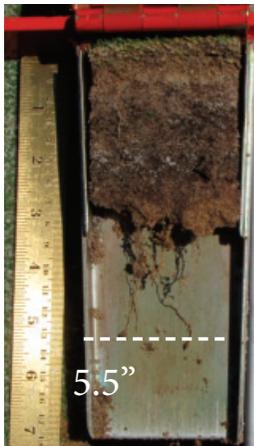
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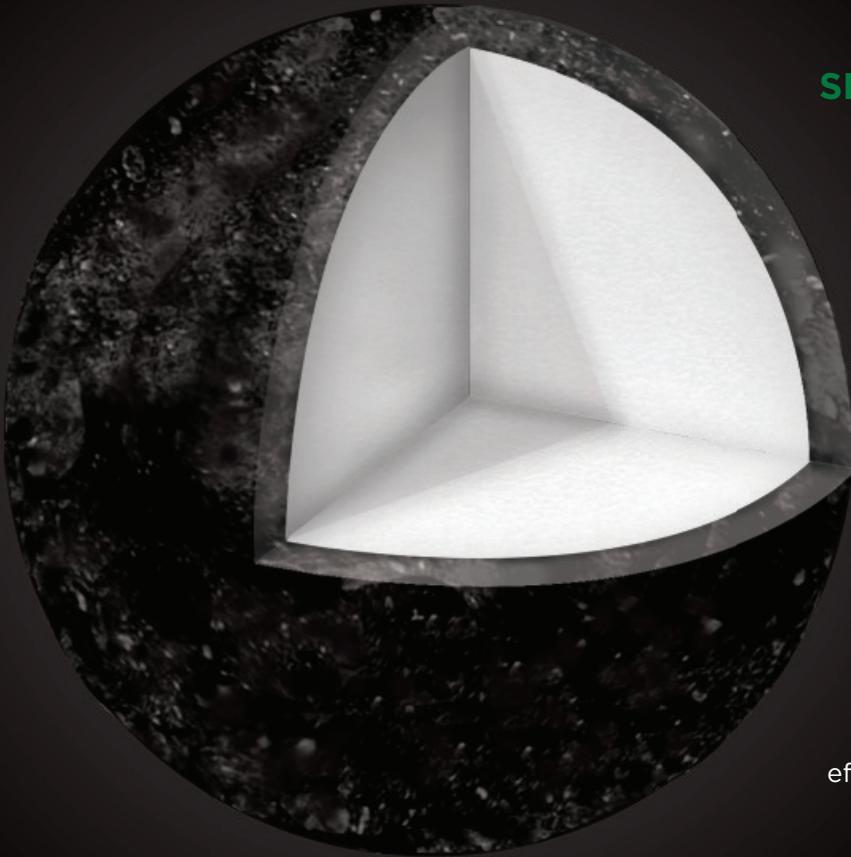
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“Previous PGA Championships at Whistling Straits have shown, Erin Hills will emphasize, and a new course will put it in stone: Wisconsin is a bucket-list golfer destination.”

SETH JONES, *Editor-in-Chief*

Wild about Wisconsin

I just got back from a trip to Lamar, Colo., to pay my last respects to my great uncle Jesse Ramirez, a 92-year-old Mexican-American World War II vet. I saw cousins I hadn't seen in 20 years. Over drinks at the wake, my job came up, and I got a question I often get when discussing my job: What's the nicest course you've ever played?

If you know me, you know I'd rather tell a golf story — like the time I hung out with Nick Price in Mexico, or for these Broncos fans, the time I interviewed John Elway on the golf course — over boasting about all the great golf courses I've hacked up. But whenever I'm pressed on the subject of “nicest course,” depending on my mood, I'll usually go with one of three courses: Prairie Dunes in Hutchinson, Kan.; Corales in Punta Cana, the Dominican Republic; or the Straits Course at Whistling Straits, Kohler, Wis.

While coming up with a favorite course is hard, coming up with favorite golf destinations is easy. With the gained wisdom of nearly 20 years as a card-carrying member of the Golf Writers Association of

America, I know what many golf nuts around the country already know: Wisconsin is a great golf destination.

There's already so much to love about Wisconsin: Its easy-going people, its delicious food (cheese curds!), its dedication to great beer (the only state where you can buy both Spotted Cow and Jigger Ale) and a rock-solid airport.

I've also played a decent amount of golf in Wisconsin and it was all memorable. The Wee One Foundation event at Pine Hills CC in Sheboygan, hosted every year by CGCS Rod Johnson, is a great time. I did a guy's trip to Kohler, stayed at the American Club and played both Black Wolf Run and the Straits Course, where I had the round of my life. Last summer, I got up there to play Erin Hills with

Jason Straka, ASGCA, and Greg Martin, current president of the ASGCA. Another great trip. The list goes on.

Previous PGA Championships at Whistling Straits have shown, Erin Hills will emphasize, and a new course will put it in stone: Wisconsin is a bucket-list golfer destination.

For my 2017 U.S. Open preview story (see page 14) I had the pleasure of doing a conference call with the course's three architects. Mike Hurdzan, Ph.D., Dana Fry and Ron Whitten all took the time to talk Erin Hills with me. I also asked them for their take on where Wisconsin stood in the pantheon of great American golf locales.

“Among real golf people, Wisconsin is well known,” Fry told me. “Now (with the U.S.

Open) to the casual golfer and sports fans, it's going to be well known throughout the world.”

“I've always thought Wisconsin was a great, diverse state for golf,” Whitten said. “You've got every site you want, from tree-lined like Brown Deer or SentryWorld, to the manufactured dunes of Whistling Straits, to the natural thing you'll see at Erin Hills and you're going to see at Sand Valley.”

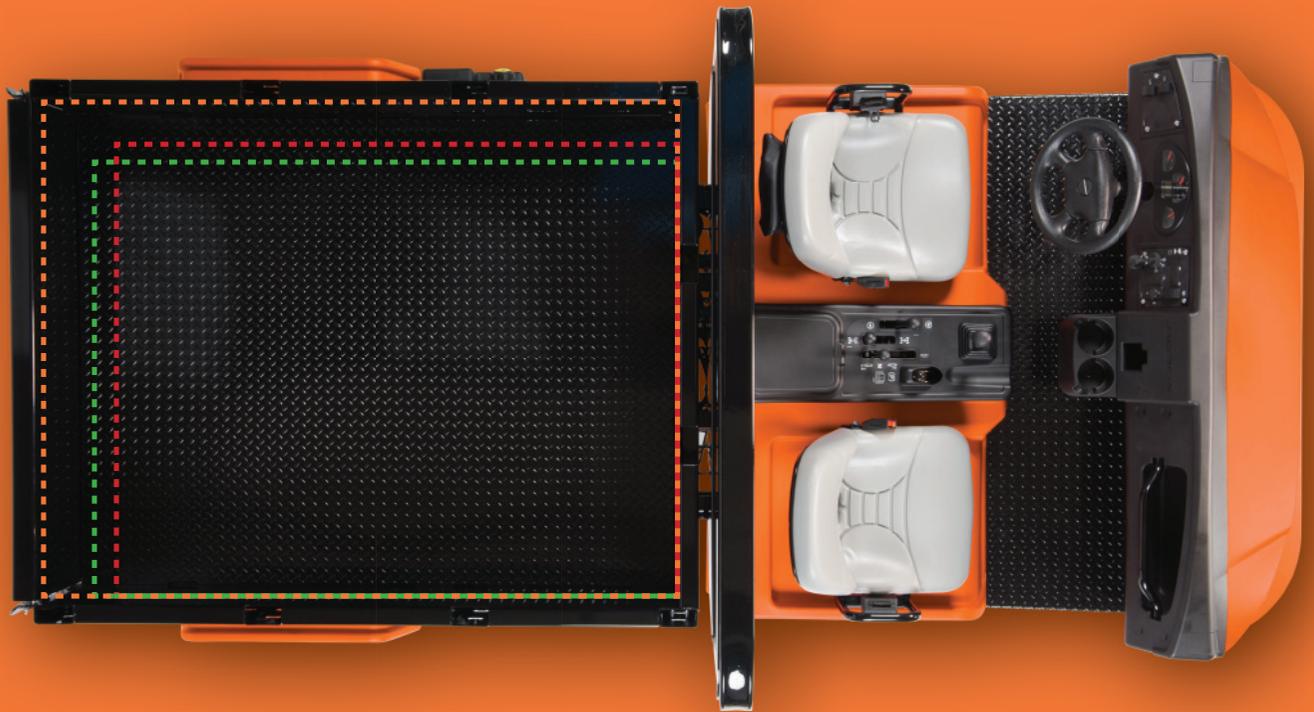
Which got us to talking about that new course, Sand Valley, which will have had its grand opening by the time you get this magazine. The first 18 is a Coore and Crenshaw, and a David Kidd course will follow. Expectations are high. I have not yet been to that property, but I'll bet you a basket of cheese curds that I remedy this soon. And I'll bet you a Spotted Cow that Wisconsin sees a U.S. Open spike in golfers that lasts for a long time.

“It started with Whistling Straits, but throw in Sand Valley and now Erin Hills — Wisconsin is a major worldwide golfing destination,” Fry said. “It's become one of three iconic areas for golf, along with Bandon Dunes and Pebble Beach. Who would have thought you'd have that in Wisconsin? It seems unbelievable to me, but it is. It has an awesome variety of golf and it's going to do a lot for golf tourism as the years go by.”

I can practically taste that Spotted Cow already.

Email Jones at: sjones@northcoastmedia.net.

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NEWS, NOTES AND QUOTES



// RIP 'BIG DAVE'

Johnson's cart sat parked next to the first tee in honor of the longtime superintendent.



REMEMBERING DAVE JOHNSON'S LPGA LEGACY

BY SETH JONES // Editor-in-Chief

DJ Viewers who tuned in to watch the 2017 ANA Inspiration may have noticed players and caddies wearing black buttons that simply read, "DJ."

Those buttons constituted just one of the many tributes for Dave Johnson, longtime superintendent at the 54-hole Mission Hills CC in Rancho Mirage, Calif. For 28 years Johnson played the role of director of course operations there. And for 28 years he hosted the LPGA's first major of the year, now known as the ANA Inspiration (previously known as the Kraft Nabisco Championship and the

Nabisco Dinah Shore.)

That streak came to a sad end this year when Johnson passed away unexpectedly a month before he would have hosted his 29th LPGA major.

"I said to him that Friday, 'Get to feeling better,' when he left for the day," says Jared Taylor, superintendent of the Dinah Shore Tournament Course. "That Sunday we had a big tournament, one he would never miss. I thought it was weird that I hadn't seen him all day. Turns out, that Friday was the last time I'd see him."

From the maintenance staff to the players, Johnson's larger-than-life presence was missed. Johnson's cart sat parked next to the first tee for the entirety of the tournament in his honor.

World Golf Hall of Famer Annika Sorenstam was saddened to learn of Johnson's passing. A three-time winner at Mission Hills (2001, 2002 and

Continued on page 9

// PASSING OF THE TORCH

CLUBCORP CEO ERIC AFFELDT SET TO RETIRE

ClubCorp's Eric Affeldt recently announced his intentions to retire from his role as Chief Executive Officer upon the appointment of his successor.

Affeldt, who joined ClubCorp as president and CEO in late 2006, oversaw the investment of more than \$720 million in ClubCorp properties and helped lead the company's 2013 initial public stock offering.

"It has been a tremendous privilege to help lead the world leader in private clubs. We have achieved so much since our IPO in 2013, and have set the industry bar for reinventions within the modern club management sector," says Affeldt. "I am so proud of our 20,000 employee partners and the outstanding service they provide to all our members and guests."

As part of its regular CEO succession planning process, the Board has identified a strong internal candidate and will engage a leading executive search firm to identify additional, highly qualified external candidates, according to a press release.

// DROUGHT FREE SINCE 2017

CALIFORNIA GOVERNOR LIFTS DROUGHT EMERGENCY FOR MOST OF STATE

By adding his signature to Executive Order B-40-17, Gov. Jerry Brown on April 17 officially lifted the drought emergency for all counties in California but four. Fresno, Kings, Tulare and Tuolumne continue to follow the emergency's standards.

Brown cited as reasons for the lifting unprecedented levels of water conservation in communities, with multiple state reservoirs holding more-than-average amounts of water, and the state's mountain snowpack water content at 164 percent of the season average. However, he warned against the state's citizens getting used to life without a drought emergency hanging over them for the first time since 2014.

"This drought emergency is over, but the next drought could be around the corner," Brown said in a statement. "Conservation must remain a way of life."

// GENEROUS GREENKEEPERS

Carolinas GCSA pledges more than \$100K in research

\$\$\$ The Carolinas Golf Course Superintendents Association has committed more than \$110,000 to two research projects intended to further refine the game's economic and environmental performance, according to a press release.

The money was raised through the annual Rounds4Research online auction, where golfers bid for access to otherwise private courses as well as discounted prices at public facilities.

The Carolinas GCSA will invest \$75,000 over three years while re-



searchers at North Carolina State University investigate improving fungicide performance on golf course turf. Earlier studies at N.C. State have shown that between 25 percent and 50 percent of fungicides applied to prevent disease can be lost by mowing within 24 hours. The association also has committed \$32,000 over three years so researchers can determine the impact of colored topdressing sand.

Some believe darker colored sands speed turf recovery by retaining more heat, but there has been little research on the subject.

GO FIGURE

150

Pounds of pig roast consumed by visitors to Smylie Kaufman's Natural Light party in Augusta... no word on how many cans of Natural Light were consumed.

Source: Zeno Group



// MUTUALLY BENEFICIAL

FMC TO ACQUIRE PART OF DUPONT CROP PROTECTION

FMC Corp. has signed an agreement with DuPont to acquire the portion of DuPont's crop protection business that it must divest to comply with a European Commission ruling related to its merger with Dow Chemical Co.

FMC will acquire DuPont's global chewing pest insecticide portfolio, consisting of Rynaxypyr, Cyazypyr and Indoxacarb, its global cereal broadleaf herbicides, including nine active ingredients and multiple formulated products, and a substantial portion of DuPont's global crop protection R&D capabilities, according to a press release. Additionally, DuPont will acquire FMC Health and Nutrition and receive \$1.2 billion in cash.

After the acquisition's closing, FMC Agricultural



Solutions will become the fifth largest crop protection chemical company in the world by revenue, with estimated annual revenue of approximately \$3.8 billion, according to the release.

The transaction is subject to the closing of the Dow and DuPont merger, as well as customary closing conditions and regulatory approvals. Closing is expected to occur in the fourth quarter of 2017.

// GOLFDOM WISDOM

You know the job market is tight when the recently announced Topgolf in Mexico begs superintendents to stop sending résumés, *por favor*.

#golfdomwisdom

ABOUT THE COVER

This month's cover shot of No. 18 at Erin Hills was photographed by *Golfdom* Editor-in-Chief Seth Jones. The course's Irish Pub and Terrace is in the center, and Holy Hill National Shrine of Mary is in the distance. "The crew was nice enough to give me a cart and let me explore," Jones says.

"Their hard work made my job easy."



Continued from page 8
2005), Sorenstam said Johnson was a fixture at the course.

"You'd always see him out there and he'd always ask what you thought of the course," she recalls. "He loved what he did. The course was his baby and he cared about it."

Johnson's friend David Hay, CGCS, had been the superintendent at Indian Wells (Calif.) CC for 19 years and was contemplating retirement. But since Johnson's passing he's changed clubs and now is director of agronomy at

Mission Hills.

"I figured I'd fill in for him and get them through the tournament," Hay told *Golfdom*. "We've been buddies for 22 years, so it's a pretty big loss for everybody. The job is so busy, we're all just pitching in. We're doing it for Dave, this is his tournament."

Hay credited the work of Johnson and Taylor. "Jared has done a spectacular job. This thing was set and ready to go," Hay said. "The pressure is going into something so good and hopefully not messing it up."

Golfdom Gallery



1 Flying the not-so-friendly skies

Golfdom EIC Seth Jones bumped in to Annika Sorenstam at the Phoenix airport. While Annika got home no problem, Jones was delayed and had to take an overnight flight to Charlotte to get to Kansas City. (At least he didn't get beat up.)



2 Miller time at the ANA

Inspiration John Miller, CGCS, LPGA Tour, (left) and David Hay, CGCS, director of agronomy at Mission Hills CC, Rancho Mirage, Calif., smile for a photo. Hey David, we dig that lid!

3 New addition to the gallery

Artist Graeme Baxter (left) has his work on display in 40 different countries. And now his print of the 18th Hole at the Dinah Shore Tournament Course at Mission Hills will be on display at *Golfdom* headquarters. Now if we could only convince Seth to take down his Velvet Elvis.



4 Best breakfast in turf

An annual tradition at Mission Hills, the crew fired out a mean Mexican breakfast for the crew during the LPGA's first major of the year.



5 This is my happy face

There are few things Jared Taylor, superintendent of the Dinah Shore Tournament course at the 54-hole Mission Hills CC, hates more than having his photo taken. Here, we somehow actually caught him in a smile.



6 Here comes the bride (and Buddy)

It was a beautiful March Saturday for a wedding. All of us at *Golfdom* came out to watch Associate Editor Grant "Buddy" Gannon and Marlee make the leap. Hope you two enjoy the bread maker we all pitched in on!



PHOTOS BY: SETH JONES (1, 2, 4, 5); DAVID HAY (3); PAT ROBERTS (6)

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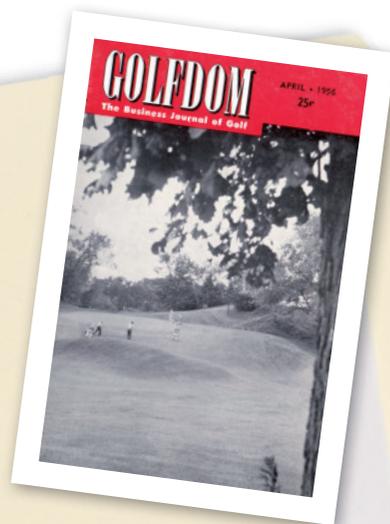
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The Golfdom



In the April 1956 edition of *Golfdom*, B.P. Robinson and J.M. Latham Jr. wrote about the exciting new Tifgreen bermudagrass. It originally was intended for use on putting greens, but it also was used on tees, fairways and roughs. Although it isn't used today, Tifgreen's descendants, Tifdwarf, and ultradwarf bermudagrasses Champion and Miniverde, can be seen on many courses, according to USGA Green Section Agronomist Patrick O'Brien's article on USGA.org, "Trip to Taylor Creek G.C. in Georgia offers agronomic history lesson while providing glimpse into the future." To read the full *Golfdom* article visit golfdom.com/exclusive.

Tifgreen, new high-rated bermuda, is released

BY B.P. ROBINSON AND J.M. LATHAM JR.

One of the primary objectives of the turfgrass program at the Coastal Plain Experiment Station has been the development of improved putting green Bermudagrasses. Releases in the past were Tiflawn in 1950 and Tiffine in 1953. As in any breeding program, the search for new types and varieties is a never-ending proposition.

ORIGIN

Fine-leaf texture is one of the highly desired characteristics of putting green grasses. To achieve this in Bermudagrass, the breeder has utilized a species from South Africa (*Cynodon transvalensis*). In most instances when this grass is hybridized with another, it imports a narrow leaf width to the offspring.

In 1946, W.G. Thomas and Walter Harkey of the Charlotte (N.C.) CC, selected a fine-textured Bermuda from their fourth green. This was sent to Tifton for further observations. During 1951, this grass, along with seven others, was cross-pollinated with the South African Bermuda. The 432 hybrid seedlings from these crosses were planted in a screening nursery in 1952. Ratings on

height of growth, rate of spread, disease incidence and turf quality were made on the seedlings. The best seedlings were transplanted into putting green test plots in 1953 (among them was selection 328 — Charlotte CC selection x the South African Bermuda).

EXPERIMENTAL RESULTS

The putting green test plots were maintained similar to golf greens during 1953, 1954 and 1955. The new hybrids, their parents and several other promising selections were graded on the many characters which make up desirable turf quality — rate of coverage, height of growth, fineness of leaves, recovery from ryegrass overseeding, lateral spread (aggressiveness), disease incidence, seedhead production, color, general appearance, et cetera. Selection 328 received the best average ratings of all Bermuda selections in all comparisons. The recumbent habit of growth makes this hybrid especially adaptable for putting green management.

FIELD OBSERVATIONS

Golf professionals and superintendents appraised the putting quality of grasses

in the putting green test plots during the 8th Annual Southeastern Turfgrass Conference, 1954. Selection 328 received more votes for the best putting Bermudagrass than any other selection. Ratings by a similar group in 1955 yielded the same results.

A survey was made in late 1955 of the golf course superintendents who had Tifgreen (selection 328) planted on their own course, and under observation from three to 36 months. Out of 10 items on this checklist, Tifgreen rated best for six and better or equal for four. Sixteen superintendents in nine states reported these results, 10 of which had Tifgreen planted in their greens. Ninety percent of the superintendents planned to plant more greens to Tifgreen. Eighty-nine percent reported less seedhead production than other Bermudas and 66 percent indicated less mat formation. These field plantings of Tifgreen were compared with such outstanding selections as Tiffine, Gene Tift, Ormond, Tiflawn, U-3, Everglades 1 and 2, *Cynodon magennisii* (Magennis Grass) and common seeded Bermudagrass. Tifgreen has a forest green color, fine texture and a low spreading growing habit. From its performance to date, it may prove to be very useful for turf purposes other than that for which it is now being recommended.

PLANTING STOCK

In keeping with Experiment Station policy, Tifgreen will be released to certified growers only... The price on foundation stock is \$15.00 per sq. yd. F.O.B. Tifton.



“How inspiring to walk in the footsteps of golf pioneers and people who loved the game way back then as we do now, and to think about how it has changed.”

JOEL JACKSON, *Senior Contributing Editor*

Farewell

It's time to hang up this, my regular column, and go from semi-retirement to three-quarter retirement, at least. Not long ago, I asked *Golfdom* Editor-in-Chief Seth Jones to take me out of the regular lineup and put me on the roster only when needed as a pinch hitter for special occasions.

A couple of days after that conversation, I found myself covering the grand re-opening of the Santa Ana Country Club in Costa Mesa, Calif. Seth had schedule conflicts and couldn't make it, so I went to bat for the team.

The *Golfdom* team signed me up in 1998, when this historic publication, which started in 1927, was brought back to life. I had just retired from Walt Disney World at the end of 1997 after 20 years in the Golf Division. Toss in roughly three years at the Isleworth CC growing bentgrass in central Florida, and you have 23 years in turf management.

Simultaneously, I was also heavily involved with the Florida GCSA and was editor of *Florida Green* from 1990 to 2013. Somehow along the way I also became the association's communications director, then executive director. So, there were another 23-plus years of service to the FGCSA.

I would be remiss if I didn't acknowledge the professional publication editors who were instrumental in my success. They include Larry Kieffer, who served as managing editor of *Florida Green* for many years, and my *Golfdom* editors, Pat Jones, Larry Aylward and current EIC Seth Jones. Thank you, gentlemen, for your ideas, guidance and your style and grammar corrections.

After I moved to California in 2015, I got to thinking that it was time to get out from under deadlines and maybe just do a few projects as needed. I also thought I might do some writing outside the bounds of journalism.

So much for my “jobs journey.” The thing that really made this time fly by so enjoyably was visiting historic and new golf courses and meeting the people who take care of them. The list is too long to just drop a few names, but besides course coverage in my *Florida Green* days, there were

also the courses I got to visit and play because of my membership in two golf writing and publication associations, the Turf and Ornamental Communications Association (TOCA) and the International Network of Golf (ING).

These memberships included writers, editors, suppliers and advertisers from every imaginable part of the golf industry. Their annual conferences took me from Florida's Golf Hall of Fame to Seattle's Space Needle and from upstate New York to the Innisbrook Resort in Tarpon Springs, Fla.

How inspiring to walk in the footsteps of golf pioneers and people who loved the game way back then as we do now, and to think about how it has changed, and yet on some levels always will have a common core. I am so thankful for the many years I had the opportunity to write about bits and pieces of the *Golfdom* world we all share.

I also want to send out heartfelt thanks to all the people who took time to thank me in person or in writing for my columns. One of those occasions was a letter I received many years ago from a Florida superintendent. I had written a *Florida Green* column titled, “It Can't Be Perfect All the Time,” and he wrote to say it touched a nerve and he cut it out, framed it and hung it on his office wall! That one stopped me in my tracks and made me aware that what I write sometimes has an impact far greater than I realize.

Then there were lots of nice folks at our GIS conferences over the years who would stop me on the streets or in the convention center and thank me for my writing. One of the first and best was a young fellow from the Midwest who stopped me on crazy, crowded Bourbon Street in New Orleans several conferences ago and said, “Excuse me, are you Joel Jackson?” I replied yes, and he simply said, “I really like your articles!”

I was amazed he could recognize me amid the jostling crowds. That encounter began a string of similar rewarding remarks. Those comments touched my soul and gave me self-confidence and a sense of worth beyond my expectations.

Meanwhile, keep the “Green Side Up,” and I hope to run into you in San Antonio next year and listen to your story.

Joel Jackson, CGCS-Ret., is senior contributing editor for *Golfdom*. Email him at flrjn@aol.com.



Beautiful Erin Hills is ready to host Wisconsin's first-ever U.S. Open. But once upon a time, it wasn't the happiest place for turf.

WORDS AND PHOTOGRAPHY BY **SETH JONES**

Looking at it today, it's hard to believe that back in 2008, Erin Hills, site of the 117th U.S. Open, didn't look good.

"It would be accurate to say the turf conditions were suffering," says Dana Fry, ASGCA, part of the design team for the Wisconsin course. "They had a very difficult time because they basically didn't have enough of a maintenance budget, money was very tight. It obviously needed a lot of work."

Continued on page 16

MAGIC KINGDOM

Erin Hills Superintendent Zach Reineking says Erin Hills came out of the winter great, with the fine fescue fairways still needing some time to wake up. "It's just a slow grass to get up and get started," he says.



in the United Kingdom. But this course is 35 miles northwest of Milwaukee. The unique turf at Erin Hills is one of the things that appealed most to Reineking when he started working at the course in December of 2004, when it was still a construction site.

"Most courses in Wisconsin are bluegrass and bentgrass, so the fine fescue at Erin Hills was exciting," says Reineking, a University of Wisconsin-Madison graduate who proudly received a Chick Evans Scholarship from his time caddying at Pine Hills CC in Sheboygan. "More than anything else, it needs a well-drained soil. The course has a fair amount of that soil, but we sit on the edge where we also have really dense clays. We have a lot of areas where we have to manage the fine fescue differently on a hill rather than in a valley."

The property, located near Erin, (population 4,500) sprawls over 658 acres. The course itself occupies 350 acres. Fine fescue rough — don't call it no-maintenance, and maybe don't even call it low-maintenance — accounts for 155 acres.

"It's a huge property, so it's not just the

Continued from page 15

Maintenance necessitates money, something the then-owner of the course was running out of. Then the superintendent abruptly left the course. Assistant Superintendent Zach Reineking, 28 years old at the time, took over the position and wondered what was next.

"By September of 2009 we were in a situation. We had very constrained resources, a small staff and a big property," Reineking recalls. "Conditions of the course were not acceptable to my standards, or I think to most golfers' standards. When the ownership change happened... I was very grateful."

In October of 2009, Wisconsin businessman Andy Ziegler, chairman of Artisan Partners Asset Management, bought the course. According to the *Milwaukee Journal Sentinel*, Ziegler's first moves included doubling the maintenance budget and building a state-of-the-art maintenance facility.

"When Andy Ziegler came in they got a chance to show what they can do — they got the proper amount of money," Fry says. "(Reineking) got through it. The time and effort and the days (the crew) put in — they're some of the hardest working guys I've ever met in my life. I couldn't be more

proud of Zach and his crew. Go back to 2007, '08, '09 — everything was sort of iffy as to what would happen there. He hung in, he was there when they had nothing, and now he's risen to the top. How could you not be proud of him and his crew?"

Taming tall fescue

Seeing the course today and imagining it less than remarkable takes some imagination. On a breezy day, the golden fescue rough moves in waves, like coastal courses



Adam Ayers (left), second assistant superintendent at Erin Hills, and Alex Beson-Crone, assistant superintendent, discuss hand-weeding progress with the crew.



HOLY HILL, WHAT A VIEW

No.18 at Erin Hills is a beast, measuring in at 663 yards from the tips. When Fox's cameras focus in on the tee shot, it will showcase an intimidating par 5 with a 100-yard long grandstand wrapped around a green. Also visible will be the course's Irish Pub and Terrace (the course clubhouse is situated further off the course) and — is that a castle in the distance?

That's Holy Hill National Shrine of Mary, built in 1863. The shrine always lined up with this particular tee shot, but it was not always the 18th hole, according to Ron Whitten.

"What is now the 8th hole was our original 18th hole because we were going to have the clubhouse where 9 tee was," Whitten tells *Golfdom*. "For a long time we resisted what is now 18. We loved that green site, and eventually we all agreed that the routing works."

For a complete history on the shrine, visit HolyHill.com.



PHOTO BY: SHOELACE#4, WIKI COMMONS

quality of the work but the volume of the work," says Mike Hurdzan, Ph.D., ASGCA, co-designer of the course (along with Fry and *Golf Digest's* Ron Whitten.) "As readers of *Golfdom* know, there is no such thing as no-maintenance areas. These low-maintenance areas are, in many instances, high-maintenance areas. But Zach and his people have gotten a handle on it through their

skills of cutting and bailing and reseeding."

Whitten, perhaps the world's foremost golf course critic, knows a good story when he hears one. The work the crew does to maintain the rough at Erin Hills, he says, is a "great story."

"Every year the crew bails the tall fescue and trades it to the local Amish community for handmade furniture. It shows

you how massive that piece of property is," Whitten says. "There's 155 acres of that fescue! That's the size of a golf course alone. There, it's just the rough."

Walkers only

The length of the course, coupled with the many hills and valleys, makes Erin Hills a

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challenging walk. But there's an important reason why it's a walking-only course: turf health.

Associate Superintendent John Jacques has been at Erin Hills since 2010. The course was his first experience working with fine fescue fairways (tees and greens there are bentgrass).

What has he learned about fine fescue in his seven years there? That the grass is "finicky."

"Traffic is a huge issue, that's why Erin Hills is walking only," Jacques says. "We don't have to worry about carts, but we do have to be aware of our own mowing patterns, and our crew — we don't take the same way every time. (Fine fescue) is a challenge, especially in our climate, but we do a good job with it and hold our own."

It was an important day in Erin Hills' short history, Fry says, when Reineking talked to Ziegler about making the course walking only.

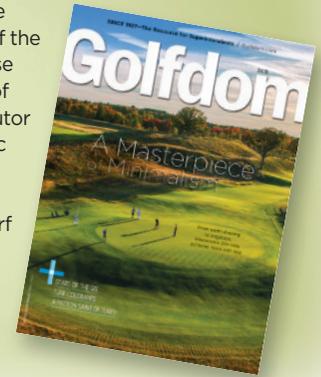
"Zach told Mr. Ziegler that he really needed to keep carts off it. Andy said, 'Let's just make it a walking golf course.' The decision was made, and he's stuck to it," Fry says. "They did it because (Ziegler) wanted this to be the best maintained golf course it possibly could. He listened to Zach, he learned about it. With carts, it was always going to struggle. I don't ever see this changing under Andy's ownership."

When the topic of carts comes up, Whitten waves the white flag and admits he believes it was his doing to allow carts on Erin Hills' sensitive fairways in the first place.

"Having owned a course at that time," Whitten says, "I realized carts were easy money generators. But I also felt, having spent several summers there, it can get hot for guys my age playing the course. We had to balance that with the concerns that

A MASTERPIECE OF MINIMALISM

Sharp-eyed readers will realize this is not the first time Erin Hills has been on the cover of the magazine. In the April 2015 issue, the course graced our cover with the story, "A masterpiece of minimalism," written by regular *Golfdom* contributor Chris Lewis. The story focused on the minimalistic approach taken by the design team during construction of the course. The cover won a bronze Azbee award for front cover photo, a 1st place Turf and Ornamental Communicators (TOCA) award for cover page design and a TOCA merit award for best photo. (But hey, no pressure on this month's cover.) To read the story, visit golfdom.com/less-is-more-at-erin-hills-golf-course/



(Hurdzan) has always pointed out: the turf is a liability. While I was campaigning to have carts, I was not sorry to see them go. The purist in me feels the walking experience with a caddie is much better. And now that the green fee is such... it's sustainable to generate revenue enough that Zach can have a budget to maintain the course and the condition we all want it in. I don't have anything against carts, but I'm not sorry to see them go."

Watching the course mature

As the clock winds down and it's nearing the 117th U.S. Open — the first ever hosted in Wisconsin — the locals are starting to understand what the crew already knows: that this tournament is a big deal.

"For the past four U.S. Opens, I've been fortunate. In some way, I've been able to go and learn from them," says Jacques, a Michigan native and graduate from Penn State's two-year turf program. "It's especially useful to visit a course like Oakmont, which has hosted multiple major tournaments, to see how they operate and take some of their pointers and implement them into our facility."

Though the course already has hosted the 2008 U.S. Women's Amateur Public Links Championship and the 2011 U.S. Amateur, the U.S. Open clearly is next-level golf.

"I've been fortunate to go to the last

couple U.S. Opens, so you get the scale," Reineking says. "As much as you try to educate the people in the area, it's hard to really fathom how big the U.S. Open is. The town is starting to understand the scale of it now that the merchandise stand and the trophy club are up. They think of tents like the ones they see at the state fair. These are legitimate structures. The town is excited, but also amazed."

Reineking stuck it out when things looked grim at Erin Hills nine years ago. His patience and hard work has paid off. Not only has he succeeded with the golf course, he's also succeeded at creating a "fun family" culture despite the hard work required to prepare for the U.S. Open, Jacques says.

"When I come to work, I'm hanging out with my best friends," Jacques says. "We get along that well. It's a blast to work with everyone, and I'm learning from Zach all the time."

Reineking and Jacques mention Assistant Superintendent Alex Beson-Crone and Second Assistant Superintendent Adam Ayers by name when they talk about how talented their crew is at Erin Hills. (*Visit Golfdom.com to see a video interview with Beson-Crone and Ayers about their work maintaining the fine fescue rough at the course.*)

"Guys have turned down jobs just to stay here with our crew and see this





(Left to right) Assistant Superintendent Alex Beson-Crone, Second Assistant Superintendent Adam Ayers, Superintendent Zach Reineking, Associate Superintendent John Jacques and Equipment Manager Tim Roddy at the 2017 Golf Industry Show.

through the U.S. Open,” Reineking says. “There’s a group of assistants in training that have been with us close to two years, and some three to four years. We have eight interns who work out here, and some

of those guys are in the second year as well. “It’s been interesting to try to establish the fescues, but it’s been rewarding to watch the course mature and become successful. (Ziegler) has done an amazing job

with Erin Hills, developing and nurturing and continuing the evolution of the golf course,” Reineking says. “I feel so fortunate to be in this situation, surrounded by so many great, capable guys.”

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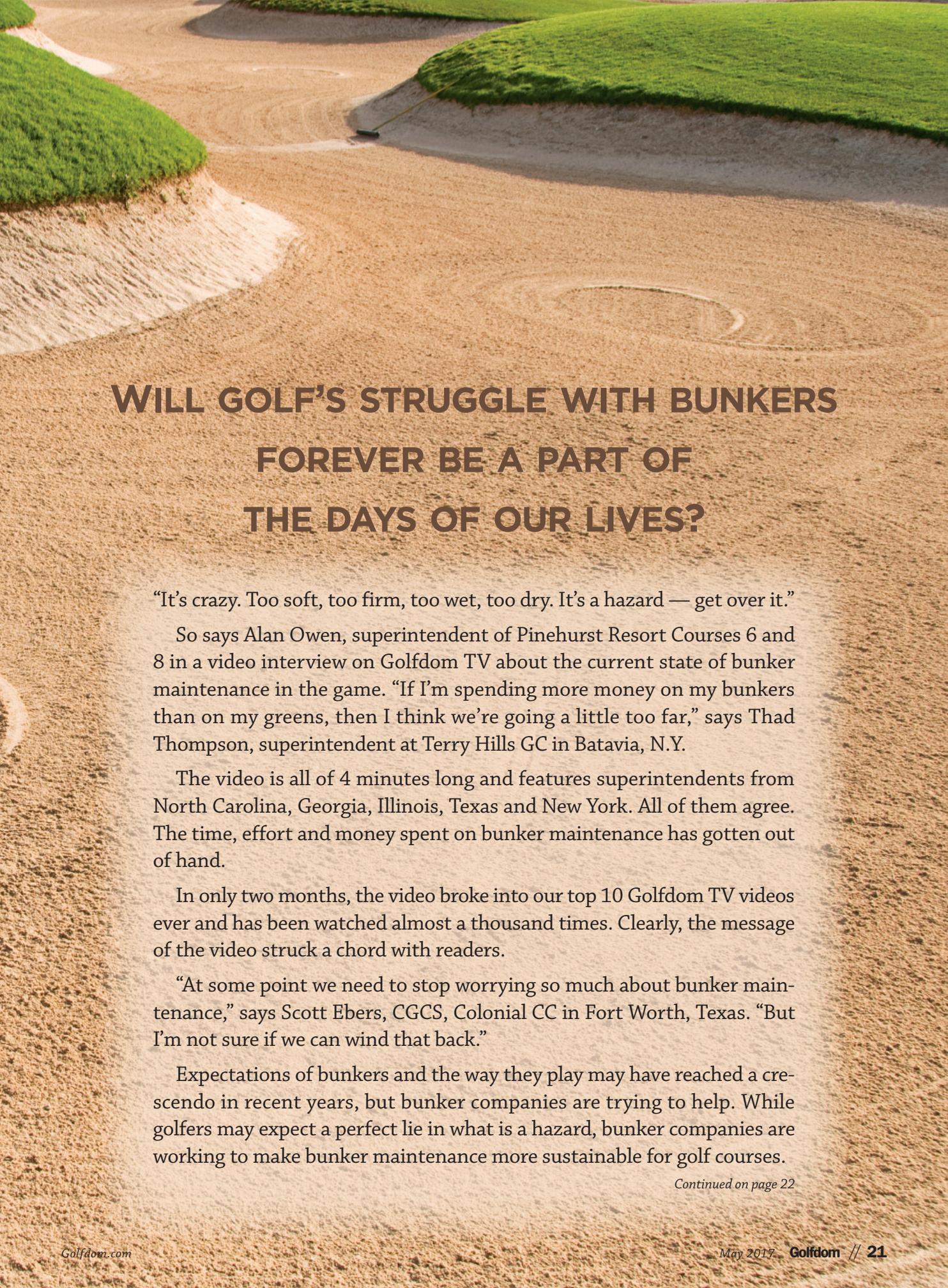
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An aerial photograph of a golf bunker. The bunker is a large, circular depression in the sand, with a white golf ball positioned in the center. The sand is a light tan color, and the surrounding area is covered in lush green grass. The text is overlaid on the sand in a large, dark, serif font.

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WILL GOLF'S STRUGGLE WITH BUNKERS FOREVER BE A PART OF THE DAYS OF OUR LIVES?

"It's crazy. Too soft, too firm, too wet, too dry. It's a hazard — get over it."

So says Alan Owen, superintendent of Pinehurst Resort Courses 6 and 8 in a video interview on Golfdom TV about the current state of bunker maintenance in the game. "If I'm spending more money on my bunkers than on my greens, then I think we're going a little too far," says Thad Thompson, superintendent at Terry Hills GC in Batavia, N.Y.

The video is all of 4 minutes long and features superintendents from North Carolina, Georgia, Illinois, Texas and New York. All of them agree. The time, effort and money spent on bunker maintenance has gotten out of hand.

In only two months, the video broke into our top 10 Golfdom TV videos ever and has been watched almost a thousand times. Clearly, the message of the video struck a chord with readers.

"At some point we need to stop worrying so much about bunker maintenance," says Scott Ebers, CGCS, Colonial CC in Fort Worth, Texas. "But I'm not sure if we can wind that back."

Expectations of bunkers and the way they play may have reached a crescendo in recent years, but bunker companies are trying to help. While golfers may expect a perfect lie in what is a hazard, bunker companies are working to make bunker maintenance more sustainable for golf courses.

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CARPETS ON THE WALLS

WHEN NATURAL SOD BUNKER WALLS BECOME TOO UNPREDICTABLE AND EXPENSIVE, A PAIR OF SUPERINTENDENTS TURN TO AN ARTIFICIAL ANSWER FOR STABILITY.

BY GRANT B. GANNON

When past hurricanes barreled through Beaufort, S.C., Superintendent Mark Mitchell's list of repairs would include rebuilding the collapsed sod walls of Secession Golf Club's 55 revetted bunkers. However, Mitchell's club, just 15 miles from the Atlantic and right on a river that feeds into the ocean, didn't need to rebuild sod walls after Hurricane Matthew hit last October.

"A lot of the bunkers were already full of water from the 20 inches of rain here," Mitchell recalls, "but we also had a storm surge. That river came up into the golf course and the wind was beating on them, and there was wave action from the ocean. They were all full of water for two days. But when the drainage went down, the walls never moved."

If it sounds unnatural for a bunker wall to survive such a beating, it's because it is unnatural. The different outcome after Hurricane Matthew occurred because the course had installed a new system that uses stacked artificial turf to build bunker walls. The new artificial turf bunker-wall system looks natural, saves money and should last another two decades, Mitchell says.

"They would've been flattened if they were natural sod walls, and we would've been redoing all of them," Mitchell says.

Reluctance rewarded

Mitchell admits he wrote off the idea of artificial turf on his bunker walls when he first heard about it. One of his mem-

bers saw the artificial turf on about 20 bunkers while playing at Trump National Golf Club, Jupiter, Fla., and suggested the idea to Secession Director of Golf Mark Harmon, who brought the idea back to his superintendent. Mitchell now thanks that member while he counts the money he saves on his annual maintenance budget.

Before the artificial turf walls went up, Secession replaced the natural sod every three to four years. Over that time, the bunkers would erode and warp from the original design. The course was spending about \$1,000 in materials each time, excluding the cost of labor, according to Mitchell.

Three companies currently sell artificial turf for use on bunker walls, and one has also found a way to help courses with traditional bunkers (see sidebar, "Thinking outside the bunker," page 25). After completing their research, Mitchell and Harmon decided to use the Wales, England-based Ecobunker. (The company now partners with IVI Golf to sell the PermaEdge Bunker System in the United States.)



The use of stacked artificial sod on bunker walls is relatively new but can be found on golf courses in North America, Europe, Asia and Australia. This bunker is from a project at the Royal Antwerp Golf Club in Belgium.

PHOTO COURTESY: DURABUNKER
PREVIOUS PAGE: ISTOCK.COM (NIRIAN)

The team at Seccession was hesitant to make a large investment in a product they weren't completely sold on, so they arranged for Ecobunker representatives to build a pair of bunkers on the course's practice area so members could see if they liked them.

"There were some naysayers at the beginning, and I was one of them," Mitchell says. "A place like Seccession is a links-style course that's supposed to look old even though it's not old, so putting some artificial turf on the course would be a big risk. Once we put it in and we saw the product for three or four months, it was unanimous that it would be stupid for us not to do it."

Material costs for a traditional bunker redo were about \$3,000 per bunker in the summer of 2015 when Seccession did a complete renovation of all 55 bunkers. The initial investment to ren-

Durabunker and Ecobunker walls use second-generation artificial turf. "Over here in the UK and Europe, we are putting a lot of that down," says Durabunkers' Rhyddian Lewis. "There's plenty of supply."

ovate the bunkers with artificial turf was three times as much, but that was fine with Mitchell because the artificial walls should last at least 25 years, or eight times longer than some of his former natural sod bunker walls.

"It pays for itself in eight years or so at our course," Mitchell says. "Even though we rebuilt the old ones every three to four years, after two years they would start to look different. These never change."

After Ecobunker was hired, Construction Manager Llewellyn Matthews traveled to Seccession and taught six crew members how to stack and assemble the bunker walls. The crew got the hang of it after two

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Prior to the installation of stacked artificial turf on Tennessee National's bunker walls, Superintendent Andrew McClintock would have to rebuild the natural sod bunker walls every six to 10 years. When a new owner purchased the course, he suggested that they should fill in all 64 of the bunkers because "he didn't want to spend money on something that wouldn't last," according to McClintock.

Continued from page 23

days, but each bunker still required supervision from someone who knows golf and what the end result should look like. It took about four months for the in-house labor force to complete the 55 bunkers, working five to six days a week.

Smokey Mountain stacks

During the time that Secession had test bunkers on its practice area, Superintendent Andrew McClintock of Tennessee National Golf Club, Loudon, Tenn., was in search of a style change that would save time, money and effort with his bunkers. If a remedy couldn't be found, his club was looking at changing 64 sod-stacked bunkers.

"Our bunkers were built the traditional way, with sod that we would rebuild six to 10 a year at \$5,000 apiece, and then we had a new owner," says McClintock. "The new owner said he didn't

want to put money into something that wouldn't last. He suggested that we fill them in, and we didn't want to do that. We searched around online and came up with the stacked artificial turf solution Durabunker."

Durabunker is the other company in the artificial turf bunker-wall business. Company Director Rhydian Lewis worked with Ecobunker before splitting off to start his own company in May 2014.

Before Tennessee National purchased materials from Durabunker, McClintock and a team from the club flew down to Trump National to talk to its superintendent and to see the bunkers. Soon after that trip, the group visited Secession and Mitchell to see Ecobunker's practice-area bunkers in action. As soon as they got back to Tennessee, the club pulled the trigger on renovating its bunkers.

The labor was contracted to an outside company, and in No-

Continued on page 26



McClintock and his team were against filling in the bunkers, so they scoured the Internet for an alternative option. They ended up finding Durabunker, and Tennessee National was the second course in the United States to purchase the product from the company. The club paid about \$5,000 per bunker, but the budget allowed for only 32 bunkers to remain, with the other 32 filled in.

PHOTOS BY: ANDREW MCCLINTOCK

THINKING OUTSIDE THE BUNKER

Company adds to aesthetics beyond links-style revetted bunkers

Though Durabunker got its start with links-style revetted bunkers, Director Rhydian Lewis says the company currently is working with more and more non-links courses in Europe. The product was first developed to mimic the traditional stacked sod look, but has now evolved by helping courses maintain bunker edges.

"The feedback we get," Lewis says, "is that during growing season, to get the good crisp bunker edge by hand is time consuming. To stay on top of that, some clubs we have worked with were employing one seasonal (worker) to do just that job. Our product defines the bunker and gives it a crisp and clean edge without the maintenance."

Other fans of artificial turf bunker walls

include golf course architects, according to Lewis. He says the products put tools in architects' hands that enable them to create shapes and bunker designs that before would leave the superintendent with a heavy maintenance burden. They can now make designs as complex as possible with the knowledge that the design is not going to change, because it's a fixed edge.

"Courses are paying a lot of money to these architects to put something in front of them that members are going to like and that looks good," Lewis says. "The issue is that these things just don't last and the design doesn't last as a result. With Durabunker, it's never going to change height vertically. It's stable, and therefore they are safeguarded in

their design integrity, as are their clients."

Lewis is confident that his clients' bunkers will look better than they did before, with less maintenance, but he hopes that he can help them make their entire golf course better as well.

"One of the hidden benefits is superintendents aren't having to take time to maintain the bunkers edges or walls," Lewis notes. "They devote that time to other tasks on the golf course. Ultimately, we're in the business of hazards, and superintendents shouldn't take the amount of time that they are because they aren't playing surfaces. If we can negate a lot of the time invested (in bunkers), it means that the playing surfaces get more attention and can improve."

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According to McClintock, all of the artificial turf came from a European distributor across the Atlantic Ocean in eight shipping containers, and the entire installation process took almost four months. McClintock adds that his membership loves the new walls.

Continued from page 24

September 2014, Lewis made a week-long trip to Tennessee National to oversee the beginning of the construction. The project was completed at the end of February 2015. The club paid about \$5,000 per bunker to lay the stacked artificial turf and add Better Billy Bunker bunker liners. The budget allowed for only 32 bunkers to remain, with the other 32 filled in. The remaining 32 require little maintenance, according to McClintock.

“It used to be it would rain 3 inches and you’d come in with multiple bunkers collapsed or washed out,” he notes. “Since we put them in I haven’t touched them, except moving some sand here or there and occasionally throw some Roundup on whatever is growing through the wall. But we leave the moss, algae and whatever is growing on it. They look better now than the day that they put them in, and the members love them.”

Both McClintock and Mitchell agree that because the bunker

walls are artificial the aesthetics are better today than when they were installed.

“They don’t change with weather, rain, wind or play,” Mitchell adds. “Players can’t take chunks out of them with the club or a ball. They look a little bit better because they start to get some age on them. They have some algae growing in them and look more natural.”

It’d be hard to say who approves of the bunkers more at Secession — its superintendent or its members. Mitchell says that before the renovation, the club’s bunkers were an eyesore and always an afterthought. Now, however, they are probably Seccession’s most talked about feature, and visitors to the course are not always convinced that the walls are made of artificial turf.

“We’ve had multiple times where members and their guests will come and they have to be told that they’re fake,” Mitchell says. “They basically have to be right up on them or almost touch them



“Since we put them in I haven’t touched them, except moving some sand here or there...,” says McClintock. “They look better now than the day that they put them in, and the members love them.”

CAPITALIZING ON CAPILLARY

A NEW PARTNERSHIP HAS CAPILLARY CONCRETE LOOKING BEYOND BUNKERS AND BEYOND GOLF.

BY SETH JONES

It's not often that "Ms. 59," Annika Sorenstam, does anything halfway. But that's exactly what the World Golf Hall of Famer did when she recently upped her ownership stake in Capillary Concrete. She is now a 50-percent owner of the sports base material company.

"Now that I'm in retirement, I find myself learning about concrete," Sorenstam told *Golfdom* at the recent ANA Inspiration LPGA major in Rancho Mirage, Calif. "For me it is an interesting product — (Capillary Concrete) goes hand in hand with design,



Annika Sorenstam & Martin Sternberg

growing the game and environmental sustainability. It's very exciting."

Though watching concrete dry might not sound as exciting as what Sorenstam did in her playing days, the rapid growth of the company is something that would excite any investor. According to Capillary Concrete founder Martin Sternberg, CGCS, the company is doubling in size every six months. He expects the company to do as many bunkers in the United States in the first half of 2017 as the company did stateside in all of 2015 and 2016 combined.

Not bad for a company that already has done 4,000 bunkers worldwide in a relatively short time.

"I wake up and pinch my arm every morning," Sternberg says. "I crossed the Atlantic 22 times last year for Capillary Concrete. We have 15 distributors worldwide now. Our biggest challenge is finding enough materials and people to help us."

Capillary Concrete uses gravity and capillary force to keep water moving through bunkers and prevents washouts, plugged lies and keeps sand faces from failing, according to Sternberg, who founded the company in 2010. But now, thanks to the addition of Sorenstam, the company plans to expand.

"Once I started listening and seeing the product, I was intrigued by its possibilities," Sorenstam says. "We can help limit injuries in sports fields by controlling the moisture under the surface where people fall. And in that market, we have no competitors — we're just finalizing our testing to show that the proof is in the pudding."

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Sternberg is thankful for Sorenstam's vision to move the company beyond the "small niche" of golf course bunkers and excitedly talks about "Head Injury Criterion" in sports turf, a measurement with which he was previously unfamiliar. Still, golf courses clearly have his heart. The expansion that excites him is tee box construction.

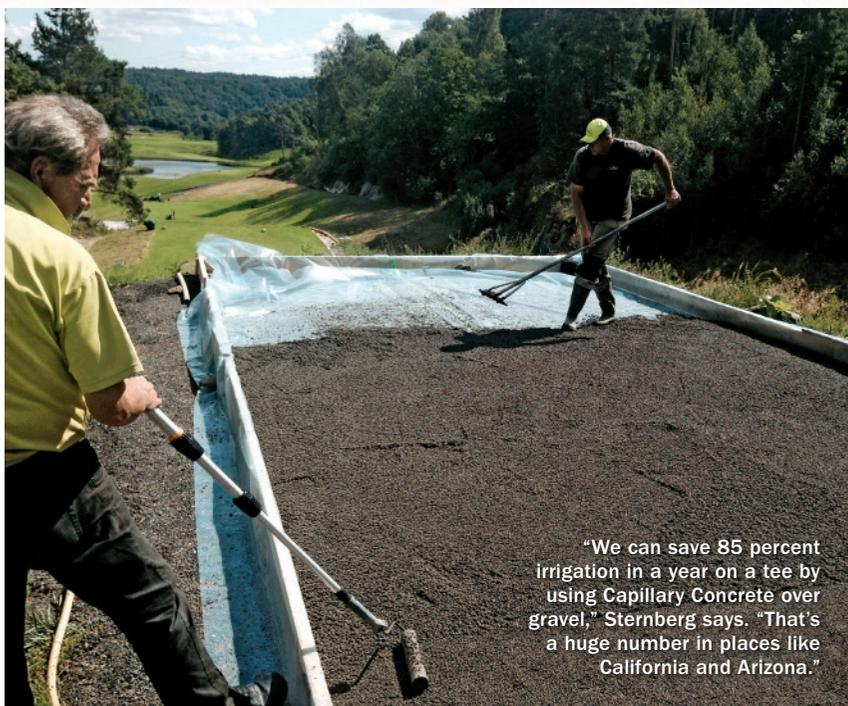
"We can save 85 percent irrigation in a year on a tee by using Capillary Concrete over gravel," Sternberg says. "That's a huge number in places like California and Arizona, where water is expensive and the restrictions are tough. It's a huge opportunity."

Sternberg — who still holds the title of superintendent of a course he owns in his native Sweden — says it's just a matter of time for them to perfect the technology to make it widely applicable.

"I've got tees (with Capillary Concrete) on my course in Sweden, where we get 35 inches of rain annually, that I've never irrigated," he says. "I've built tees that can do without irrigation entirely, but that's not how you do field testing. We're working, looking for the right application for each and every area, warm season and cold season."

Sustainability is a big part of the company's credo, and Sternberg says it's for good reason: He's old.

"I'm an old guy — I was the first superintendent in Europe to get certified by the GCSAA back in 1992," Sternberg says. "I've been a superintendent for over 30 years. I remember all the times, and it bugs the hell out of me that as a profession, an industry, we can't seem to prove all the benefits (golf) has done for society as a whole. We get beaten up. Everyone has a perception, 'Golf is just for the rich, they spray chemicals, use too much fertilizer.' Noth-



"We can save 85 percent irrigation in a year on a tee by using Capillary Concrete over gravel," Sternberg says. "That's a huge number in places like California and Arizona."

ing is further from the truth. Look at landscaping, sports turf and parks — we're leading this technical revolution. Everything originated in golf. Golf is on the cutting edge of maintenance practices for everyone."

Sorenstam comes to the bunker business foremost as a player, and knows the way she wants a bunker to play when she (rarely) hits in one. She says Sternberg has taught her more about bunkers than she thought she'd ever know.

"People are starting to see the benefits, not just from a maintenance standpoint, but from an environmentally friendly standpoint," she says. "They're seeing and recognizing the sustainability."

Sternberg says he and Sorenstam make a good team. She's famous and well organized. They've known each other a long time, and when she talks, people listen. Sternberg sees the company growing around the world, and not just at exclusive destination golf courses but also the mom and pop courses.

"We have big projects like TPC Sugarloaf — we'll be there for two years getting all their bunkers done. Next week I'm heading to Top of the Rock in Missouri, an amazing place," Sternberg says. "Those are the famous places with an abundance of money. My favorite projects are the local small-town courses. Those are the places where you can truly help people make their golf courses be more sustainable." 



◀ TOO MUCH TIME IN THE SAND

For a video interview with superintendents from around the country on their opinion on the current state of bunker maintenance, visit Golfdom.com/category/video.



Super Science

// THE STUFF IS NUTS-EDGE

MANAGING UNMELLOW YELLOW NUTSEGE

By Luqi Li, Roch Gaussoin, Ph.D., and Zac Reicher, Ph.D.

Yellow nutsedge is a difficult-to-control weed that increasingly is a problem on golf courses. Its yellow-green color, coarse foliage and fast growth decrease visual quality, uniformity and, in the worst case, playability.

Yellow nutsedge is a perennial that reproduces primarily through tubers, which may remain dormant in the soil for years and/or may sprout more than once in a year. Control from yellow nutsedge herbicides is inconsistent across years and geography, frustrating superintendents across the country.

In cool-season turf, the typical recommendation is to make an initial application before the summer solstice, when new tubers have not yet developed and nutsedge plants are relatively small. We think it may be too late to wait until late June for herbicide application.



Yellow nutsedge tubers survive winter underground. Tubers may remain dormant for years and may sprout more than once in spring.

We initiated a study in 2012, evaluating application timings of early June, summer solstice and mid-July or early August, using Sedgehammer (halosulfuron-methyl, Gowan) or Dismiss (sulfentrazone, FMC) at their recommended rates for yellow nutsedge control. The study also compared single applications to sequential applications made three weeks after the initial. We repeated the study for four years, observing control in the

summer, plus yellow nutsedge coming back the following summer.

Results suggest the first application should be made the first week of June, followed up for maximum control with a second application three weeks later. The key is to apply herbicides as soon as the plant can be identified. We found Sedgehammer produced consistently better control, regardless of timing or number of applications. However, we still recommend using both herbicides over multiple years to limit the possibility of herbicide resistance.

A study is being established this year to understand what makes yellow nutsedge invasive in turfgrass. We will evaluate how fertility and irrigation amount affect the growth of yellow nutsedge.

Luqi Li, Roch Gaussoin, Ph.D., and Zac Reicher, Ph.D. Li and Gaussoin are at the University of Nebraska, and Reicher is with Bayer Environmental Science. Li can be reached at impin06@hotmail.com for more information.

NEWS UPDATES

DLF PICKSEED REBUILDS AND MAKES PLANS TO EXPAND

DLF Pickseed USA's Halsey, Ore., warehouse burned down last August, and Warehouse Manager Terry Walker acknowledges that the winter was challenging because of the missing storage space. However, the structure has now been rebuilt and the company is ready to expand.

The Halsey warehouse reopened its doors in late March, and the company is building a new 35,200-square-foot warehouse in Tangent, Ore. The new warehouse will hold an estimated 11 million pounds of seed. It will allow the company to use more of its own property as opposed to outsourcing storage, according to a press release.

By expanding and improving warehouse logistics for mixing and packaging, DLF Pickseed USA is investing in the future to accommodate a more robust push into the U.S. retail market, according to the company. With the recent acquisition of the retail line, X-Seed, this new warehouse space is designed to support growth in wholesale markets.

"We will consolidate our storage in order to improve throughput by having our seed close by, reducing transferring seed from outside locations, while simultaneously improving trucking productivity," says Steyn van Niekerk, VP of operations. "It also allows us to improve the workflow of our seed processing, improving response time."

A RECENT SURVEY OF NORTH CAROLINA AND SOUTH CAROLINA GOLF COURSES REVEALED A HIGH DIVERSITY OF 24 NEMATODE SPECIES..."

Bruce Martin, Ph.D.

(see story on page 30)

// TAKING SOME OF THE STING OUT

Nematodes in southern turfgrasses

By Bruce Martin, Ph.D.

Nematodes have been recognized as significant pests of turfgrasses in the South for more than 60 years, corresponding with increased U.S. economic vitality after World War II and heightened interest in golf. That heightened interest added dollars to promote better playing conditions and led scientists to investigate nematodes as a potential cause of stressed turf. Florida was the first state to report nematode injury in bermudagrass (*Cynodon dactylon*) turf.

After this initial recognition, many U.S. locations reported nematodes associated with damaged turf. In the ensuing decades, many products were evaluated for nematode control. Initial reports usually were surveys of the genera and species of nematodes associated with various turfgrasses, and included familiar nematodes such as *Belonolaimus longicaudatus* (sting), *Hoplolaimus galeatus* (lance), *Trichodorus* and *Paratrichodorus* spp. (stubby root) and others such as *Helicotylenchus* (spiral), *Criconebella* (ring), *Criconeoides* (sheathoid), *Hemicycliophora* (sheath), *Tylenchorrhynchus* (stunt), *Meloidogyne* (root-knot) and *Hypsoperine* (false root-knot nematode). Surveys still are important and they continue, however, identification now employs morphology and molecular identification tools that allow better identification.

A recent survey of North Carolina and South Carolina golf courses revealed a high diversity of 24 nematode species belonging to 19 genera and 11 families. Of those, 23 species were found in South Carolina, 19 species in North Carolina and 18

FIGURE 1



Belonolaimus longicaudatus (sting nematode) is a large nematode, reaching sizes of about 1/8-inch long when mature.

species in both states. *Helicotylenchus dihystra*, *Mesocriconeema xenoplax*, *Hoplolaimus galeatus*, *Tylenchorrhynchus claytoni*, *Belonolaimus longicaudatus*, *Meloidogyne graminis* and *Paratrichodorus minor* were the most prevalent and abundant species on golf courses in both states. Twelve species were new records of plant parasitic nematodes in turfgrasses in both North Carolina and South Carolina. Further work, such as the development of molecular tools to quickly identify species of root-knot, will lead to a better understanding of these pests and their impact on golf course turfgrasses.

Many nematologists and pathol-

ogists, based on previous work and their own experiences, recognize these and other nematodes as significant but often overlooked pests in golf turf. These pests are unseen root parasites, and their effects can mimic other causes of weak turf which likely leads to some delay in diagnosing their true nature as primary pathogens, and even misdiagnosis of the nature of the malady under investigation. In many states, the primary diagnostic lab is not coupled with nematode identification services. Nematode identification and enumeration requires different techniques and experiences than those typically employed in diagnostic labs for fungal pathogens. This means that the diagnostician should also be trained in nematology, be familiar with the symptoms they can induce and have an appreciation of the potential contribution of nematodes as pests. This is especially important in the South, where nematodes are recognized and known to be important. It's also important that nematodes be considered in other states where heat and drought stress are more variable.

In southern states, arguably, the most important nematodes include sting, root-knot species and lance nematodes. Other species also cause significant damage themselves or as components of mixed populations if their counts are high enough. They can be a significant problem, but more credit is given them as significant pathogens when their counts considerably exceed threshold numbers. These might include nematodes such as stunt, stubby root, ring or even spiral nematodes.

ALL PHOTOS BY BRUCE MARTIN

STING NEMATODES

Belonolaimus longicaudatus is a large nematode, reaching sizes of about 1/8-inch when mature (Figure 1). Size may particularly matter in the case of the stylet of this nematode, which is long and allows the nematode to feed deep within root tissues (Figure 2). The feeding habit of this nematode likely is why it causes damage even at low threshold numbers (most labs indicate a damage threshold of about 20 per 100 cc of soil). It feeds on root tips where the meristematic tissues are located, and thus stops root growth.

Feeding leads to a shallow, stunted root system, and wounds from the nematode feeding invite other soil organisms to colonize and further debilitate the host plants (Figure 3). Sting nematode is an *ectoparasitic* feeder — its body remains outside of the host tissues as it feeds, and it can move short distances to reach other roots for further feeding. As an ectoparasite, it's presumed to be more susceptible to nematicides.

If there is anything good about a sting nematode (except being a fascinating organism), it is that it doesn't survive in frozen soils for long periods and that it's limited to soils of at least 80 percent sand. In the United States it is truly a southerner, although populations introduced into southern California have done well and are quarantined. *Belonolaimus* and related species also occur in turf in other parts of the world and are recognized

(Nematodes') effects can mimic other causes of weak turf, which likely leads to some delay in diagnosing their true nature as primary pathogens

FIGURE 2



Sting nematode has a long stylet that allows it to feed deep within root tissues.

as major pathogens. It's obvious that sand-based putting greens are ideal habitats for sting and other nematodes. Besides being good habitats for the nematodes themselves, sand-based greens inherently are nutrient deficient and prone to drought stress. Therefore, root parasites such as nematodes are particularly important in sandy soils.

ROOT-KNOT NEMATODES

Nematodes in the genus *Meloidogyne* are the root-knot nematodes. At least five species have been identified in turf, including *M. graminis*, *M. incognita*, *M. naasi*, *M. microtyla* and *M. marylandi*. In bermudagrass turf, it appears *M. graminis* and *M. marylandi* are commonly identified. *M. naasi* and *M. microtyla* sometimes are identified in cool-season grasses as well as warm-season grasses. Root-knot nematodes are sedentary *endoparasites*. That is, they spend the majority of their lifecycles inside roots, except for newly hatched juveniles and males. Juveniles penetrate roots and set up feeding sites from where they no longer move (become sedentary), but instead induce giant cell formation from the host tissues. Giant cells of the host become metabolic sinks whose purpose is diverted from

FIGURE 3



A shallow, stunted root system caused by sting nematode damage.

normal plant physiological processes to nutrition for the nematodes. In this way, root-knot nematodes are more stealthy parasites of their hosts.

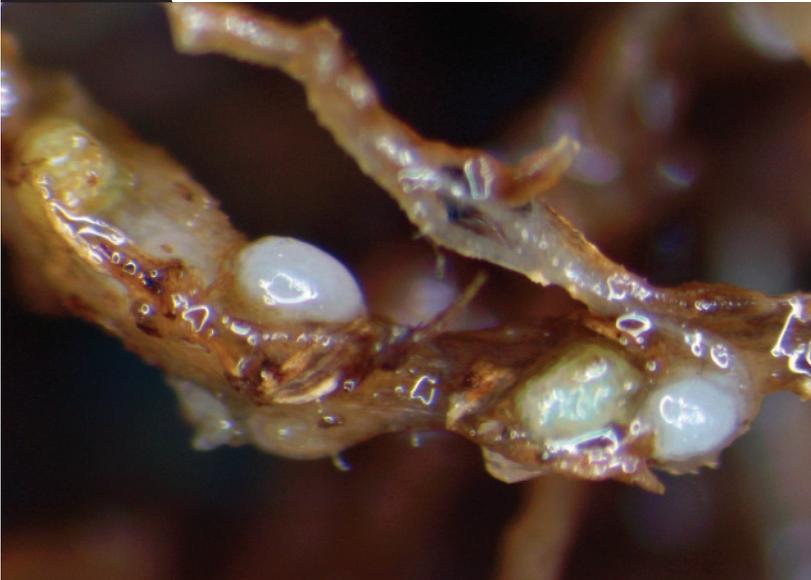
Root-knot females within infected roots swell and become gourd-shaped when mature, producing eggs contained in a gelatinous egg sack (Figure 4). Egg sacks and mature female nematodes may break through the root cortex and become visible with a microscope. Results from control trials also have generally shown root-knot nematodes to be more difficult to manage than sting nematodes, probably because of their high reproductive capacity (multiple generations, high egg production) per season and the protection their bodies enjoy as endoparasites within roots. Root-knot nematodes are encountered in many soil textures, and are not limited to sandy soils. Their damage potential, however, likely is higher in sandy soils because of the inherent higher risk of drought and nutrient deficiency stresses.

LANCE NEMATODES

Lance nematodes belong in the genus *Hoplolaimus*. The most commonly encountered lance nematode in turf

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FIGURE 4



A bermudagrass root thoroughly colonized by gourd-shaped female root-knot nematodes.

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is *H. galeatus*, although other species such as *H. stephanus* have been recognized recently. More research is needed in specific identification of lance nematode populations in turf, as the morphological differences among some species are not obvious.

Lance nematodes are *migratory endoparasites* in their feeding habits. They move inside and outside roots and feed seemingly indiscriminately on roots, not necessarily targeting specific regions of roots like sting or stubby root nematodes. A study in Kansas revealed that juvenile lance nematodes were most abundant within the roots, while more adults were encountered outside the root system. Lance nematodes have a high reproductive capacity, and in some locations counts easily can exceed several thousand per 100 cc of soil. Lance nematodes generally have relatively high damage thresholds, particularly in northern states in cool-season grasses, where environmental stress is less severe than in the South.

DAMAGE THRESHOLDS

Plant parasitic nematodes are obligate parasites of their host plants. They

must feed on these hosts in order to thrive, survive and reproduce. In most cases, we see separate sexes within a species of nematode, with males and females. Reproduction typically is by cross fertilization, which results in egg production by females. Development of a nematode from egg to adult is about a month. During this time, the

nematode feeds and grows. It also sheds its chitin-based body wall several times to accommodate the increases in size as the nematode grows to adult and becomes sexually mature. Some nematodes, such as the root-knot nematodes, lay many eggs and their populations can reach high numbers in favorable conditions. Others, like sting nematodes, may not lay as many eggs and populations may not be nearly as high as those with high reproductive capacities. Nevertheless, some of these, like sting in particular, cause significantly more damage per individual nematode.

These biological phenomena and observations of damage, coupled with experimental evidence, have provided published “damage thresholds.” These are numbers of nematodes of a species per volume of soil or roots, and compare the potential of particular nematodes to cause meaningful damage. Generally, they are reported as numbers of individuals per 100 cc or per 500 cc of soil. Thresholds are guidelines in creating a diagnosis of particular nematodes in a particular problem.

FIGURE 5



A putting green with nematode damaged turf outlined in orange. Sample the margins of the damaged area where there is still green turf and symptoms are showing.

As general guidelines, the numbers show how different nematodes compare relative to their pathogenicity or ability to cause damage. In some cases, thresholds are being refined to include different species, such as stubby root nematodes in the genus *Trichodorus* versus those in the genus *Paratrichodorus* (now *Nanidorus*). In Florida, *Trichodorus obtusus* has a lower threshold number than does *Paratrichodorus* on specific turfgrass species. *Trichodorus obtusus* has been found in North Carolina and South Carolina, so thresholds in the near future likely will be adjusted in these states to include this more damaging stubby root nematode.

SAMPLING

For nematode damage thresholds to have their greatest value, some thought into sampling methods is needed for sampling of soil and root systems. One obvious factor is that nematodes are going to be most abundant where roots are present. Rooting in golf course greens generally extends to about 4 inches, but may be shallower if a particular nematode problem is present. This is the depth of sampling generally recommended, but some nematodes — like root-knot — seem to be concentrated much more densely in the upper 1 to 2 inches, so stratified sampling may be appropriate.

Also, nematodes are not uniformly distributed throughout a green, tee or fairway. Rather, they typically cluster in “hot spots” that may correspond to more favorable soil texture (e.g. sandy areas). This means that sampling for *diagnostic* purposes (to answer the question of whether nematodes are responsible for the symptoms expressed) is different than more routine or systematic sampling that might be done to determine an average population in an area, such as a research plot.

Diagnostic samples should be taken at the margin of damaged patches or

areas. The objective is to find damaging species at high levels, if they exist. Do not sample dead or extremely thin turf, as nematodes are more likely to be at low populations where their food base is scarce. Rather, sample the margins, where there is still turf but where the turf is showing symptoms (Figure 5). Most labs prefer multiple cores of 1-inch diameter taken at the recommended depth and bulked to provide about 500 cc of soil. The lab will mix and subsample from the composite sample and provide counts of encountered nematode species. If the purpose is to monitor nematode populations in a turf stand, systematic sampling typically is recommended. Areas may be divided into plots (e.g. treated with a nematicide versus not treated), with multiple cores taken from each area in a zig-zag pattern to provide a good average count. We pay no attention to symptomatic turf in this method, so hot spots as well as healthier turf may be sampled.

Nematode populations change over time. Generally, populations are highest when plant growth, especially root growth, is favored, and may be lower when plant growth is slower or dormant. For bermudagrass in the southern Transition Zone for instance, root growth is abundant just as bermudagrass is moving out of winter dormancy in spring (Figure 6). Soil temperatures are likely still cool, 50 to 60 degrees F, and top growth is slow or almost imperceptible. Nematodes, if present, already may be feeding on these young roots. The same phenomenon occurs in fall when soil temperatures dip again as bermudagrass approaches dormancy. New

FIGURE 6



Nematodes are most abundant when root growth is most abundant.

roots appear in September and October but may also form in November and early December, when frosts have induced semi-dormancy and top growth is suppressed. Typically, a good time to sample for high levels of nematodes in this region would be April/May or September/October. Sampling for sting nematode in mid- or late summer in this region and even in Florida may show lowered populations as soil temperatures are high, and sting nematodes may move deeper in soil profiles and beyond the typical sampling depths. In winter months, counts may be lower because of nematode mortality.

NEMATODE MANAGEMENT

Like most pests, options for management include cultural, biological and chemical methods. IPM strategies typically provide the most practical and consistent results. Even in southern regions where nematode induced stress is high, the most practical management is cultural and depends on the knowledge and skill of superintendents. These practices include spoon feeding nutrients, hand-watering

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greens, avoiding stressful verticutting/aerification practices when the root system is so damaged that turf can heave, and other practices. These practices are labor and knowledge intensive. In some cases, even when nematode damage is severe, a putting surface can be maintained at an acceptable quality for short periods. The problem is that the risk is high for damage to exceed acceptable levels if the environmental stress becomes too high.

Biological controls include natural products that may suppress nematodes, such as certain extracts of sesame, neem or mustard-based products that release glucosinolate metabolites that are nematicidal. Some biological products are based on microorganisms that are antagonistic to nematodes and perhaps exclude them from their feeding sites or produce metabolites that harm nematodes.

One such product is the bacterium *Bacillus firmus* strain I-1582, the active ingredient in Nortica (Bayer). It's thought that this bacterium is antagonistic to certain nematodes, but it also may promote plant growth, thereby effectively avoiding some of the stress induced by nematode-compromised root systems. Other bacteria can be parasites of nematodes, such as species of *Pasteuria*. These are naturally occurring parasites, with strains that are more or less specific to their particular hosts (e.g. *P. usgae* parasitizes sting nematode but not root-knot or lance). As of this writing, *Pasteuria* bacteria are not available in a product, but there is hope that an effective biological control of certain damaging nematodes may be developed.

Where nematode damage is chronic and frequently severe, the use of chemical nematicides has provided the best method for suppressing populations and allowing turf to tolerate the stressful months adequately.

Three new nematicides were

introduced in 2016 and 2017, including fluensulfone, the active ingredient in Nimitz Pro G, marketed by Quali-Pro. Also, fluopyram, the active ingredient in Bayer's Indemnify, is registered and was sold as of late 2016.

Finally, abamectin, the active ingredient in DivaNem, developed and marketed by Syngenta, is available and replaces the Avid 0.15EC formulation of abamectin, which had previously been available under 24c labels in certain states. All of these materials are much safer than the old pesticides used for nematode control. As with any material for control, we are presently learning more about timing, placement, rates and effectiveness for nematodes.

Strategies that develop over time likely will include more than a single product, as none of these materials seems to be highly effective against the "big three" nematode species in the South.

Bruce Martin, Ph.D., is a turfgrass pathologist at Clemson University. You can reach him at sbmrtn@clemson.edu for more information.

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KARL DANNEBERGER, PH.D., *Science Editor*

Michael Hurdzan, teacher

The 2017 U.S. Open will be played at Erin Hills, a golf course just north of Milwaukee, Wis. Michael Hurdzan, Ph.D., along with Dana Fry and Ron Whitten, designed this links-style golf course with the vision of eventually hosting an Open.

It's an honor for these architects to see that vision come true in just a few weeks. I'm especially pleased to see Mike Hurdzan receive the acclaim that goes along with designing a U.S. Open venue, not that he hasn't received a career full of awards, including the ASGCA's Donald Ross Award, GC-SAA's Old Tom Morris Award and the GCBAAs Don A. Rossi award. He has a love of and lifelong commitment to the game of golf. I've been fortunate to see that passion conveyed to college students here at The Ohio State University.

I met Mike only a few days after I started working at Ohio State. He was speaking at a turf club meeting in the old Union Building on campus. At the time, Mike was the partner in the firm Kidwell and Hurdzan, which was founded in 1975 in Columbus, Ohio. Jack Kidwell had been Mike's mentor, and not only in golf course architecture. Jack was a Class A PGA professional and a Class A golf course superinten-

dent who encouraged Mike to embrace all facets of golf. I can't think of a time when Mike talked to my students that he didn't mention the impact Jack had on his life and the loyalty he had to him.

Mike tells students the story about Jack being a paratrooper in World War II, how he had sworn that once he returned to Columbus he would never fly again, and that the only golf courses he would design would be within a day's drive of Columbus. I'm not sure how true the story about flying is, but given that Kidwell and Hurdzan designed and renovated almost 140 golf courses in Ohio, we were fortunate to have them close.

Mike has been active with my students, receiving little more than a thank you for his time. Whether they are turfgrass science majors or arts and science students, Mike has shared his unique expertise with them. He's been involved with traditional activities, like giving class lectures, but he has

also hosted students on unique, and for many, once-in-a-lifetime adventures. These have included “golf tours,” where Mike would take them over a few holes and describe architectural ideas and provide insight on how professional and novice golfers react to various concepts.

One “lecture” that stands out is the visit to his office. Mike must rank as one of the top private golf collectors in the country, maybe the world. His passion for anything golf is on full display in his office. His office building is constructed to highlight and tell the story of golf. Included is a walk down “Main Street” at St. Andrews. His collection is a proverbial trip through the history of golf.

Students following and listening to Mike on this tour gain an appreciation for the game. That appreciation does not come from an artifact, but from the story behind the object. The way Mike explains provides an enrichment experience students rarely forget. He always seems to have time to talk with the students, not only about golf, but what is on their minds.

Mike is famous, but his self-deprecating manner helps bond with students. As the visits close, Mike often will graciously hand out one of his books as a gift to the students. I watch these students — and I take this as a sign of respect — they often nervously ask for his autograph.

The traits that make Mike a great teacher are not just for the classroom. I see these same traits in how he treats people in our industry.

Karl Danneberger, Ph.D., *Golfdom's* science editor and a professor at The Ohio State University, can be reached at danneberger.1@osu.edu.

Digging deep into fraze mowing

Brian Whitlark is a USGA agronomist in the West Region. Brian conducts course consulting visits, writes for USGA publications and is a conference speaker. Brian has observed several golf courses using fraze mowing to improve their turf. You may reach Brian at bwhitlark@usga.org for more information.

Q What is the fit of fraze mowing in your region?

Fraze mowing is still in its infancy in the Southwest. Superintendents are still in the learning mode with fraze mowing. Most superintendents start by fraze mowing a driving range tee, and if satisfied start fraze mowing tees, fairways and approaches. Currently, most of the fraze mowing is done by contract providers.

Bermudagrass is a prolific thatch producer, and over a few years a large accumulation of organic matter makes the soil surface hydrophobic, which impedes water movement into soil. Organic matter accumulation also reduces playing quality and makes winter overseeding a challenge because seed does not reach the soil surface.

Superintendents have tried all sorts of cultivation techniques to reduce organic matter accumulation with limited success, thus the interest in fraze mowing to reduce organic matter accumulation.

So far, golf courses in the Southwest have used an aggressive form of fraze mowing to reduce organic matter accumulation. Typically, the first pass is with the fraze mower set at 0.75 inch deep,

followed by a second “clean-up” pass with the mower set at 0.25 inch. This results in all the thatch and organic matter being stripped off, leaving behind only surface stolons and underground rhizomes for recovery.

DEPENDING ON THE AGGRESSIVENESS OF FRAZE MOWING, IT WILL TAKE ABOUT THREE WEEKS FOR THE BERMUDAGRASS TO RECOVER ENOUGH TO ALLOW THE GOLF COURSE TO REOPEN. THIS IS NOT FULL RECOVERY, BUT SUFFICIENT TO REOPEN FOR PLAY.

An additional benefit of fraze mowing is the removal of annual bluegrass (*Poa annua*) seed. Removal of annual bluegrass seed greatly reduces the annual bluegrass population during the next few years.

Q Describe the recovery process after fraze mowing.

Some superintendents top-dress right after fraze mowing because it's an excellent opportunity to apply up to 0.25 inch of sand to smooth the surface and improve the soil profile. The sand also helps the bermudagrass recover more quickly. The rate of recovery depends on the

time of year the fraze mowing occurs, the aggressiveness of fraze mowing and the quality of the bermudagrass stand prior to mowing. Some courses have had success seeding bermudagrass to enhance recovery where the stand was thin prior to fraze mowing.

In the Phoenix area, aggressive bermudagrass growth doesn't really begin until around July 4, so

debris hauled away, which is costly; some golf courses spread the debris in the rough, which is a problem if one of your goals for fraze mowing is to remove annual bluegrass seed; and some golf courses dig pits on underused portions of the property and bury the debris. If the debris is clean of weed seeds it can be a valuable source of sprigs to fill in thin areas in roughs. I'm not aware of any simple, inexpensive method to dispose of the debris.

Q How do you see fraze mowing being used in the Southwest?

This is something superintendents will figure out once the process is used more widely. One approach might be to aggressively fraze mow four or five fairways a year every four years or so. Another approach might be to aggressively fraze mow all the fairways one year, followed by several years of less aggressive fraze mowing.

Everyone needs to come to terms with the fact that fraze mowing means closure of all or a portion of the course during the recovery period. The barren look of the turf right after fraze mowing can be a shock, and debris disposal is a challenge.

superintendents schedule their fraze mowing around this time to take advantage of the aggressive growth. Depending on the aggressiveness of fraze mowing, it will take about three weeks for the bermudagrass to recover enough to allow the golf course to reopen. This is not full recovery, but sufficient to reopen for play.

Q What's done with all the debris generated by fraze mowing?

Debris disposal is a huge challenge. Fraze mowing generates a tremendous volume of debris. Some golf courses pay to have the



Clark Throssell, Ph.D., loves to talk turf. Contact him at clarkthrossell@bresnan.net.

The Shop

// MUST-HAVE NEW EQUIPMENT



1 HF600 Reel Mower

With a cut path of 138 inches, the HF600 Reel Mower from **JACOBSEN** was released at the 2017 Golf Industry Show. The unit comes with 65-hp Kubota turbo charged Tier 4 Final common-rail diesel engine. The electronically controlled engine combined with the InCommand control console enables mow speeds and transport speeds to be adjusted. AdaptiThrottle Control provides three selectable drive modes on the HF600 – Adaptive, Manual and Garage. The HF600 features the SureTrac traction control system, which automatically transfers power from a slipping front wheel to the opposite rear wheel. jacobsen.com

2 AP 300 batteries

The AP 300 battery is compatible with the full line of **STIHL** battery products, with no gradual drop in performance during use, according to the company. This 3.8-lb. battery is the most powerful handheld lithium-ion battery in the Stihl lineup and allows users to work on larger projects with fewer recharges, producing 28 percent more energy content. The battery can recharge in as few as 35 minutes with the Stihl AL 500 high-speed charger. stihlusa.com

3 Optimax Blowers

The Optimax line of blowers from **LITTLE WONDER** features an all-steel impeller design and reverse-angled, seven-blade fan, and delivers air speeds ranging from 143 to 179 mph. Self-propelled models move as fast as 4.1 mph forward and 2.5 mph in reverse. The steel, single-piece deck and lower handle give a solid base that also protects the engine. The company recently released three new accessories for the units — a tool holder, parking brake and solid front wheel. Littlewonder.com

4



5

6

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4 Everflo EFHP2000

Reaching up to 2 gpm and 200 psi, the Everflo EFHP2000 12-volt high-pressure plunger pump provides multiple Quick-Connect ports that provide the necessary flow for a spray gun, boom and other sprayer accessories. This plunger pump from **VALLEY INDUSTRIES** features Viton valves and Santoprene diaphragm for increased durability and efficiency, according to the company. The unit includes an automatic shut off when no flow is required, conserving battery life.

Everflopump.com

5 8900A PrecisionCut

The 8900A PrecisionCut Large Area Reel Mower from **JOHN DEERE** features a width of 114 to 130 inches depending on cutting unit size. It's capable of mowing speeds up to 8 miles per hour and provides a quality of cut in undulating terrain thanks to a rear-attaching yoke on the cutting unit. The unit can attach 26-inch and 30-inch verticutters and large capacity reel motors for scalping during overseed operations.

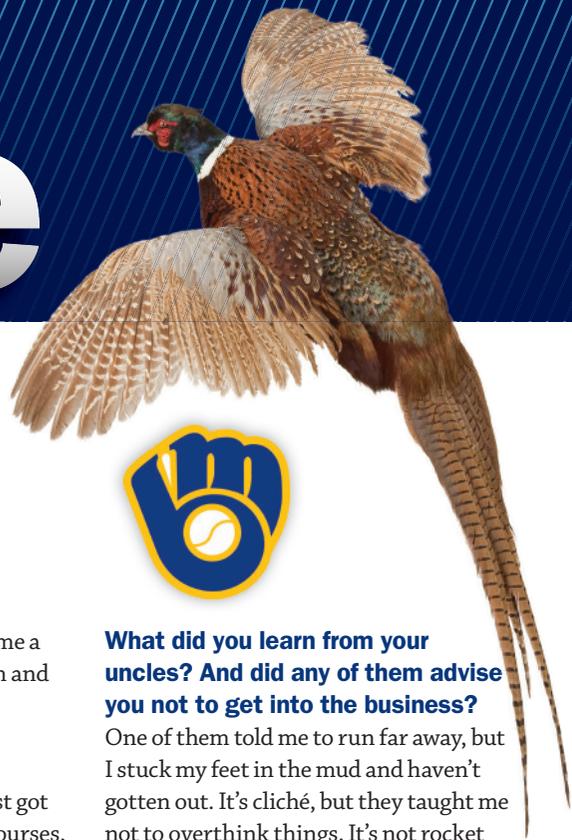
Deere.com

6 Groundsmaster 5900/5910

The 16-foot wide cutting width of the Groundsmaster 5900/5910 rotary mower from **TORO** enables operators to mow more than 100 acres per day. It comes with a Tier 4 Final compliant Yanmar 3.3-liter turbocharged diesel engine. The units' SmartPower system keeps the cutting blades running at optimum speed regardless of turf conditions, and the SmartCool system blows clippings and debris off the intake screen to prevent overheating. The Groundsmaster 5900/5910 models feature a larger ControlArm console, which now positions all key controls at the operator's fingertips.

toro.com

The 19th Hole



Steve Houlihan

SUPERINTENDENT // Blue Mound G&CC, Wauwatosa, Wis.



What can I get you? I'll have a Captain and Coke.



Tell me about your family. My wife, Kate, and I have two daughters. Aubrey is 5, Brynn is 3. They like to be active, especially now that the snow is melted.

Tell me about Blue Mound. It's a classic course, a Seth Raynor design, opened in 1926. I relish the history component of the course. Each hole is modeled after a famous hole in Scotland. It's our goal to keep restoring the course back to its original design.

What kind of wildlife do you see at Blue Mound? We seem to be a magnet for stray dogs, so I have to put on the hat of animal control every once in a while. Lots of deer, coyotes, turtles, ducks. Last

year, I put on a new hat and I became a pheasant farmer. I'm feeding them and trying to keep track of them.

Did you go to UW-Madison specifically for turf? When I first got to school I wanted to design golf courses, but they reminded me I'm not Jack Nicklaus, Arnold Palmer or Tiger Woods, so you better take this soil science program and be a golf course superintendent. I had four uncles who were superintendents. I saw what they did and I wanted to model what they were doing. I thought it'd be a good career choice.

Are your uncles still in the business? Two of them are still in the business. I'm part of the Shaw family tree — Jim, Pat, Charlie and Dan. They've all been superintendents in the Milwaukee area.

What did you learn from your uncles? And did any of them advise you not to get into the business?

One of them told me to run far away, but I stuck my feet in the mud and haven't gotten out. It's cliché, but they taught me not to overthink things. It's not rocket science, use common sense.

You went to UW-Madison, I'm guessing you're a Badgers fan...

Packers, Badgers, Brewers, Bucks, you name it. I'm a home-grown guy.

What's something you never leave home without?

I have a soil probe with me at all times. When I see something, I want to dig into the ground and see what the ground is showing me.



Did you see that the new Star Wars preview came out today? I didn't! I grew up a Star Wars fan. I'm a movie buff.

Have you considered what age, and in what order, you'll let the girls see the movies? They've already watched them all! We started with the new one,



they liked it so much we went back and watched one through six, and now we have

a date to see number eight when it comes out in December. Start 'em early, right?

As interviewed by Seth Jones, April 14, 2017.



"I LIKED MADISON SO MUCH I STAYED FOR SIX YEARS. I GOT A BACHELOR'S AND A MASTER'S IN SOIL SCIENCE. I WAS PUSHED TO PURSUE A PH.D., BUT I WANTED TO GET OUT AND GET MY HANDS DIRTY."

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