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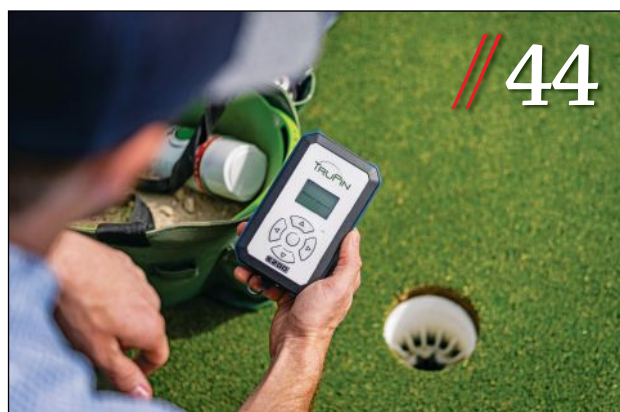
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“How will this summer of 2023 treat our readers? Only time will tell, but one thing is for sure: our readers are ready for the war.”

SETH JONES, Editor-in-Chief & Associate Publisher

Looking for legendary

Greetings from the Hall of Justice — or H.O.J. for short — my two-car Morton Building garage that I’ve converted into my own sports bar. Now that summer is here, you can be sure these next few columns are written under the soft glow of my two Budweiser neon signs, Ms. Pac-Man and the newest addition, an upright *The Simpsons* arcade game.

I say bring on the summer of 2023! If you’re a working journalist stiff like me, you love this time of year. But I’ve learned over the years to be careful when I speak about my excitement for the summer around *Golfdom* readers. Summer fun, for me, is the same time they are lacing up their work boots a little tighter as they prepare for a battle ...

In this issue’s Focus on Fungicides supplement — sponsored by my friends and neighbors at PBI-Gordon, whose new office is less than 30 minutes from the H.O.J. — I spoke with three superintendents at high-end private clubs.

The pressure is turned up everywhere, and that’s no

exception at places like Congressional CC, Bethesda, Md.; Arcola CC, Paramus, N.J.; and Piedmont Driving Club in Atlanta, where the expectations are sky-high.

These superintendents shared what the summer heat and high humidity can bring. Scott Slemple, director of grounds at Piedmont Driving Club, called it a “90-day war.” Then he corrected himself. “Or more like a 120-day war.”

Slemple added that just because there’s high heat and humidity doesn’t mean they can settle for good.

“We’re not looking for good or great (conditions),” he said. “We’re looking for legendary.”

How will this summer of 2023 treat our readers? Only time will tell, but one thing is

for sure: our readers are ready for the war. You can see my story with the superintendents at those three courses, *A high-stakes game*, on page FS10, and also check out a more laid-back Q&A with Pete Wendt, Congressional’s director of golf courses and grounds, in this issue’s 19th Hole.

Water, water, everywhere

Another theme for the issue is the work being done across the industry to save water. In this month’s cover story, Associate Editor Rob DiFranco spoke with Cole Thompson, the USGA’s director of turfgrass and environmental research, about how the organization’s recent \$30 million

commitment to water conservation will be put to good use. That story, *Leading the charge*, begins on page 11.

Also in this issue, our research editor, Mike Kenna, Ph.D., discusses a study performed at Cal State Polytechnic University, Pomona, on wireless soil moisture sensors. And we have a giant research article penned by enough well-known industry researchers to face the Miami Heat. That article breaks down research on cool-season turfgrass water use and needs and begins on page 36.

Before I turn off the neons

Before I sign off from the H.O.J. for the month, we have a couple of noteworthy life moments to mention in the world of *Golfdom*:

Congratulations to DiFranco on recently tying the knot! A photo of the happy couple on their wedding day is in this month’s *Golfdom* Gallery page. And another shout-out to Emma Seltzer, the daughter of our Art Director, Pete Seltzer. The proud pops happily reports that Emma graduated from college and was offered a full-time job in her chosen career path before the ink was dry on the diploma.

If you know me, you know I don’t need an excuse to celebrate. But I sure do like it when I have one! Cheers, and good luck to you all this summer. ☺

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Starter

NEWS, NOTES AND QUOTES



//MO' MONEY



SUPERINTENDENT SALARIES INCREASE AGAIN

Superintendents and their crews saw an average salary increase of 14 percent from 2021 according to a GCSAA report



A new report from the Golf Course Superintendents Association of America (GCSAA)

shows golf course superintendents and their teams continue to see salary increases outpacing the national average. The average salary for superintendents has climbed to \$109,621 annually.

The salary data, from the GCSAA's biennial Compensation and Benefits Report, shows an average salary of \$109,621. More than 3,200 GCSAA-member superintendents responded to the survey — a response rate of 40 percent — providing salary, budget, benefits and staffing information.

The new average salary is an increase of 12.6 percent over the 2021 report and continues a trend of increases since GCSAA began tracking the data in 1993.

Superintendents' salaries have risen more than 146 percent since the first report. At the time, the average salary was \$44,500.

Assistant superintendents and golf course equipment managers saw even higher increases in their incomes.

Average assistant salaries rose 15.3 percent to \$56,299, and equipment managers saw a 14.2 percent increase to \$60,584.

Certified Golf Course Superintendents saw their average salary rise to \$128,731 in 2023. This is 16 percent higher than the survey's average for a superintendent.

"Superintendents and their teams bring the essential knowledge and expertise driving the enjoyment of the game of golf and providing environmental, economic and recreational benefits to their communities," said Rhett Evans, GCSAA CEO. "The substantial rise in their salaries acknowledges golf course management teams for the highly skilled professionals that they are and the essential role they play in golf's success."

Another element of the report is the profile of GCSAA superintendents and their operations. The average age of a superintendent is 47.1 years, with 16.6 years in the profession.

The average number of years superintendents have spent in their current position decreased slightly to 10.3 years.

//OPEN TO ALL

USGA TO RESTORE MUNICIPAL COURSE AHEAD OF US OPEN

In anticipation of the 123rd U.S. Open Championship at Los Angeles Country Club (LACC), the USGA announced several community outreach efforts in the host city.

The USGA will donate \$1 million to restore the Maggie Hathaway Golf Course, a nine-hole, par-3 public facility operated by Los Angeles County that provides thousands in the area with affordable, accessible golf.

The association will join with the Southern California Golf Association, LACC, Los Angeles County and several other organizations and donors to bring the project to life. Gil Hanse will lead the restoration project.

USGA will also welcome 20 college undergraduate and graduate students from diverse backgrounds to Los Angeles for the USGA Pathways Internship Program, a weeklong immersive experience that exposes participants to the many career paths in golf.

//PASSING THE TORCH

WILKINSON STEPS IN AT PRIME SOURCE AS PROPRIETARY PRODUCTS MANAGER

Prime Source recently added Matt Wilkinson as proprietary products manager following Steve Jedrzejek's retirement after more than 40 years in various roles in the turf and ornamental industries.

Jedrzejek had been with the company since 2018.

Wilkinson joins the company with nearly 30 years of experience in the green industry with previous roles in agronomy, golf course management, as well as turf, ornamental, golf and sports turf product sales and portfolio development.

He earned his bachelor's in horticulture, turf and landscape management from Oregon State University.



Steve Jedrzejek



Matt Wilkinson

//WINNER-WINNER

USGA names Johnny Miller as Bob Jones Award winner



The United States Golf Association (USGA) selected Johnny Miller, player, broadcaster and golf course designer, as the recipient of the Bob Jones Award. It recognizes character, respect and a commitment to sportsmanship in the game of golf.

"Johnny's contributions to our game are significant, and honoring him with the Bob Jones Award reflects everything he means to the game and everything the game means to him," Mike Whan, CEO of the USGA, said.

The USGA has presented the award — named in honor of Jones, a nine-time USGA Champion — annually since 1995.

Miller created the Johnny Miller Champ Foundation, which focuses on nurturing junior golfers, fostering positive coaching and promoting the dreams

and aspirations of young athletes.

"This is such a great honor to receive the Bob Jones Award," said Miller, who was inducted into the World Golf Hall of Fame in 1998. "It was always about the USGA events for me. Growing up at The Olympic Club was such a privilege because it was a U.S. Open course, and my father always told me that's the one I needed to win, the U.S. Open."

In 1997, the National Golf Foundation (NGF) honored the Miller family with the Jack Nicklaus Golf Family of the Year Award, recognizing families who have made significant contributions to the game and exemplified the ideals of golf and family.

For more than 40 years, Miller has been helping American Indian Services provide scholarships and educational programs to Native Americans in pursuit of higher education.



//A CENTURY OF MEMORIES

NORTHERN OHIO GCSA TURNS 100

The Northern Ohio Golf Course Superintendents Association (NOGCSA) recently celebrated its 100th anniversary.

To commemorate this milestone, the NOGCSA hosted a kick-off event at Youngstown Country Club, the home of Colonel John Morley, the founder of the NOGCSA. Leadership in Northeast Ohio eventually led to the 1926 formation of the Golf Course Superintendents Association of America (GCSAA).

"The efforts of Colonel John Morley and our founders laid the groundwork for the success of our industry not only in Northeast Ohio, but the world," said Mark F. Jordan, CGCS, natural resource leader at Westfield Group Country Club in Westfield Center, Ohio, and GCSAA and NOGCSA past president.

The NOGCSA currently has more than 300 members at approximately 154 facilities and companies in Northern Ohio and extends into neighboring Michigan and Pennsylvania.

//DYNAMIC DUO

HANSE AND WAGNER TEAM UP FOR NEW COURSE

Construction recently began on Florida businessman Anthony Soave's, new golf course, Kinsale Golf Club in Naples, Fla.

Soave has developed 174 acres in southwestern Florida that will encompass the facilities of the club. Gil Hanse and Jim Wagner will design the course.

"Our vision is that Kinsale Golf Club is a true golf club that will incorporate all the elements that provide our members with the experiences that make them smile and want to talk about," said Soave.

Running with a membership of 250 each year, the facilities will include an 18-hole golf course, driving range, teaching and short-game areas, practice putting green and a clubhouse.

"The holes are not to be interpreted as replicas but rather as a foundation of our design's thought process and a basis of the course character," said Hanse.



Johnny Miller, 1973 U.S. Open Champion, is the USGA's latest Bob Jones Award winner, honoring character, respect and a commitment to sportsmanship in golf.

//NEW BEGINNINGS

PBI-GORDON WELCOMES TWO NEW FACES

PBI-Gordon recently added Matt Steward as senior director of national accounts and Patrick Bastron as a sales representative for Illinois and Indiana.



Matt Steward

As senior director of national accounts, Steward will lead the national accounts team in all aspects of account management in the turf and ornamental markets. As an active member of the sales leadership team, he will develop and implement strategic business plans to ensure alignment with customer and company objectives. Additionally, Steward will serve as a mentor and coach for sales team members.

Bastron will be responsible for product sales to turfgrass management customers in Illinois and Indiana. He will also identify new business opportunities to achieve strategic goals and objectives within his sales territory.

Before joining PBI-Gordon, Bastron was an assistant golf course superintendent at Kenosha (Wis.) Country Club.



Patrick Bastron

//RECORD-BREAKING ROUND

ROUNDS 4 RESEARCH BREAKS RECORDS AGAIN

For the second year in a row, the GCSAA Foundation's Rounds 4 Research program supporting turfgrass research broke records, yielding more than \$544,500 during its online auction on April 24-30.

The online auction received more than 1,500 donated rounds of golf and more than 16,000 bids. It sold 1,471 rounds to golfers and the top bid was \$13,010 at Ohoopee Match Club in Cobbtown, Ga.

"We were blown away by the response from our generous donors and bidders who helped set records again this year," Rhett Evans, GCSAA's CEO, said. "Thank you to our chapters, the facilities who donated rounds, and the bidders for working together to ensure golf's future."

More than 70 GCSAA chapters helped secure donations and the majority of funds raised go back to the chapters to support local research projects. The Carolinas GCSA was the top-earning chapter and raised more than \$112,000. The program has raised more than \$3 million since launching in 2012.

//UTAHNS ACKNOWLEDGED

UTAH GCSA RECOGNIZED FOR ENVIRONMENTAL IMPACT

➔ The Utah Golf Course Superintendents Association (UGCSA) and sustainability consulting firm Radius Sports Group recently released a new educational video showing the environmental and economic benefits of golf courses in the state.

The video, titled *This Place*, highlights conservation practices and the positive impacts of 17,000 acres of green infrastructure for vital ecosystem services, such as wildlife habitat, urban cooling and water filtration.

Utah golf courses generate \$805 million in total economic impact and support 9,600 jobs. Additionally, golf courses in Utah have donated more than \$11 million to local charities.

"We are thrilled to share education about our eco-friendly golf courses

in Utah," said Josh Virostko, UGCSA president and superintendent at Lakeside Golf Course, in West Bountiful, Utah. "We have more than 100 golf course superintendents who serve as stewards of the land and play a vital role in supporting the environment and our local communities ... we are proud to share our story."

Utah golf courses use secondary, non-potable water for irrigation at nearly 60 percent of facilities and reclaimed water at 11 percent statewide.

The video and educational content were developed with the support of the Utah Golf Alliance, Utah Golf Association, Professional Golfers' Association Utah Section, and a grant from the Golf Course Superintendents Association of America (GCSAA).



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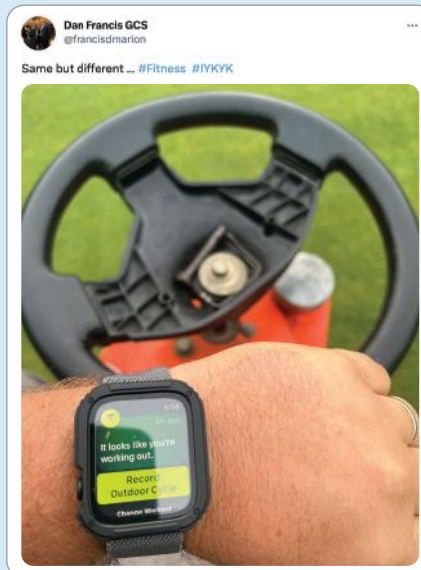
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Golfdom Gallery

1 Ride and drive Golfdom Publisher Craig MacGregor (center) recently tried out the latest in battery-operated equipment from Greenworks Tools with Anthony Marchese (left), senior vice president of sales and operation for Greenworks, and Yin Chen (right), CEO-Chairman of Greenworks.



2 Bringing home the hardware Editor-in-Chief Seth Jones (left), Group Publisher Bill Roddy and Publisher Craig MacGregor represented the Golfdom team at the Turf and Ornamental Communicators Association's (TOCA) annual meeting in Portland, Maine.



3 Here's to forever Congratulations are in order for Golfdom Associate Editor Rob DiFranco and his new wife, Sammi. The two tied the knot in front of family and friends in Columbus, Ohio, on April 29.

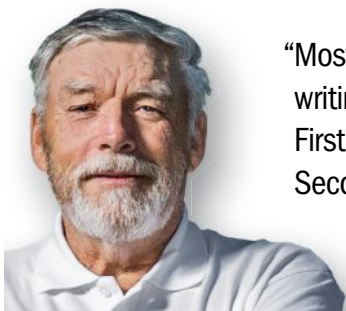


4 We can all get along! All three magazines dedicated to golf course maintenance came together to catch a ball game (and get on the field) at Fenway Park recently. (Left to right) Russ and Christina Warner, *Golf Course Industry*; Scott Hollister, *Golf Course Management*; Mark LaFleur, Syngenta; Craig MacGregor, Seth Jones and Bill Roddy, *Golfdom*; and Kristine White and Julia Verhoef, Performance Marketing.



5 Meet-up in Maine The TOCA tour took this group to a cocktail reception at Sea Bags, a company that refurbishes old sails into designer bags. From left to right are Justin Wallace and Cecilia Brown, Sod Solutions; Roddy; and Samantha DiFederico and Tessa Norton, Hunter Industries.





“Most superintendents face a few challenges when writing updates for their organization’s newsletter. First, it’s hard to find the time during the growing season. Secondly, golfers often find the information boring.”

JIM MOORE, retired director of education and outreach, USGA Green Section

How AI can strengthen communication with golfers

Here is what you need to start your day — another article about the importance of communicating with your golfers. My guess is that there have been more articles written on this subject than on *Poa annua*. So, what is different about this one?

How about Rodney Dangerfield — or at least the artificial intelligence version of him — contributing to your article in the next newsletter?

Most superintendents face a few challenges when writing updates for their organization’s newsletter. First, it’s hard to find the time during the growing season. Secondly, golfers often find the information boring. And finally, not everyone is comfortable with writing.

So, how do you get help from AI Rodney Dangerfield? Enter ChatGPT, an artificial intelligence chatbot developed by OpenAI. In short, the chatbot generates text from a few keywords or phrases you enter.

For example, when I entered the phrase, “Give the golf course maintenance staff

a break, don’t hit at them,” ChatGPT instantly created the following text:

It’s important to remember that golf course maintenance staff are working tirelessly to ensure the course is in top condition for golfers to enjoy. Any aggression or violence towards them is completely unwarranted.

Instead of hitting at maintenance staff, golfers should show their gratitude by treating them with kindness and respect. A simple ‘thank you’ or a friendly wave can go a long way in showing appreciation for the hard work they do. Golfers can also help out by being mindful of their actions on the course, such as repairing divots, replacing ball marks and following course rules and regulations.

At the end of the day, it’s important to remember that we are all on the same team when it

comes to maintaining and enjoying the golf course. By showing respect and appreciation for the maintenance staff, we can all work together to create a positive and enjoyable experience for everyone involved.

That’s not bad for a first try. It touches on the main points, but it’s still a little boring. So, I asked the AI to rewrite the text, but this time, in the style of the legendary Rodney Dangerfield.

The new text was much more interesting and fun. As a result, it is much more likely your golfers will stop and read it. Here’s what AI Rodney had to say:

Hey, I tell ya, no respect for the maintenance guys out here! These guys work hard to keep this course in good shape for us golfers, and what do they get? Swung at by some crazy golfer!

Come on, folks, we gotta give these guys a break. They deserve some respect and appreciation for all the hard work they do. Without ‘em, we wouldn’t have a course to play on. So, let’s give ‘em a little nod, a smile, or a pat on the back. That’s the least we can do to show we appreciate ‘em.

And golfers, come on, let’s do our part too. We gotta take care of this course, replacin’ divots, fixin’ ball marks, and followin’ the rules. It ain’t that hard, and it’ll help keep this course in top shape for us all to enjoy.

So, let’s show these maintenance guys some respect and appreciation, huh? They’re out here workin’ hard for us and we should be grateful for that.

Rodney’s style is just one example. I also asked ChatGPT to write the text in the styles of John Wayne, Winston Churchill and even Carl Spackler.

Obviously, this tool is not a complete substitute for good writing. But, if you are dreading writing your next update, why not have a “guest author” contribute some insight? You might be surprised at how well it works. 📌

Jim Moore is the retired director of education and outreach for the USGA Green Section. While with USGA, Moore made more than 1,000 consulting visits to golf courses in the U.S., Mexico and Germany. Now retired, he lives on the family farm in McGregor, Texas. He can be reached at jfcmoore@gmail.com.

Leading THE charge

Superintendents have embraced innovative approaches to reduce water usage. Now, what's on the horizon?

BY ROB DIFRANCO

By now, you've probably heard someone spout the notion that golf courses are major water wasters. You've probably had to hold back from immediately explaining why that's not true.

Those in the industry know that golf courses don't waste water. In fact, golf course superintendents are among the most effective water managers in the world. Of course, there can always be room for improvement.

The future of irrigation and water management is an ongoing effort. Through its Mike Davis Research Program, the United States Golf Association (USGA) is a major part of that initiative, in partnership with superintendents across the country.

"Superintendents do a good job of managing water and resources," says Cole Thompson, director of turfgrass and environmental research at the USGA. "It's exciting to talk about the research grants and all of this new technology, but (the USGA and others in the industry) are just here to bring it all together so we can get better."

The USGA established its Davis Program

in 1982 — then known as the Turfgrass and Environmental Research Program — as a research initiative to address issues related to golf course management, including water conservation and resource optimization.

In the 41 years since its launch, the program has seen its fair share of wins, from better ways to schedule irrigation to improved drought-tolerant turfgrasses. What's next for the Davis Program as the USGA ups its commitment to water conservation?

Solving the water problem

On the surface, turfgrass breeding programs might not seem like they directly influence water usage and conservation, Thompson says. In reality, it's one of the most important factors in growing golf's presence as a water conservation leader.

"Breeding programs really set the stage for water conservation," says Thompson. "There are several projects where we're directly advancing water conservation, and then there are projects, like breeding programs, where it's maybe not readily apparent that is happening."

One such project — part of the Davis Program class of 2023 — at Rutgers University aims to evaluate the use of warm-season grasses (zoysiagrass, bermudagrass and creeping bentgrass) in

Continued on page 12



Cole Thompson



Turfgrass research is a crucial component to continued improvement of water conservation by golf course superintendents.

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the northern transition zone.

“The idea behind the project is to, first, see which ones can survive and what kind of quality they provide, and then secondly, determine the irrigation requirements and other management practices needed to maintain those conditions,” he says.

Thompson adds that drought-tolerant turfgrass research will play a significant role in water conservation efforts as the transition zone continues to migrate north due to rising temperatures.

“We’ve got all of these materials now, and we just need to get more widespread adoption of some of these grasses,” he says. “With that comes finding ways for quick establishment, so there’s less downtime on the course. Also, how we can do that in an economically viable manner?”

He continues, while there are encumbrances to adopting some of these grasses, that’s something the project will work to reduce.

“Those are some of the things that we hope this project can work through and find out,” he says. “What is the ROI on this grass? And how can you tell that story to whoever is paying the bills to say, ‘Hey, we need to do this.’”

A better way to irrigate

Soil moisture sensors aren’t new to the golf world. Thompson says their increased usage on courses across the country has been —



In conjunction with drought-tolerant turfgrass, more native areas are a potential solution to water usage concerns.

and will continue to be — a major part of the future of irrigation.

“That’s been a big win for the industry driven by the Davis Program,” he says. “(Moisture sensors) were used in turf research in the ’80s, but when they became commercially available, they were a bit slow to take off. But now we know, if you want to know when you need to water, soil moisture (testing) is the best way to do it.”

Advancing the use of soil moisture sensors for irrigation scheduling has been important in water management.

Thompson points to Davis Program-funded research projects at Kansas State University and the University of Minnesota, which both demonstrated significant water savings of 50 to 80 percent with the use of soil moisture sensors compared to evapotranspiration-based (ET-based) scheduling.

PHOTOS COURTESY UNITED STATES GOLF ASSOCIATION
SELCHUK ONER / ISTOCK-GETTY IMAGES PLUS / GETTY IMAGES (BACKGROUND)

A major commitment

In April, the USGA committed \$30 million over 15 years to reduce water usage, recognizing the increasing difficulty of sourcing water and the need for a concerted effort in water conservation (for more on that see the May issue of *Golfdom*.)

“We’re not just going to come up with more water,” Cole Thompson, director of turfgrass and environmental research at the USGA, says. “This commitment will lead to a more concerted effort than we’ve ever had. It’s a challenge to the industry to really think about how we’re irrigating, how we’re using water and where we can improve on that.”

As part of the initiative, he adds, the USGA will host water summits, which will bring together top minds in the field to explore innovative approaches and push the boundaries of water conservation in golf course management.

Previously held summits in California have facilitated discussions among various stakeholders, including golf industry representatives, agronomists, superintendents and water purveyors.

Thompson says these summits provide a platform for sharing knowledge, practical experiences and water-saving strategies.

“They’ve all been successful, and we’ve had good attendance,” he says. “There will be more of them in 2023. I know there’s a discussion of at least two more happening this year.”



Superintendents have more technology at their disposal than ever before, giving them the tools to be master water managers.

These projects found efficient ways to use sensors on golf courses, optimizing irrigation based on representative sensors in different soil zones. The projects highlighted the potential for reducing irrigation between rain events and showed the benefits of soil moisture sensing in water conservation.

In the future, Thompson says soil moisture sensors will work in tandem with other promising technologies — like GPS and drones — to make superintendents better water managers.

By sea, land and air?

Irrigation tech isn't just limited to the ground, however. It's begun to take to the skies as well.

"Another thing that people are really excited about is the use of drones that have either a thermal sensor or an NDVI camera on it that can tell you information about the surface of the plant," says Thompson.

That information includes the surface temperature of the turf

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Changes in irrigation methods, such as subsurface drip irrigation on tees, are one way to keep quality while reducing water usage.

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and how well it absorbs light, which gives superintendents more data to influence their decisions.

“There’s definitely a validity in using these technologies, but there are also many things that can affect the reading that those sensors can give you,” he says. “It’s not as simple as taking a drone out of a box, getting it up in the sky and having it tell you how much water you need to use.”

Thompson says the USGA has ongoing research into how superintendents can weed through the data drone cameras give them and make an informed irrigation decision with it.

Projects exploring the adaptation of microwave radiometry, a ground penetrating radar used by NASA for estimating soil moisture, to turfgrass management are also being pursued.

“There’s a project at New Mexico State (funded by a 2023 Davis Grant) that is focused on taking these satellite-based radiometers and correlating them with soil moisture to decide if they’re enough to inform irrigation decisions,” Thompson says.

Always learning

Golf course superintendents are open to embracing innovative approaches to conserve water and improve irrigation practices, Thompson says.

Through combined scientific research, practical expertise and



industry collaboration, golf courses — with the help of bodies like the USGA — are poised to become even more effective water managers in the future.

He adds that constant improvement is a shared goal between the USGA and golf course superintendents.

Thompson says the USGA values the practical experiences and insights of superintendents, which inform their research and recommendations.

“We learn as much from golf course superintendents as much as we teach them,” he says. “They’re the ones who are applying the research and the recommendations we’re making. There’s bilateral communication there with both education and looking for opportunities where we can do more.” ©

Tree troubles

BY JOHN C. FECH, UNIVERSITY OF NEBRASKA-LINCOLN

Unfortunately, trees and shrubs on the golf course can't take care of themselves. Like the turf on the tees, greens and fairways, there are all sorts of abiotic maladies caused by non-living factors that can influence their demise.

Regardless of the specific cause, the keys to success are the same. A step-by-step approach, beginning with an accurate diagnosis, should guide the process from start to finish.

Along the way, honing in on the most effective treatment options and an honest assessment of the tree's value to the course will result in retaining an ornamental as an asset rather than an eyesore or a liability.

An accurate diagnosis

At the outset, it's helpful to think of the diagnosis process as an all things considered, eyes-wide-open endeavor.

Jumping to conclusions with preconceived notions usually leads to an inaccurate diagnosis. Another initial consideration is to define "malady" or "disease." While there are many, perhaps the best one, in this case, is any factor that limits a plant from reaching its full potential.

This definition is truly in line with the open eyes and all-things approach. Overall, the best

path is to start with general influences and gradually begin narrowing the scope and number of possible factors.

Considering various problems in three categories of causes is helpful in terms of finding the actual limiting factor ... general influences, species-specific ailments and a set of responsible agents, both biotic (insects, mites, fungi and bacteria) and abiotic.

Generally speaking

Many influences affect a wide variety of — if not all — trees. They include site-related conditions, the forces of Mother Nature and the negative impacts of ill-advised maintenance activity.

Gathering relevant historical information about the location on the course, both in recent times and over the past 5-7 years (utility line trenching, soil moved over roots, cold winters, hot summers, irrigation system breakdowns) is also useful.

Some typical examples include:

- **Soil Compaction.** Compressed soil particles leave less room for oxygen and water to flow between them and be available for future root growth. Construction equipment is the most common cause of compaction. Chronic mower

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When diagnosing a troubled tree, consider these unnatural factors

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and foot traffic can also lead to long-term injury. The classic symptoms of compaction are stunted stems, usually seen in shortened internodes over time. Prevention is paramount through the redirection of traffic, extensive mulching and fencing during construction activity.

- **Slope.** Slope has the effect of preventing the infiltration of water into the root system of woody plants. A double influence occurs when the soil root zone has been compacted previously, facilitating the movement of the water downslope. Superintendents should check soil moisture content with a simple screwdriver test to determine if they need to make any adjustments.

- **Basal trunk damage a.k.a. mower blight.** String trimmer and mower injury to tree trunks is quite problematic, as this area of the tree is at a critical location for water and nutrient movement from the roots, up the trunk and into the crown. It can occur slowly with small taps and slices or with a single major force. Contrary to popular belief, both are equally injurious. Prevention is the key; placing wood chips, bark chunks or pine needles over the roots around the base of the tree (but not on the trunk) goes a long way.

- **Planting Errors.** Correcting an improperly planted tree later in life is impossible. Common errors include planting a tree too deep, digging a smaller-than-needed sized hole and mixing sand, compost or topsoil with the native soil that is backfilled over the roots. Prevent these

problems by placing the first lateral root of the root mass at or slightly above the final grade, and digging a planting hole three times the width and no deeper than the root mass.

- **Herbicide Injury.** Wind speed and proximity to the canopy are the biggest factors in herbicide injury to trees. Roots can take up certain active ingredients, such as dicamba, causing damage. Reversal of herbicide injury is usually not possible, so prevention is paramount. Good prevention methods include spraying only when wind speeds are less than 5-to-8 mph, using

- ① One symptom of soil compaction is a slowdown in growth over the years.
- ② Temperature extremes can cause significant damage to trees and shrubs.
- ③ Unfortunately, herbicides that target turf weeds can also damage trees.
- ④ Low-pH soils often tie up essential elements that some trees require to photosynthesize.
- ⑤ The forces of Mother Nature such as hail damage are typical of a general abiotic malady.

large droplets and low-pressure equipment and directing the formulation only on the target weeds through spot treating instead of the tree.



• **Temperature Extremes.** When trees experience wide variations in temperature, the leaves, needles, roots and stems dry out. The spring, when a tree forms new shoots, mid-to-late summer, when roots can desiccate, and the middle/end of winter when drying winds blow over leaves are the most critical times for injury. In summer, this injury usually appears as marginal leaf/needle browning. In winter, lifeless, brown tissue is common. Keeping soil moisture in the moist range is a good preventative step, but that only goes so far, as damage is inevitable in some years.

To get specific

The diagnosis of problems in woody plants is a two-step process — first, identify the plant, then the malady.

In addition to the general influences, certain abiotic factors tend to be associated with specific plants or groups. Also,

consider causes that the tree/shrub species are known to contract, for example:

Sunscald

Young and thin-barked trees such as birch, maple, aspen, crabapple and honey locust are historically associated with sunscald, which occurs mainly in winter when the sun warms and softens the bark. This happens on the south and west sides during the daytime and is followed by freezing temperatures at night. Splitting, cracking and exposure of the thin water/nutrient movement cambium layer to the elements results. Superintendents can prevent sunscald by installing light-colored PVC collars on the lower trunk in late winter and removing them in early spring.

Chlorosis

When planted in high pH soils, chlorosis often develops in trees that prefer low pH,

including sweetgum, river birch, pin oak and silver maple. This condition is a general term that describes the symptoms of the inability to transform nutrients from the soil into adequate carbohydrates and sugars necessary for growth. In high-pH soils, some needed elements such as iron, manganese and magnesium are tied up, making them unavailable for root uptake. Again, prevention is the best control method, avoiding planting trees with a historical issue with chlorosis. Treatments can be implemented, but in most cases are short-term fixes and should be used only for high-value trees.


Intolerance to wet soils

Trees that don't tolerate wet soils, such as trees near greens that are frequently and thoroughly watered, are often damaged by a lack of oxygen in the root zone,

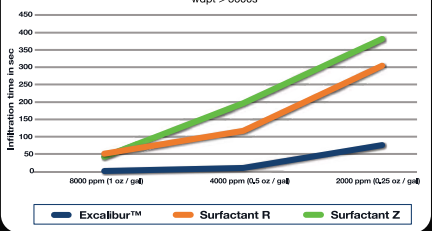
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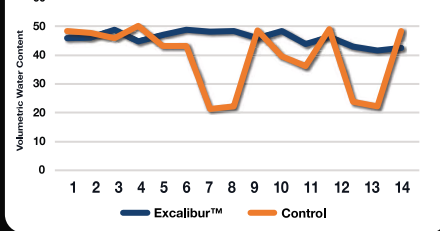
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Product	8000 ppm (1 oz / gal)	4000 ppm (0.5 oz / gal)	2000 ppm (0.25 oz / gal)
Excalibur™	~50 sec	~100 sec	~150 sec
Surfactant R	~100 sec	~200 sec	~300 sec
Surfactant Z	~150 sec	~300 sec	~400 sec

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Volumetric water content across transect
Stafford, NY - August 2022





Transect Point	Excalibur™	Control
1	~45	~45
2	~45	~45
3	~45	~45
4	~45	~45
5	~45	~45
6	~45	~45
7	~45	~20
8	~45	~20
9	~45	~45
10	~45	~45
11	~45	~45
12	~45	~20
13	~45	~20
14	~45	~45



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// IF A TREE FALLS ...

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created by the replacement of air with water. Proactive species selection at planting time is the best approach for this malady. Certain species, such as red maple, river birch, cottonwood, honey locust, dawn redwood, London planetree, swamp white oak and bald cypress are well adapted to wet soils. Intolerant species include hickory, dogwood, sassafras, red oak, bur oak, linden, black walnut, beech and buckeye.

Desiccation

Desiccation in winter of the leaves of plants such as hollies, arborvitae, yews and boxwood can cause major injury. Once damaged, these plants often do not recover. Anti-desiccant sprays have been used in the past, however, recent research by Washington State University has cast doubt on their effectiveness and documented a reduction in photosynthetic activity because of their use. Pruning and removing damaged stems as well as avoiding planting these species in windswept areas is the best solution.

Closing arguments

Comparing the appearance of these influences with biotic agents brings clarity to the diagnosis. For example, when diagnosing damage to spruce, photos in university references of known insect or fungal problems such as spruce spider mites or cytospora canker usually look different from abiotic issues.

Another aspect of the comparing technique is to consider that



① & ② Wide, not deep, planting holes lead to the development of strong lateral roots. ③ Failure to spread roots out in the planting hole leads to the development of stem girdling roots. ④ String trimmers and mowers can cause varying degrees of injury. ⑤ Sunscald destroys the all-important conductive vessels of a tree.

the symptoms of biotic agents usually are spotty or random in trees and shrubs, whereas abiotic influences are frequently found on one side of a plant or the entire plant.

Approximately 70-to-80 percent of the time, several abiotic factors or a combination of abiotic and biotic factors are causing the symptoms. Rarely is only one influence responsible for tree decline. As outlined above, taking steps to decrease abiotic stresses will allow plants to be more resilient towards biotic stresses. In most cases, well-chosen preventative steps are the key to success, rather than relying on curative treatments. ⑥

John Fech is an extension educator with the University of Nebraska-Lincoln, serving the Omaha, Neb. area. He also is an ISA Certified Arborist. You may reach John at jfech1@unl.edu for additional information on this article.

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FOCUS ON FUNGICIDES

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Segway Fungicide SC:

Best uses for a product that exemplifies more than just industry-leading Pythium control

By Brian Aynardi, Ph.D.

When speaking with superintendents about the use of fungicides for control of *Pythium* diseases, I often ask, “What is one word you would use to describe why you use



Brian Aynardi

Segway?” The precise words may vary, but the adjectives used are all similar: reliable, proven, trusted, consistent and dependable.

Others simply say, “It works.”

Perhaps the more important question is, “When and how do you use Segway?” The answer I get to this question varies widely. Some people tell me they use Segway in case of emergency, particularly when *Pythium* root disease symptoms start breaking through.

While Segway may be the best choice for a rescue application, that’s not the *best* way to use the product. And remember, a “curative” application takes time to take effect and allow infected turf to recover. The optimal time to use Segway for root diseases is in



Jim Kerns, Ph.D., stands on a green treated with Segway Fungicide SC at North Carolina State University in 2018. Areas outside of the red square were untreated.

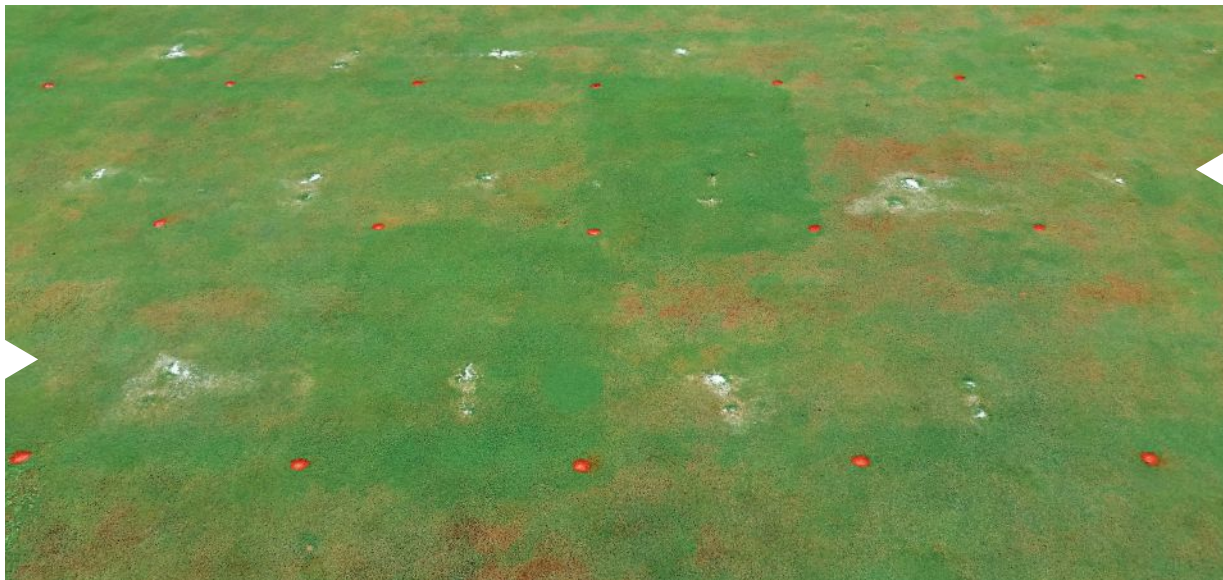
the spring when infection begins to take place on cool-season turf or fall/early spring when infection occurs on warm-season turf.

Utilization of Segway as the cornerstone of a 14-day *Pythium* root disease prevention program yielded

outstanding results, especially with rotation partners from the tetrazolyloxime or strobilurin groups. While often mentioned as part of a program, carbamate and phenylamide fungicides are not very

Continued on page FS4

FOCUS ON FUNGICIDES



A 2016 study at the University of Tennessee put Segway Fungicide SC to the test. Dark green plots seen above are Segway-treated patches of turfgrass.

Continued from page FS3

effective groups for control of *Pythium* root rot.

If you have not tried a preventive root program with multiple applications of Segway on a shorter interval (14 days) with optimal rotational partners, consider this as a better option for this season or when the upcoming EOP season comes around to prepare for the year ahead.

Another critical factor when making applications of Segway for root rot or root dysfunction is to ensure immediate post-application irrigation of at least one-eighth of an inch is applied. PBI-Gordon has done numerous research studies in conjunction with universities, and it is abundantly clear that waiting even a few hours (more than 4-6) to water-in applications yields diminished fungicide efficacy.

Pythium blight on cool-season turf requires specific environmental conditions, and preventive applications of 0.5 fl. oz./1,000 are ideal on a 14-day interval when these conditions manifest. It is critical to not wait until you see *Pythium* blight developing — by the time you treat, asymptomatic turf may already have fallen prey to infection by the pathogen.

In warm-season turf, applications of Segway are warranted when prolonged wet, humid and cloudy conditions are forecast, especially with tropical systems. The same rates and intervals apply to all types of turf for *Pythium* blight control.

What does Segway exemplify beyond leading *Pythium* control? Recall those adjectives used to describe everyone's favorite *Pythium* product: reliable, proven, trusted, consistent and dependable.

The same terms apply to the company that sells and supports Segway, PBI-Gordon Corporation. Our business and our portfolio of products are built with the turf industry in mind. So, when you buy SpeedZone EW Broadleaf Herbicide for Turf, Q4 Plus Turf Herbicide for Grassy and Broadleaf Weeds, TZone SE Broadleaf Herbicide for Tough Weeds, Trimec or any other PBI-Gordon product, you are getting a dependable and proven product from a dedicated industry partner, just like when you buy Segway.

A handwritten signature in black ink, appearing to read 'B. Aynardi'.

Brian Aynardi, Ph.D., is the Northeast research scientist for PBI-Gordon. Aynardi is a turfgrass pathologist and has conducted numerous research projects on the management and control of anthracnose, along with many other diseases. You may reach him at baynardi@pbigordon.com for more information.

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STUCK IN A FAIRY RING?



PEDIGREE IS THE WAY OUT.

The stories are true: A fairy ring can trap you forever. It comes back year after year – and it grows. **No worries: Pedigree Fungicide SC eliminates it.** The liquid formulation of an industry favorite, Pedigree also controls 10 other turf-damaging diseases, including large patch and brown patch.

Add Pedigree to Your Rotation Management Program.

The legacy and trust in the solution of Pedigree

By Brian Love

Experts share why Pedigree Fungicide is a top choice for superintendents looking to control fairy ring

Superintendents strive for perfection on their courses, especially on greens. Signs of disease pressure on greens are a worst-case scenario for turf managers from coast to coast. One disease — fairy ring — is especially pesky.

Thankfully, since the 1990s, flutolanil, the active ingredient in PBI-Gordon's Pedigree Fungicide SC, has been a one-stop-shop solution that superintendents can rely on.

"It's important to use fungicides because once fairy ring fungi enter a turf system, getting rid of them can be very difficult," says James Kerns, Ph.D., professor and extension specialist in turfgrass pathology at North Carolina State University.

"It could take a few years to successfully clean up a severe case of fairy ring. Pedigree is consistent and continues to perform well against diseases. Plus, it is a liquid formulation, which also helps."

STOPPING FAIRY RING

Mike Fidanza, Ph.D., professor of plant and soil science at Penn State University, enjoys discussing the importance of applying fungicides, such as Pedigree,

with professionals. He has spoken about fairy ring with *Golfdom* before, and is well known to share photos on his Twitter account (@MikeFidanza) with his favorite self-created hashtag, #Frisky-FairyRingFriday.

While Fidanza is known to have fun with spotting the disease, he knows it isn't a laughing matter when it comes to golf course conditions.

"Superintendents want to protect the turf," says Fidanza. "Members want to play in the most ideal conditions. Fungicides will help protect turfgrass from diseases such as fairy ring. Superintendents protecting their turf and plants are like golf courses protecting their investments."

Pedigree has been widely used for fairy ring control as both a preventive and curative basis.

Fairy ring occurs in the root zone. It is the rapid decomposition of the organic matter of the soil, forming a ring-like pattern. When this fungus breaks down organic matter, it releases nitrogen.

A visual symptom comes from the grass manifesting an obvious shade of green in the shape of a ring because of the nitrogen shortage. Another way it



Mike Fidanza



James Kerns

will show is through mushrooms. A fungus body will be sent up in the pattern.

MANAGEMENT PRACTICES

Superintendents can apply Pedigree by filling a spray tank with three-fourths of the amount of water that is needed for the application. From there, the applicator pours the specified amount of product onto the surface of the water in the tank. After the solution is agitated, the fungicide is ready for use.

Alongside fungicides usage, comes best management practices that all applicators must consider.

“When it comes to cases of fairy ring, I think that a preventive application is always going to be the best option,” says

Fidanza. “There is always going to be a challenge of sorts when applying a preventive fungicide. This ultimately depends on the nature of the disease and how it shows up on the turf.”

A preventive application is all about controlling the disease during an early curative approach. This is a time when symptoms are just starting to become evident. Making an application during this stage and watering the fungicide in helps to irrigate the material off the foliage. This allows the fungicide to make its way into the upper root zone, where the disease resides.

APPLICATION TIMING

Another measure to consider is applica-

tion timing. Is there a particular season when it is wise to incorporate fungicides into the green? How often should each application cycle be?

“For a curative approach, you should always read the label to get an understanding of the application rates, timing and instructions,” Fidanza says. “For that curative application, I like to make the first one when I first see the symptoms and visual signs that the fairy ring is growing. That first application will last 14 to 28 days, depending on the severity of which it is growing.”

Following this first application, Fidanza advises two or three additional applications to suppress the disease.

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PHOTO BY: MIKE FIDANZA

Pictured in Virginia, fairy ring is a rapid decomposition of the organic matter of the soil, forming a ring-like pattern.

Continued from page FS7

The best time to begin a preventive approach is in the cool spring months, around March or April. It's the time of year when temperatures rise and the daily soil temperature average is in the 50s to 60s. Fidanza says that temperature is an excellent signal to begin monthly intervals.

With preventive approaches, warm-season grasses can sprout, especially in southern states.

The time prior to the dry season can serve as a time to have multiple applications in areas where there could be more disease. These applications should happen in December or January so they will dry in subsequent months.

WETTING AGENTS

The third consideration is a wetting agent, which are surface-active molecules that help to reduce the tension on the surface of water. These agents depend on the chemical being used and the disease present.

"If using it for preventive applications, be sure to be on a wetting agent program," says Kerns. "Also, for fairy ring applications, it is best to water those treatments immediately after the application with an eighth inch of water."

There are many wetting agents for superintendents to choose from. Fidanza says there are over 300 different wetting agents worldwide. But he advises that, for them to have proper consideration, science and labels must back up that the product has research data behind it, along with technical support and research done on it.

"Some can have data and make claims that show how they work and why they work that aren't backed up," says Fidanza. "That doesn't make these products bad. Just ask your local sales representative for data. Talk to distributor representatives. Ask for research to back up the claims on the label and



Mike Fidanza, Ph.D., professor of plant and soil science, Penn State University, explains why Pedigree is a solution with a legacy.

proceed from there. That is always an ideal place to start."

LASTING LEGACY

The active ingredient in Pedigree is flutolanil, which has been in the solution since the 1990s. Flutolanil debuted as a wetting agent, before reformulation turned it into a trusted fungicide in liquid form.

Pedigree was one of the first fungicides with an active ingredient that directly targeted fairy ring.

Since 1947, PBI-Gordon Corp. has been a constant in the industry. The

industry relies on PBI-Gordon and products like Pedigree Fungicide SC for control of fairy ring, brown patch, large patch, red thread, yellow patch and gray snow mold.

"Pedigree has become a standard when we evaluate it to other kinds of fungicides and it has been included as an industry standard," says Fidanza. "Both in forms of commercial or experimental forms of fairy ring, it has been one of the most effective, along with being one of the oldest and most historical of its kind. With it being used since the 1990s, Pedigree has a legacy to it." **G**

PHOTO BY: MIKE FIDANZA

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A high-stakes game

By Seth Jones

At these premiere courses, achieving the best conditions is not a game of chance

Congressional Country Club

Pete Wendt, CGCS, is in his sixth season as director of golf course and grounds at legendary Congressional CC in Bethesda, Md. It's been a productive half-dozen years at the course for Wendt. The Blue Course underwent an Andrew Green-led renovation from 2019 through 2021 and as a payoff, hosted the 2022 KPMG Women's PGA Championship.



Pete Wendt

This is Wendt's second stint at the famed course, though the stakes were lower — for him, at least — when he was an intern at the club under the watchful eye of Paul Latshaw, a year when the course hosted the 1995 U.S. Senior Open.

A native of the suburbs of Toronto, Wendt admits it's a little surreal to have one of the most prestigious clubs in the world as his office.

"When you see the biggest clubhouse in North America, with the white stucco and the red barrel tile roof and then you get out on the amazing storied property, it is pretty cool," he says.

A self-proclaimed ski bum, Wendt

was working in Whistler, British Columbia for two seasons when a golf boom hit the area. He paid some dues on the crew at Chateau Whistler GC and then worked construction at Nicklaus North when the general manager at Chateau Whistler suggested he look into getting into the business for good and enroll at Penn State.

After the internship at Congressional, Wendt worked as an assistant for Glenn Smickley at Robert Trent Jones Golf Club in Gainesville, Va., then in construction again to build Kinloch Golf Club in Manakin-Sabot, Va. He stayed at Kinloch for almost 15 years before heading back to the D.C. area, to take the director's position at Woodmont CC, a 36-hole facility in Rockville, Md.

In 2018, he ended up back at Congressional CC — where it all started, and also where he met his wife. Calling that internship formative would be an understatement.

"I worked at a country club every summer through high school and college, but I really thought I'd get into the banking world — I thought I'd be an investment banker," Wendt says. "During my time in Whistler after college, I was lucky to have a GM at the time who said, 'Hey, you know ... you really seem to like this.'"

POWER PLAYERS

The important golf that Congressional



The 140,000 square foot clubhouse at Congressional CC is the largest in the United States, with three swimming pools, 20 rooms for overnight guests and a bowling alley.

has hosted is undeniable. Its location near the nation's capital makes it easy to imagine the business deals orchestrated on the back nine among politicians and power players. The course also boasts five majors — three U.S. Opens, a PGA Championship and the U.S. Senior Open.

The PGA of America committed to the course in 2018 when it awarded it the 2022 and 2027 Women's PGA Championships, the 2025 and 2033 Senior PGA Championships, the 2029 PGA Professional Championship and the 2024 Junior PGA, along with the 2030 PGA Championship and the 2037 Ryder Cup.

But just because a place is important doesn't mean it's invulnerable.

"We get city-dome heat in the summertime. We're right off the I-495 Beltway. I feel like that even contributes to the heat, the amount of traffic we have

down here," Wendt says. "We get your typical transition zone hot, humid summers. You get up in the morning, look outside and your windows are all fogged up. You're thinking, 'here we go again.'"

Wendt and his team at Congressional rely on Segway Fungicide SC to keep the course *Pythium*-free. He says he's been using it since it came on the market.

"It's a trusted partner through the summer months, keeping all our cool season surfaces in great shape," Wendt says. "We've got a great plant protection program and with Segway in the mix, it really helps out. Here in the D.C. area, we're in the transition zone. We have to be on a strong program to make sure we don't see (*Pythium*)."

ON THE CLOCK

The expectations are clearly high at a place like Congressional. A lot of guest

play comes to the course. People in town with business in D.C. want to play at the storied U.S. Open venue.

But some of the pressure is also self-inflicted.

"There's a tremendous amount of pressure. But I think we (superintendents) put a lot of that pressure on ourselves," Wendt says. "I think all superintendents put more pressure on themselves than the membership does. We have a really good team of bright young guys who keep me in check. They do a phenomenal job."

Now on the clock for the 2025 Senior PGA, Wendt looks back at his years in the industry and acknowledges that this might be better than banking.

His good friend Curtis Tyrrell, CGCS, MG, introduced him to his wife Cindy all those years ago. Their daughter Clau-

Continued on page FS12

Continued from page FS11

dia graduated from the University of Maryland and now works in New York City as a consultant for Ernst & Young. Their son Hunter is a junior at the University of Tennessee, studying business and about to embark on a 10-day international business class in London.

Not bad for a former ski bum in Whistler, working to pay for his ski pass. Turns out that GM gave him some pretty good advice.

"I need to find that guy and thank him," Wendt laughs.

Arcola Country Club

Arcola Country Club in Paramus, N.J., is well known for its exceptional playing

conditions. The membership wants the course to be challenging. More than 100 members are single-digit handicaps.

Their superintendent, a born-and-raised New Jersey native, also is quite the player. Today, Paul Dotti says he doesn't post enough scores to play the game he used to, but he can relate to the attitude of his membership.

"They're not worried about color here," he says. "They're not worried about green and lush. They want firm and fast."

PUSHING THE ENVELOPE

Dotti always loved golf, but he never planned to be the person in charge of maintaining a course. He originally planned to get into television.

He worked for Pay-Per-View and got a degree in communications from Rutgers. But the different courses he'd play — and the subtle difference in conditioning from one course to another — piqued his interest.

"I would play golf during the days, and I got to the age where I told myself, now is the time to make the change," Dotti recalls. "I enrolled in the Rutgers short course. Then I started my career at Edgewood CC (River Vale, N.J.) and worked my way up to superintendent."

Dotti worked for 20 years at Edgewood and is now in his 13th season at Arcola. At both courses, management empowered Dotti to push the envelope to exceptional, he says. At Arcola, the membership appreciates that to have



At Congressional CC in Bethesda, Md., Director of Golf Course and Grounds Pete Wendt, CGCS, relies on products like Segway SC Fungicide to keep his course *Pythium*-free.

PHOTO BY: JAMES LEWIS

exceptional conditions, he needs the right tools at his disposal.

"We have our spells of humidity. We've had summers where, for weeks on end, we have humidity," Dotti says. "July and August are when you really can't let your guard down. You don't push chemicals past their disease rate coverage."



Paul Dotti

Arcola has *Poa annua* greens and fairways. *Poa* makes for a great putting surface, Dotti says, but you've got to stay on top of them.

"It's hard to talk about green speeds, but last year we averaged 14.01," Dotti says. "We can keep them up there pretty good. The members expect them to be fast every day. They're also educated to know that if the weather isn't conducive, they aren't going to be that fast."

SET FOR THE SEASON

Pressure from *Pythium* was a constant worry in the past, Dotti says. With products he used in the past, he's 'had issues,' he says, including one that created an unpleasant odor for anyone nearby.

"If you're seeing any kind of foliar *Pythium* if the weather is conducive, it can spread pretty fast and you can lose a lot of turf," Dotti says. "We had our issues, but we feel like now, with Segway, we really have a go-to product that's going to allow us to sleep at night."

Dotti makes an application for *Pythium* root rot in late April, then waits to see what conditions are like. He typically makes his second in late May.

"That really sets us up for the rest of the season," Dotti says. "We have pretty good control the rest of the way. If we have to, we'll make another one near our big member/guest (event) in early June. And then we're definitely good for

the year as far as *Pythium* is concerned."

The club underwent an in-house renovation in 2011, but recently hired Andy Staples, ASGCA, of Staples Golf, to keep the course moving forward. Dotti says everyone at the club is excited to see what Staples will bring to the player-focused course. Maybe it will even get him out to play more.

"I probably play to about a 10 now," Dotti says. "It's fewer and farther between my rounds these days. But we're pretty excited to see where Andy takes us for the next 20 years."

Piedmont Driving Club

Georgia is home to some of golf's most recognizable venues. Some are well known, while others make an effort to remain ... unknown.

Atlanta's Piedmont Driving Club — the name derived from the days when members used to drive their horses and buggies to the club — prefers to be in the latter category. To see the course firsthand requires either a fortuitous invitation or a well-timed flight into nearby Hartsfield-Jackson Airport and good eyesight.

"It's extremely private, a hidden gem in Atlanta," says Scott Slemple, director of grounds. "We're doing a lot of things to keep our foot on the throttle. We're pleased with the 'never satisfied' mentality. We're not looking for good, or great. We're looking for legendary."

A 90-DAY WAR

Slemple has been in the industry for more than 30 years. He spent most of his career in the Atlanta area; 11 years at Pinetree CC, four years at Atlanta National and four years at Champions Retreat GC.

He's entering his fourth year at Piedmont and enjoys maintaining the Rees Jones design that features bentgrass

greens, primarily bermudagrass playing surfaces throughout and some Zoysia in the mix.

At 24 years old, the course is about to break ground on a \$7 million teaching facility. There are also plans for a new maintenance complex and a major re-grassing of the course. Slemple and his team are looking into new varieties now.


While eyeing that project, he also focuses on the task at hand — keeping the course healthy through the hot summer months.

"Disease pressure in Atlanta on bentgrass is high ... we call it the 90-day war, or the 120-day war," Slemple says. "Late July and August are when the pressure is at its worst, that's when your *Pythiums* are really gnawing at your feet every single day. These old greens have quite a bit of material that has built up over the years. They stay moist and we have to fight those conditions."

Slemple uses fans to help keep airflow on the greens during the summer months. He also relies heavily on his fungicide program.

"I've been using Segway throughout my career, it's the backbone of my defense," Slemple says. "It's a great product. You can visibly see results when the course is under duress, in the next few hours, after it's applied. It's a vital part of my program. I can sleep better because of it."

The summer months can be stressful, Slemple adds. Just like any job, some days can be difficult. But he also adds there's nothing else he'd rather do.

"For me, it's never been a job," Slemple says. "I've always enjoyed tinkering outside. I'm always so excited when I come down here. I think of all the jobs I've had in my career, and I just have a passion for being a superintendent. I try to surround myself with people who are also passionate about it. If we chose to tee it up, we'd be proud to say this is our golf course." 

Class is in session

By Seth Jones

James Kerns, Ph.D. wraps up the Spring 2023 semester with a lesson on sprayers

Now wrapping up his 15th year as a professor of turfgrass pathology, James (Jim) Kerns, Ph.D., is seeing a promising trend: more of his students are pursuing a career in golf.

“Everyone in the industry knows we were pretty low (on students pursuing golf maintenance careers) five or six years ago,” Kerns says. “I give N.C. State credit for giving students different avenues to get involved in the turf program. Most of our students five to seven years ago were not interested in golf. In this year’s class, we have 18 students and all but two of them are interested in pursuing a career in golf.”

Kerns started his teaching career at the University of Wisconsin-Madison in 2008. Since 2012, he has been at North Carolina State University, focusing on etiology, epidemiology and management of diseases in both warm- and cool-season grasses.

Kerns just wrapped up his final class — Insects, Diseases and Weeds — co-taught with Fred Yelverton, Ph.D. and Terri Billeisen, Ph.D., when he took the time to deliver one more lesson to his friends at *Golfdom*, on the topic of best practices when working with sprayers.

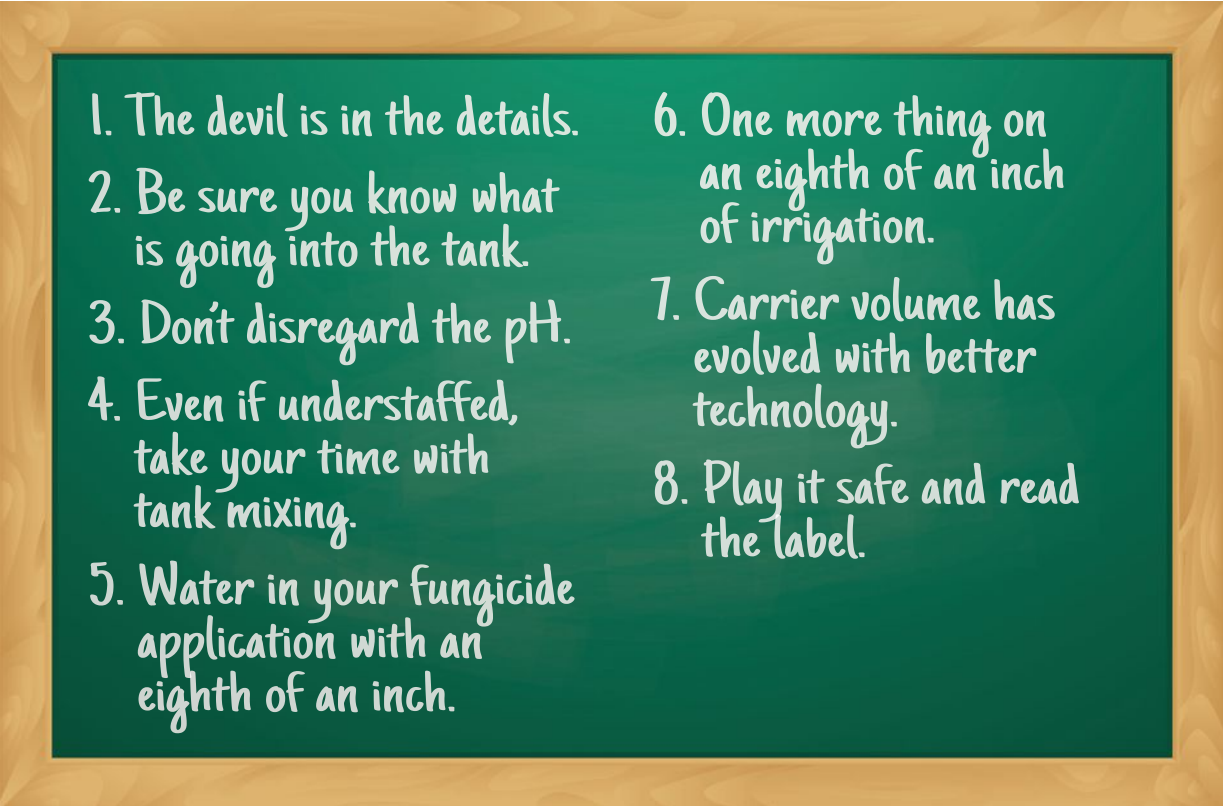
1 The devil is in the details. “People just assume that sprayers come ready to go, and that is not the case,” Kerns says. “You may need to change the nozzles to make sure the sprayer is

doing what you want it to do. Write it down: sprayer No. 9 can cover 5.7 acres with 300 gallons. Make sure you know exactly what the sprayer delivers to prevent unforced errors.”

2 Be sure you know what is going into the tank. “If I were a superintendent that had any products that were injurious, I would keep those locked up,” Kerns says. “I’ve seen it happen numerous times; someone grabs a plant growth regulator and sprays it at a rate of a fungicide. Those rates are way too high for a growth regulator. I haven’t seen turf die from this, but those plants are going to be regulated for six to eight weeks. Some of these labels look really similar, from a herbicide to a fungicide. It makes perfect sense to someone who is well trained, but the day-to-day laborer could easily make a mistake if they were in a hurry.”

3 Don’t disregard the pH. “I still see a lot of people assume they know the pH of their water,” Kerns says. “Research has been done to show that the spray tank pH doesn’t necessarily affect foliar disease control ... I still wonder if it would affect soilborne disease control because we’re not getting much of that product down to where it needs to be. Know what your spray water is going into the tank.”

4 Even if understaffed, take your time with tank mixing. “It’s a struggle. You’re trying to be efficient, but you put too many things in the tank and now it’s

- 
1. The devil is in the details.
 2. Be sure you know what is going into the tank.
 3. Don't disregard the pH.
 4. Even if understaffed, take your time with tank mixing.
 5. Water in your fungicide application with an eighth of an inch.
 6. One more thing on an eighth of an inch of irrigation.
 7. Carrier volume has evolved with better technology.
 8. Play it safe and read the label.

solidified. If you haven't made a mixture before, do it in a small jar beforehand to make sure there's chemical compatibility. If a tank solidifies, you've lost its contents, but also a day, two days, maybe even a week."

5 Water in your fungicide application with an eighth of an inch. "We've seen this from Rounds 4 Research, the USGA and other supporting research: pathogens affect the roots," Kerns says. "With things like summer patch, take all root rot, nematodes, fairy ring ... we know the fungicides don't readily move through the soil profile. Unfortunately, fungicides also aren't translocated down in the roots. We have to physically move them into that zone of influence. We have been saying this for years now: targeting these soilborne diseases, you get much better control with post-application irrigation of an eighth of an inch immediately after the application.

There may be a group out there that is resistant to post-application irrigation because they're programmed to think the fungicide is going to leach too far. There is nothing in any literature that supports that. Fungicides are huge molecules, and they stick."

6 One more thing on an eighth of an inch of irrigation. "That is the magic number in our studies," Kerns says. "We looked at it up to an inch of irrigation, and there was no difference between an eighth of an inch and an inch of irrigation — that is actually a good story right there."

7 Carrier volume has evolved with better technology. "Carrier volume is basically the amount of water you add in to deliver the pesticide. For many years, dating back to Houston Couch (Ph.D.), we always stressed getting to two gallons per thousand sq. ft., or 88 gallons to the acre. These systems have evolved

— we have better spray equipment, better irrigation and better nozzles. The research isn't supporting that you need to be at two gallons to get good control. What we have seen in our own work and many of my colleagues — Mike Fidanza (Ph.D.), John Kaminski (Ph.D.), Megan Kennelly (Ph.D.) — we see as good of control, in some cases slightly better at a gallon versus two gallons."

8 Play it safe and read the label. "The beautiful thing about most turf pesticides is what they mostly ask is to cover your hands, arms, legs and eyes," Kerns says. "There are only one or two products where a respirator is required. But the biggest risk is to the golf maintenance employee, not the golfer. Protect your skin — dermal absorption is a way to be exposed to a pesticide. But the first thing is to be familiar with what is on the label, the label provides guidance on what you should be wearing." **G**

What if a Pythium Product Did More?



Union® Fungicide SC:

Dual mode-of-action control of all Pythium diseases and 17 other diseases in a single product.

Union® Eliminates:

- All Pythium Diseases
- Brown Patch
- Summer Patch
- 15 More Turf Diseases

+Plus

Union also eliminates the time and labor needed to tank mix fungicides.



Super Science

// WATER WARS

WHAT'S THE BEST WAY TO SCHEDULE IRRIGATION?

By Mike Kenna, Ph.D.

Researchers at California State Polytechnic University, Pomona (Cal Poly), compared different irrigation scheduling methods.

The research, on hybrid bermudagrass, maintained as a golf course fairway, compared soil moisture sensors from Toro (Turf Guard Soil Monitoring System), Rain Bird (Integrated Sensor System), and Tucor Inc. (Soil Moisture Monitoring) with an evapotranspiration-based (ET-based) schedule.

The goal was to determine potential water savings between a soil moisture sensor and ET-based irrigation scheduling. The experiment results demonstrated that soil moisture sensors effectively reduced overall water consumption at golf course fairway settings while maintaining an excellent hybrid bermudagrass fairway.


When soil moisture sensors maintained gravimetric water content at or above 15 percent, the resulting turfgrass quality consistently received visual color, quality, and density ratings of minimally acceptable levels or above. These results suggest optimal turfgrass growth is possible under irrigation regimes based on in-ground SMS readings.

Higher volumetric water content in ET plots resulted in slightly better overall turfgrass growth and performance based on both clipping yields and turfgrass visual ratings.

Moisture sensor technology effectively reduces water consumption by roughly 30 to 50 percent of ET while maintaining acceptable turfgrass conditions.

Overall water savings vary from season to season. Water savings between treatments were most substantial in the hot summer season. The contrast in water savings between ET-based irrigation and soil moisture sensor scheduling was far less dramatic during the cooler fall seasons.

The results show that moisture sensor technology reduces water more effectively than ET-based irrigation scheduling. Soil moisture sensors were most effective at reducing overall water usage during the hot summer when water demand was highest.

Soil moisture sensor technology may prove a more helpful tool for golf course superintendents in the southwestern U.S. in reducing overall water consumption on larger golf course fairway areas while still maintaining a quality turfgrass stand. 



Wireless soil moisture sensors installed in golf course fairways or putting greens can help conserve irrigation water.

NEWS UPDATES

QUALI-PRO ADDS KERR AS TECHNICAL SERVICES MANAGER

Quali-Pro recently added Bobby Kerr, Ph.D., as technical services manager. Kerr has more than 20 years of experience in the turf and ornamental industry, with an emphasis on golf turf.



Bobby Kerr

Kerr is originally from Scotland and completed his Ph.D. in weed sciences at Clemson University with a focus on goosegrass biology and control and a master's degree from the University of Guelph in Ontario, Canada, where he studied plant physiology.

In his previous endeavors, Kerr designed, implemented and summarized field studies on turf and ornamentals for a large pesticide manufacturer.

MANY TURFGRASS PLANT CHARACTERISTICS ARE RELATED TO CULTURE AND MAINTENANCE PRACTICES. THE RELATIONSHIP BETWEEN THESE PLANT CHARACTERISTICS AND TURFGRASS EVAPOTRANSPIRATION WERE DETERMINED UNDER NONLIMITING SOIL MOISTURE USING WEIGHING LYSIMETERS."

Ross Braun, Ph.D., Dale Bremer, Ph.D., Scott Ebdon, Ph.D., Jack Fry, Ph.D., and Aaron Patton, Ph.D.

(see story on page 36)

//SOAK IT UP

Breaking down the research on cool-season turfgrass water use and needs

By Ross Braun, Ph.D., Dale Bremer, Ph.D., Scott Ebdon, Ph.D., Jack Fry, Ph.D., and Aaron Patton, Ph.D.

Knowledge of drought resistance for cool-season turfgrasses is necessary because drought stress can occur wherever they grow, even in humid regions with wet climates. We provide a short review of water use and requirements of *Agrostis* species compared to other cool-season turfgrasses. This article is a small part of a much larger two-part companion review of cool-season turfgrass water use and needs.

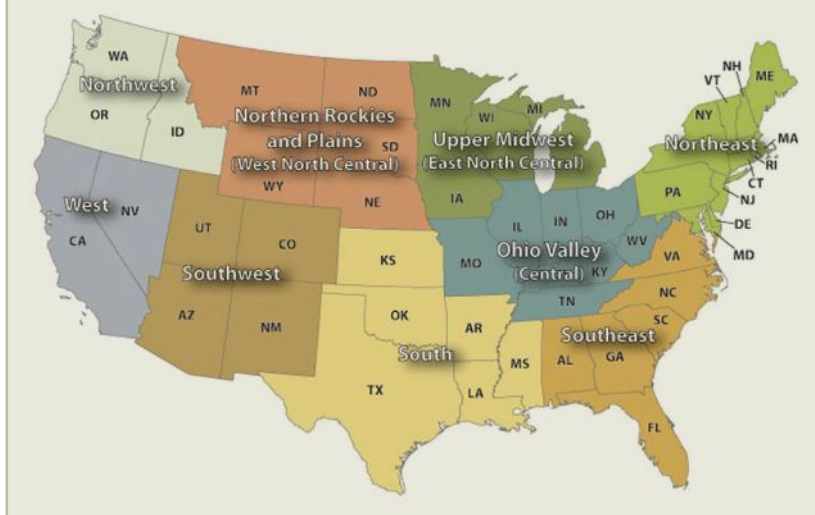
The history of early water conservation and quantification methods in turfgrass began in the mid-1930s. We summarize research results since 1980 on cool-season turfgrass evapotranspiration (ET) and deficit irrigation and provide an outlook to identify knowledge gaps and future research needs.

Several authors reviewed turfgrass water conservation, quality, use, requirements, ET measurement techniques and irrigation technology (21, 22, 24 and 28). More recently, researchers reviewed warm-season grasses (C4) for ET, deficit irrigation and drought resistance (10).

Following the advent of ET calculations and an improved understanding of cool-season turfgrass ET, the development of a deficit irrigation strategy became the next key area of water conservation research. Water deficit, in simple terms, occurs when plant

FIGURE 1

Nine climatic regions of the contiguous United States (Karl and Koss, 1984). Map retrieved from <https://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php>



transpiration exceeds absorption (26).

Building on the use of ET, turfgrass scientists explored deficit irrigation in the 1980s to conserve water without compromising turf quality and the ecosystem services that the turf provides (15). Deficit irrigation provides the turf with water amounts less than evapotranspiration (17).

The improved understanding of plant water loss from climatic factors and the development of water conservation strategies provided the building

blocks for modern research focused on new genetics, technology, strategies and management techniques for improved cool-season turfgrass irrigation efficiency.

EVAPOTRANSPIRATION

Daily evapotranspiration (ET_c) by turfgrass is typically measured using weighing lysimeters under nonlimiting soil moisture. Turf ET_c can then be used to derive crop coefficients (K_c) by dividing the plant's ET (ET_c) by reference evapotranspiration (ET_o) derived from aerodynamic models (i.e., Penman-based equations) using climatic data (relative humidity, air temperature, wind speed, solar radiation) collected from nearby weather stations. Computed K_c values developed under well-watered conditions can then adjust reference ET_o predictions to match the turf's ET_c.

We used several peer-reviewed studies to summarize the turf ET_c or K_c of cool-season turfgrass species, where ET was measured principally using weighing lysimeters under well-watered conditions.

Continued on page 38

TABLE 1

Daily *Agrostis* species evapotranspiration rates (Etc, mm per day) measured under nonlimiting soil moisture, height of cut (HOC), reference ET model (ET₀), crop coefficient (K_c), the season of ET measurement, location and associated references from published *Agrostis* species experiments. Turfgrass Etc measured using weighing lysimeters unless otherwise noted.

<i>Agrostis</i> spp.- cultivars	HOC cm	Etc mm d ⁻¹	ET ₀ Model	K _c	Season /Month	Location (climate classification) ^b	Reference
Creeping bentgrass							
10 cultivars	1.25	3.2 - 10.7	Modified Penman	0.73 - 1.11	May-Oct.	NE (Dfa)	34
Independence	0.3 - 0.5	—	FAO 56 PM	0.76	May-Aug.	Norway (Cfb)	1
L-93	0.95	4.8 - 6.3	—	—	July-Sept.	NJ (Cfa)	11
Memorial	0.31 - 0.94	4.11	FAO 56 PM	0.97	July-Aug.	MA (Dfa)	32
Pennicross	5	10.1	—	—	Chamber, 22 °C	—	19
Pennicross	0.9	3.1 - 5.8	—	—	Greenhouse	Germany	27
Providence	0.5	3.1 - 5.2	FAO 56 PM	0.98	July-Aug.	MN (Dfa)	35
Providence	0.9	3.1 - 5.7	—	—	Greenhouse	Germany	27
Pennicross, Emerald	0.6 - 1.2	4.1 - 4.9	—	—	June-Aug.	CO (BSk)	17
Colonial bentgrass							
Cezanne	0.3 - 0.5	—	FAO 56 PM	0.82	May-Aug.	Norway (Cfb)	1
Tiger 2	0.95	5.1 - 6.9	—	—	July-Sept.	NJ (Cfa)	11
Velvet bentgrass							
Legendary	0.3 - 0.5	—	FAO 56 PM	0.8	May-Aug.	Norway (Cfb)	1
Greenwich	0.95	4.5 - 6.0	—	—	July-Sept.	NJ (Cfa)	11
Summary (lysimeter data)		Etc avg. (CV)%^c mm d⁻¹		K_c avg.^d	Climate classification^b	US regions^e	Total studies (lysimeter studies)
<i>Agrostis</i> species	—	6.12 (19.0)		0.94	BSk, Cfa, Cfb, Dfa	ENC, NE, WNC, SW	8 (7)
<i>Festuca</i> (fine) species	—	5.52 (16.8)		0.85	BSk, Cfa, Cfb, Csa,	NE, SW, W	7 (6)
<i>Festuca</i> (tall) species	—	7.79 (14.5)		0.95	BSk, Cfa, Csa, Dfa	ENC, S, SE, SW, W, WNC	13 (10)
<i>Lolium</i> species	-	5.90 (19.9)		0.92	BSk, Cfa, Cfb, Csa, Dfa,	ENC, NE, SW, W, WNC	8 (8)
<i>Poa</i> species	—	5.35 (30.2)		0.91	BSk, Cfa, Cfb, Csa, Dfa,	ENC, NE, S, SW, W,	17 (14)
All turfgrass species ^f	—	6.25 (26.9)		0.91		7 U.S. regions	29 (24)

^a 5 mm d⁻¹ = 0.2 inches per day¹

^b From the Köppen-Geiger climate map (Figure 2).

^c Weighted (based on the number of entries for each study) average Etc and weighted coefficient of variation (CV) for each turfgrass species evaluated in field and greenhouse experiments using lysimeters.

^d Weighted (based on the number of entries for each study) average K_c for each turfgrass species evaluated in field experiments using lysimeters.

^e Nine climatic regions of the contiguous United States (Figure 1).

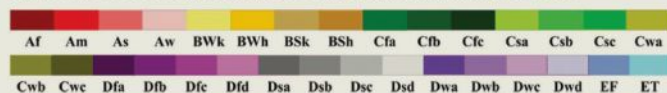
^f Weighted (based on the number of entries for each species) average Etc and K_c across all turfgrass species evaluated in experiments using lysimeters.

FIGURE 2

Köppen-Geiger climate classification map of the United States (Kottek et al., 2006; Rubel et al., 2017). Map retrieved from <http://koeppen-geiger.vu-wien.ac.at/>

US Map of Köppen-Geiger Climate Classification

updated with CRU TS 2.1 temperature and VASCLIM v1.1 precipitation data 1951 to 2000



Main climates

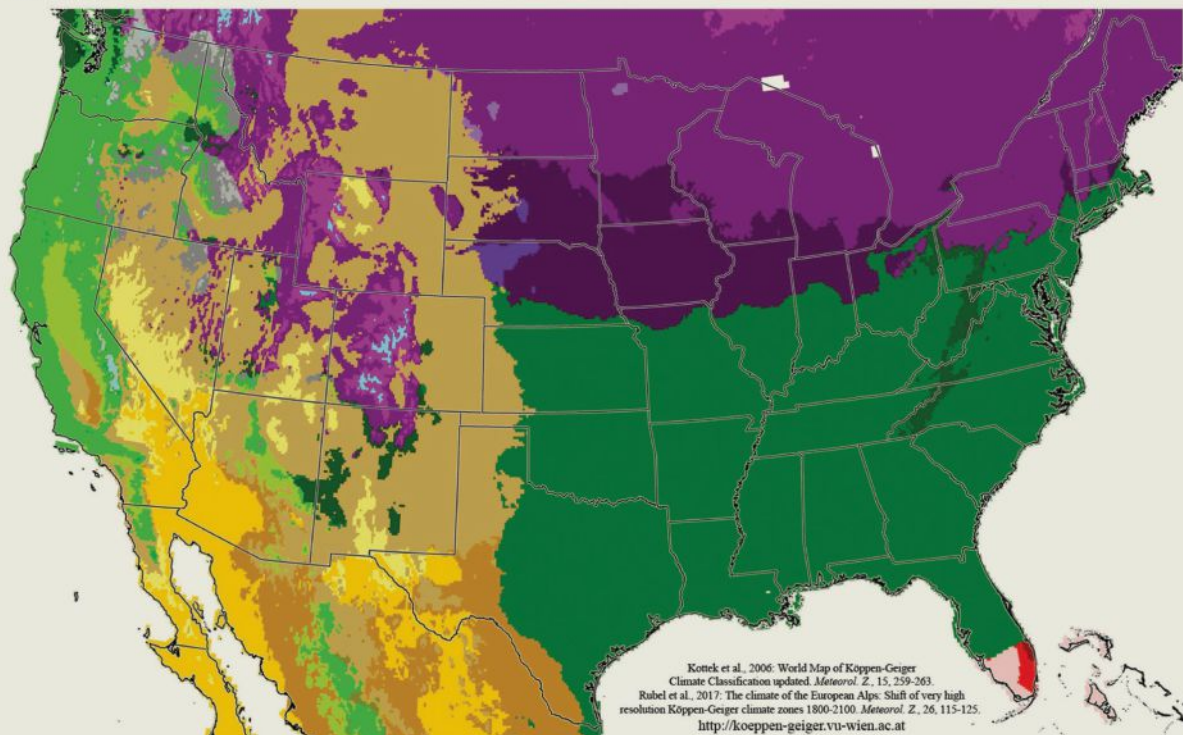
A: equatorial
B: arid
C: warm temperate
D: snow
E: polar

Precipitation

W: desert
S: steppe
f: fully humid
s: summer dry
w: winter dry
m: monsoonal

Temperature

h: hot arid
k: cold arid
a: hot summer
b: warm summer
c: cool summer
d: extremely continental
F: polar
T: polar



Kottek et al., 2006: World Map of Köppen-Geiger Climate Classification updated. *Meteorol. Z.* 15, 259-263.
Rubel et al., 2017: The climate of the European Alps: Shift of very high resolution Köppen-Geiger climate zones 1800-2100. *Meteorol. Z.* 26, 115-125.
<http://koeppen-geiger.vu-wien.ac.at>

Continued from page 36

As such, Kc values need to be adjusted (calibrated) to local conditions because Kc values may not extend to other climatic regions or sites. Moreover, different reference ETo equations are also known to vary in their estimate of ETo and are known to deviate from lysimeter-measured ETc even when evaluated under similar climatic environments (6, 18, 30, 37, 38).

Furthermore, reliable ET estimates using appropriate Kc values calculated as ETo × Kc are then used to adjust (replace) only a portion or fraction of the calculated ET of the turf using deficit irrigation replacement levels to promote additional water-saving measures without compromising turf quality and

function (summarized in Table 2).

We used several peer-reviewed studies to summarize the turf ETc or Kc of cool-season turfgrass species, where ET was measured principally using weighing lysimeters under well-watered conditions. The height of cut (HOC) varied from 0.3 to 10.5 cm (0.180 to 4.0 inches, e.g., golf course putting green and golf course fairway turf to lawn turf). It included seven of the nine climatic regions of the contiguous United States (20) and two international sites (Germany and Norway) where cool-season turfgrasses are grown (Figure 1).

Accompanying the classified climatic regions of the United States (Figure 1) are the Köppen-Geiger

climate classification types and descriptions (Figure 2) (25, 33). The majority of the reported research on turf ET arose from field studies. In contrast, three studies were conducted in growth chambers (19) and another five experiments in greenhouse conditions (5, 27).

All studies measured ETc of mature turf, with only one of the 29 studies reporting turf ETc and Kc values using lysimeters measured during the establishment stages of turf (31). Researchers conducted field studies to measure turf ETc and Kc values during the principal periods of irrigation ranging from one to several months over two or more years or seasons.

BENTGRASS VS. OTHER COOL-SEASON TURFGRASSES

Researchers evaluated of ETc and Kc of bentgrass species (*Agrostis* L. spp.), including creeping bentgrass (*Agrostis stolonifera* L.), colonial bentgrass (*Agrostis capillaris* L.) and velvet bentgrass (*Agrostis canina* L.) in eight studies (Table 1) across four of the nine climatic regions of the United States (Figure 1: East North Central, Northeast, West North Central, Southwest;) and an international site (Norway).

The overall ETc average *Agrostis* species of 6.12 mm d^{-1} is 4 to 13 percent higher than *Poa* spp. (including Kentucky bluegrass), fine fescue (*Festuca* L. spp.) and perennial ryegrass (*Lolium perenne* L.) species averages of 5.35 to 5.90 mm d^{-1} (0.21 to 0.23 inches per day, Table 1).

Except for one study (19), in which researchers did not factor into the weighted average, most studies maintained *Agrostis* species to approximately 1.0 cm height of cut (0.394-inch HOC) and lower with an average HOC of 0.7 cm (≈ 0.276 inches HOC), typical of golf course putting green and fairway turf. For six of the seven published studies on *Agrostis* water use, *Agrostis* evaluations were for a single cultivar of creeping bentgrass (L-93, Memorial, Penncross, or Providence), colonial bentgrass (Cezanne or Tiger 2) and velvet bentgrass (Greenwich or Legendary).

In one of the seven field experiments with 10 cultivars of creeping bentgrass, researchers observed a greater than threefold differential in ETc (3.2 to 10.7 mm d^{-1}) in the growing season, with a significant range observed in Kc of 0.73 to 1.11 (34). Researchers observed considerable variation (19 percent) in field studies for this species (Table 1).

There have been very few to no experiments published on ETc and Kc of bentgrass species in the East North Central, Central and West North Central climatic regions of the United States, where this species is common on golf courses.

Additional research is needed to evaluate ETc and Kc of *Agrostis* species to include greater numbers of cultivars in testing conducted at almost all of the climatic regions of the United States where *Agrostis* species are adapted.

MEASUREMENTS

There are different reference ETo models to calculate Kc, including modified Penman (13) and FAO 56 PM (2). In the 1980s, researchers compared Pan E with the modified Penman ETo in calculating Kc (3,9).

Under the same climatic conditions in the cool-humid Northeast region (New England), the Aronson et al. study of three major cool-season turfgrass species reported 11 percent higher Kc using Pan E than the modified Penman ETo (3). Pan E produces a disproportionately lower reference ETo than the modified Penman reference ETo when calculating Kc values.

In the warm-humid Southeast region, Kc values for tall fescue between Pan E and modified Penman reference ETo

Continued on page 41



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TABLE 2

Minimum deficit irrigation replacement levels (DRL) for acceptable turf quality and associated reference ET mode (ET_o), irrigation interval, crop coefficient (K_c), the season of measurement, location and cited references from published *Agrostis* species experiments. We calculated DRL using deficit levels to adjust reference E_{to} (following adjustment using K_c) or deficit irrigation level to adjust turf ET_c measured using weighing lysimeters.

<i>Agrostis</i> spp.- cultivars	DRL ^a percent	Irrigation Interval (d)	ET _o Model	K _c ET _c /ET _o	Season/Month	Location (climate classification) ^b	References
Creeping bentgrass							
Three-way blend	39 – 62	3.3 – 3.7	Modified Penman	–	July–Aug.	OR (Csb)	4
L-93	60 – 80	3 times/wk	Lysimeters	NAC	July–Nov.	NJ (Cfa)	12
L-93	70	Every 5 days	Lysimeters	NA	Greenhouse	VA	16
Providence	80	Daily	FAO 56 PM	1.0	July–Aug.	MN (Dfa)	35
Colonial bentgrass							
Three-way blend	47 – 68	2.9–3.1	Modified Penman	–	July–Aug.	OR (Csb)	4
Tiger 2	80 – 100	3 times/wk	Lysimeters	NA	July–Nov.	NJ (Cfa)	12
Velvet bentgrass							
Three-way blend	42 – 55	3.1 – 3.6	Modified Penman	–	July–Aug.	OR (Csb)	4
Greenwich	60 – 80	3 times/wk	Lysimeters	NA	July–Nov.	NJ (Cfa)	12
Summary	DRL avg.^e percent				Climate classifications^b	US regions^d	Studies (no.)
<i>Agrostis</i> species	67.2	–	–	–	Cfa, Csb, Dfa	ENC, NE, NW	4
<i>Festuca</i> (fine) species	74.0	–	–	–	BSk, Csb,	NW, SW	2
<i>Festuca</i> (tall) species	58.7	–	–	–	BSk, Cfa, Csa, Csb	NW, S, SW, W	10
<i>Lolium</i> species	59.0	–	–	–	BSk, Csb	NW, W	2
<i>Poa</i> species	74.0	–	–	–	BSk, Cfa, Csa, Csb	NW, S, SW, W	10
All turfgrass species ^e	66.7	–	–	–	–	6 U.S. regions	17

^a Deficit irrigation replacement level (DRL) relative to 100 percent ET replacement.

^b From Köppen-Geiger climate map (Figure 2).

^c Not applicable.

^d Nine climatic regions of the contiguous United States (Figure 1).

^e Weighted average within each species and across all turfgrass species.

Continued from page 39

were similar. In the arid Southwest, the modified Penman reference ETo generated 10 to 25 percent higher ETo than FAO 56 PM ETo (7, 8).

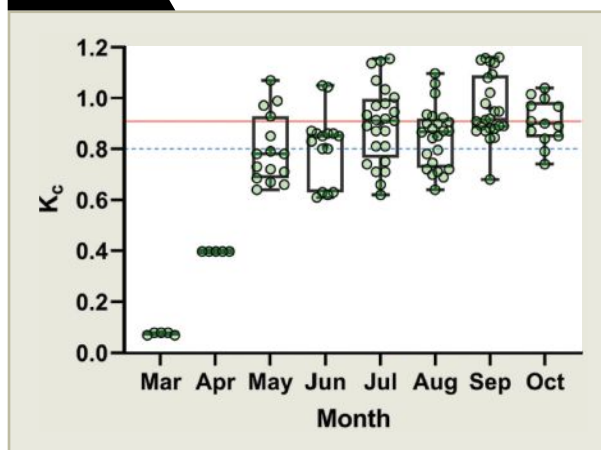
Based on these results, researchers recommend using the FAO 56 PM in future water use studies to reduce confusion in developing appropriate Kc for turf use. Additional research in Kansas demonstrated the original Penman reference ETo (29) overestimated cumulative lysimeter ET by as much as 38 percent compared with only 1.5 percent when using FAO 56 PM reference ETo (6).

Crop coefficients vary with time (seasons) to accommodate the growing turf and mowing height, ground cover and growth stage. However, studies from the cool-humid regions of the Northeast and East North Central United States recommend one Kc (0.80 to 1.0) for all irrigation months (3, 32, 35).

Published research on Kc averaged by species ranged from 0.85 (fine fescues) to Kc averages approaching 1.0 [*Agrostis* species (0.94) and tall fescue (0.95)] with *Lolium* and *Poa* species having intermediate Kc values of 0.91 to 0.92 (Table 1).

Continued on page 42

FIGURE 3



A box and whisker plot with jittered data points, maximum, minimum, median and mean (+) monthly crop coefficients (Kc) across all cool-season turfgrass species from field experiment data from Table 1. The boxes represent the data between the lower and upper quartiles. The red line indicates the mean Kc (0.91) weighted average across the growing season months of May through October. The blue dashed line at 0.8 represents the general Kc recommendation for cool-season turfgrass species during a growing season.

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Continued from page 41

Figure 3 summarizes the 29 field experiments for Kc. The blue line represents the past general recommendation of a Kc of approximately 0.80 for cool-season turfgrass species. The compiled data from the field experiments illustrate slight variation from month to month, but the overall mean Kc from May to October is 0.877, which aligns with past recommendations (Figure 3).

Regardless, additional research with each cool-season turfgrass species in more climatic regions of the United States would provide more accurate Kc estimations that could improve irrigation efficiency. Crop coefficients with values less than 1.0 suggest less water is needed than predicted by the reference ETo to match measured ETc using lysimeters.

Some studies report Kc values greater than 1.0 and as high as 1.42 when using Pan E or the modified Penman ETo (3, 23, 34, 36), suggesting the reference ETo underestimated measured ETc. Most calculated Kc values derived using FAO 56 PM ETo are consistently less than 1.0, underscoring the problems when comparing studies using different reference ETo equations.

There is a need for more research on ET and Kc during the establishment of grass cover to distinguish establishment from mature turf. This is because of the potential for distinctly lower transpiration and water requirements from the lower fraction of ground covered by vegetation during establishment.

CONCLUSIONS

Over the last 35 years, researchers have measured ETc for *Agrostis* spp., fine fescue, tall fescue, *Lolium* spp. and *Poa* spp. and reported weighted averages of 6.12, 5.52, 7.79, 5.90 and 5.35 mm d⁻¹, respectively, with an overall weighted average ETc rate of 6.25 mm d⁻¹ across these cool-season turfgrass species based on 22 peer-reviewed studies (Table 1).

In addition to different equations

Research Takeaways

- Average cool-season turfgrass evapotranspiration rates ranged from 5.35 to 7.79 mm d⁻¹.
- Average cool-season turfgrass crop coefficient rates ranged from 0.85 to 0.95.
- Minimum deficit irrigation replacement levels ranged from 59 to 74 percent of ET.

and procedures that offer varying estimates of reference ETo, it is essential to recognize that reference ETo is a function of weather and climatic (evaporative) factors, assuming a well-watered turf and estimates of plant height and surface roughness.

Estimating Kc values is mainly a function of crop (plant) characteristics in the transfer of reference ETo to approximate turf ETc for turfgrass use. Many turfgrass plant characteristics are related to culture and maintenance practices. The relationships between these plant characteristics and turfgrass evapotranspiration were determined under nonlimiting soil moisture using weighing lysimeters.

Average crop coefficients ranged from 0.85 to 0.95, with a weighted average of 0.91 across species and vary slightly from month to month based on ten peer-reviewed studies. These findings align with past irrigation practice recommendations of a Kc of 0.8 for cool-season turfgrass species during a growing season.


We need further research to standardize the estimates of Kc values in turfgrass studies, such as using a standard ETo (e.g., ASCE or FAO-56) across studies and developing a standard measurement protocol to improve consistency across future studies.

We also need more research on turfgrass species, such as *Agrostis*, *Lolium* and fine fescue taxa. Moreover, we need experiments for ET and Kc for Kentucky bluegrass and tall fescue in the Central, East North Central, West North Central and Northeast regions.

Deficit irrigation is an important water conservation strategy studied in one or more cool-season turfgrass species in 17 studies. Minimum deficit irrigation replacement levels for acceptable turf quality have ranged from 59 to 74 percent of ET with different irrigation intervals in various seasons. Typically investigations took place during the summer months.

Additional research on deficit irrigation replacement levels in cool-season turfgrass species, especially fine fescue and perennial ryegrass, is required and investigations on the impact of deficit irrigation on rooting characteristics over time are warranted.

Of the 24 lysimeter studies measuring ET and Kc, researchers conducted only seven in northern climatic regions (East North Central, West North Central and Northeast) but none in the Northwest or Central climatic regions. Only three of 17 studies evaluating deficit irrigation replacement levels took place in northern climatic regions (East North Central, Northeast and Northwest).

There is a need for further research on ET, Kc and deficit irrigation in northern and central climatic regions of the United States to develop further and improve our understanding of plant water loss related to climatic factors, development of water conservation strategies and management techniques for enhanced cool-season turfgrass irrigation efficiency. 

Ross Braun, Ph.D., Dale Bremer, Ph.D. and Jack Fry, Ph.D., department of horticulture and natural resources, Kansas State University; Scott Ebdon, Ph.D., school of agriculture, University of Massachusetts; Aaron Patton, Ph.D., department of horticulture and landscape architecture, Purdue University.

This article presents a portion of a much more detailed review by the authors: Braun, R. C., Bremer, D. J., Ebdon, J. S., Fry, J. D., & Patton, A. J. (2022). Review of cool-season turfgrass water use and requirements: I. Evapotranspiration and responses to deficit irrigation. *Crop Science*, 62, 1661–1684. <https://doi.org/10.1002/csc2.20791>

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GPS spray technology can save time and make your spray operation more precise, reducing inputs and waste.

How precision agriculture GPS technology can benefit your course

GPS-equipped sprayers not only benefit the agricultural industry, but golf courses, too

By: *Chris Lewis*

Superintendent of Sammamish, Wash.'s Aldarra Golf Club, Sean Reehoorn and his team utilize three GPS-equipped sprayers. GPS spraying is popular in the agriculture industry and is becoming more common in golf.

By utilizing precision agriculture GPS technology, Reehoorn can spray every maintained area of the club's 18-hole championship course — within specifically defined sections — whenever he needs to. And, since the club's sprayers feature the latest technology advancements, they're able to communicate with one another through the cloud.

"Due to these upgrades in technology, we can divide and conquer, so to speak, whenever it's time for us to spray our problematic areas," he says.

So far, the results have exceeded Reehoorn's expectations. Since his team no longer sprays the same area twice in the same application due to individual nozzle control, he estimates his team reduced the area sprayed by 20 percent in



Sean Reehoorn

addition to the time spent spraying.

"We've saved, on average, 1 hour for each application, while using the GPS-equipped sprayers, compared to former equipment," he stresses. "As a result, we've been able to spend our time on other projects and complete them earlier in the day than we previously could."

These results led Reehoorn to recommend precision agriculture GPS technology to other superintendents, as he said he considers it an upgrade for any golf course. After all, it not only improves accuracy but also reduces inputs.

"While the scrutiny of pesticide and fertilizer usage on golf courses continues to rise, GPS technology provides superintendents assurance, with regards to accuracy, which helps ensure best management practices compliance," he says.

The bottom line is consider utilizing a local GPS technology provider this year.

"In doing so, you'll find a suitable, cost-effective upgrade to your sprayers — and you'll notice the benefits, regarding cost and time savings, nearly immediately," he adds. **G**

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President and CEO



The most impressive advancements in GPS technology have been in the receivers. New receivers have faster processors to minimize convergence time and make more accurate repeatability. Earlier generations of receivers would require 30 to 40 minutes to do all the math necessary to locate signals and make error corrections. The new receivers can achieve this in seconds, though. Therefore, users no longer have to wait for a signal to return after traveling under bridges or dense tree cover. And they'll have repeatability — within 1 centimeter — as they use a generation receiver like Novatel's Smart7, along with the Terrastar-X error correction subscription. These receiver advancements will replace obsolete RTK systems that require more investment and often don't work in certain geographical locations.

John Deere

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Product Manager



GPS technology continues to advance every year. Improvements in receivers — with the ability to pull in information from additional satellite constellations, for instance — continuously provide enhanced accuracy and precision for critical operations, such as application work. This accuracy allows users to be more efficient and sustainable in their practices. Additional improvements also unlock their abilities to receive satellite-based Real Time Kinematic corrections, which will eliminate the need for additional, on site infrastructure, commonly referred to as a "base station." These improvements will begin to find their way onto future John Deere equipment, manufactured specifically for the turf industry. Furthermore, users can utilize GPS technology for lower accuracy needs like machine tracking. For example, at John Deere, we've also introduced standard connectivity for our ride-on mowing equipment for Model Year 2023.

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A foundational component of many recent golf course maintenance technologies, GPS is helping to revolutionize golf course maintenance. As the latest innovation in this field, autonomous mowers, for example, feature GPS technology, which enables superintendents to navigate courses without any human intervention. Additionally, due to GPS technology, they can mow turf in a more precise and efficient manner, saving time and resources, ensuring they can maintain courses at a higher standard. Consequently, GPS technology is becoming more prevalent in the golf industry as golf course managers opt for GPS-enabled equipment — such as autonomous drones and mowers, along with sprayers and sensors — to maintain their courses more effectively. As GPS technology continuously evolves, maintenance will, in turn, likely become more efficient and cost-effective.

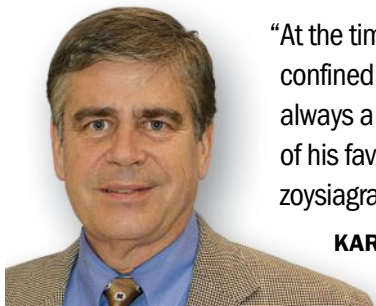
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ERIC KEISTER

National Sales Manager



Pace Technology recently unveiled TruPin, a new handheld device that enables golf courses to update new pin placements and par-3 tee locations quickly, easily and accurately in their Pace system's course maps. While using a handheld device, cup cutters will stand over a new location, select the right hole and press a button. From there, TruPin will automatically update the pin or tee location, yardage and other information in the Pace technology platform, so that golfers can track their distance to the cup from their golf car. TruPin yardages are accurate within 1 meter, and the system uses a cellular network for reliability. The system also helps eliminate inconsistency and human error, with regards to measuring yardages and making proper pin placements.



"At the time, Daniel's teaching style was not confined by a syllabus. Each lecture or lab was always a surprise and a new experience. One of his favorite topics was the release of Midwest zoysiagrass and the potential use of the grass."

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

What's new with zoysiagrass?

This past spring, I attended a Greater Cincinnati Golf Course Superintendents Association meeting where Patrick O'Brien, superintendent at Hyde Park Golf and Country Club, in Cincinnati, Ohio, and John Ballard, CGCS, superintendent at Valhalla Golf Club in Louisville, spoke on establishing and managing zoysiagrass.

While listening to O'Brien and Ballard speak, I couldn't help but be struck by how far we have come with zoysiagrass development and management.

My first exposure to Zoysia was as an undergraduate student at Purdue University. The turfgrass professor at the time was William Daniel, Ph.D.

During Daniel's career, he had numerous accomplishments including teaching several undergraduate and graduate students, developing the Prescription Athletic Turf (PAT) system and releasing Midwest zoysiagrass in the early 1960s.

At the time, Daniel's teaching style was not confined by a syllabus. Each lecture or lab was always a surprise and a new experience. One of his favorite topics was the release of Midwest zoysiagrass and the potential use of the grass.

Driving through Lafayette, Ind., you could observe the fruits of his teaching

as zoysiagrass lawns dotted the community. Even when returning home, during our breaks, to Champaign, Ill., I noticed more and more zoysiagrass lawns.

REMEMBER YOUR FIRST

The first golf course I came across with Zoysia fairways was Danville (Ill.) Country Club. Danville is a small town 30 miles outside of Champaign, close to the Illinois-Indiana state border on I-74. Danville was also home to some celebrities back in the day including Dick and Jerry Van Dyke.

The Danville CC superintendent — when I was a student — James Brandt, CGCS, was a progressive superintendent and a past president of GCSAA (1968) who converted his Kentucky bluegrass fairways to zoysiagrass.

Brandt was a good friend of Daniel, whom he no doubt consulted in the decision to go with zoysiagrass. Looking

back now Danville CC must have been one of the most northern courses to have converted to zoysiagrass fairways.

In 1951, the most popular cultivar of Zoysia debuted, which you know as Meyer zoysiagrass.

In an excellent review article on zoysiagrass, turfgrass researchers at Purdue University, the University of Georgia and the University of Florida (2017) reported that Meyer remained the most popular and dominant zoysiagrass cultivar in the transition zone.

ALL GROUPED UP

When I arrived at The Ohio State University, Tom Brehob at the time was the superintendent of Hyde Park Golf and Country Club. He was the one who converted the fairways to Meyer zoysiagrass. I remember the conversion process was not much different than in Danville.

Golf course superintendents and turfgrass researchers group the Zoysia species and refer to them as zoysiagrass. For this reason — and plenty of others — I am very excited to see John Ballard work with Zeon zoysiagrass at Valhalla GC, as the course works toward hosting the 2024 PGA Championship, its first since 2014.

Zoysiagrass consists of multiple species with the two primary being *Zoysia japonica* and *Zoysia matrella*. Meyer zoysiagrass, and almost all the Zoysia grass in the transition zone, is *Zoysia japonica*, while Zeon zoysiagrass comes from the *Zoysia matrella* species.

I believe Louisville is the furthest north in the transition zone that *Zoysia matrella* has been established. Given that *Zoysia japonica* is reported to have slightly better cold tolerance than *Zoysia matrella*, while *Zoysia matrella* has a finer texture, the performance of these species here will be of interest. **G**

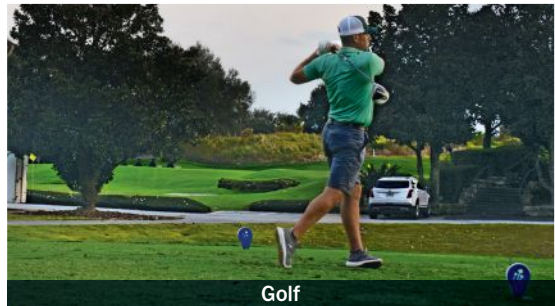
Karl Danneberger, Ph.D., *Golfdom's* science editor and a professor at The Ohio State University, can be reached at danneberger.1@osu.edu.

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"I was fortunate to see much of this work firsthand over the last 40 years. I hope the USGA can provide some funding to the Crop Science Society of America to make the articles available to nonmembers."

MIKE KENNA, PH.D., *Research Editor*

A look at 40 years of cool-season turfgrass research

We have general article topics and guidelines for each issue of *Golfdom*. Sometimes, finding the latest information in peer review journals or USGA Davis Program research summaries takes me a while. Thank goodness for the Turfgrass Information File at Michigan State University and internet search engines.

Review articles are a lot of work. While with the USGA, a constant request was to summarize all of the research on a particular subject. We accomplished this by sponsoring symposia at professional meetings or working with another interested association. Sometimes I attempted to write a review for a meeting or the *USGA Green Section Record*.

So, I wanted to find something on turfgrass water conservation for June. WOW, did I find a gem! Actually two.

Professors Ross Braun, Ph.D., Dale Bremer, Ph.D., Scott Ebdon, Ph.D., Jack Fry, Ph.D., and Aaron Patton, Ph.D., summarized hundreds of cool-season turfgrass water use articles in a two-part crop science review.

HISTORY LESSON

In part one, the group presents the history of early water conservation and quantification methods in turfgrass and summarizes research on cool-season turfgrass evapotranspiration (ET) and deficit irrigation. The second part of the article summarizes research on

cool-season turfgrass drought resistance completed since 1980.

Summaries of research from more than 60 experiments related to ET include: measured ET rates in various climates; comparisons of actual ET to estimated ET; crop coefficients; deficit irrigation; and how plant characteristics and management practices influence ET.

They summarize daily evapotranspiration (ETc in mm per day) rates for bentgrasses (6.12), fine fescues (5.52), tall fescue (7.79), ryegrasses (5.90) along with bluegrasses (5.35). The overall ETc is 6.25 mm per day for all the cool-season grasses.

The average crop coefficients range from 0.85 to 0.95 mm with seasonal variation. The minimum deficit irrigation replacement levels to produce acceptable turfgrass quality ranged from 59 to 74 percent of ET under different irrigation levels.

FREE FOR ALL

In part two, research on greater than 30 field experiments evaluating drought response to irrigation amounts, length


of dry down, and the influence of environmental and management factors. Most of the research was on the intra-species variation of Kentucky bluegrass and tall fescue varieties.

This group of turfgrass researchers recommends more investigation into crop coefficients among cultivars within species, cultural influences, deficit irrigation replacement levels and standardizing measurement protocol to improve consistency in crop coefficients across future turfgrass experiments.

They suggest further investigating differences in drought resistance strategies among plants and management practices, shoot and root responses, subsequent recovery and inter- and intraspecies variation in cool-season turfgrasses, especially in northern climatic regions where cool-season turf species are adapted.

These two articles provide an excellent review of cool-season turfgrass water use. I was fortunate to see much of this work firsthand over the last 40 years. I hope the USGA can provide some funding to the Crop Science Society of America to make the articles available to nonmembers.

Water conservation will continue to be one of golf's most significant challenges in the future. Since the 1980s, the USGA invested heavily in supporting research on turfgrass water use. The USGA projects and research funded by allied turfgrass organizations provide a solid foundation to improve water management and the grasses we use for golf.

Several technologies are available that need vetting for daily use on golf courses. Multiple opportunities exist to reduce the water we need for golf courses significantly. Thankfully, we have completed much of the preliminary work, and the effort now is to get it in the hands of superintendents. 

Mike Kenna, Ph.D., retired director of research, USGA Green Section. Contact him at mpkenna@gmail.com.

The Golfdom

F I L E S

FROM THE ARCHIVE

Modern-day superintendents have access to dozens of tools that make their lives easier. Technologies like soil moisture meters, labor-tracking software and autonomous mowers, are just a few examples.

It makes you wonder; how did superintendents balance their budgets back in the day? For some, outside data processing companies and their advanced computers (for the time) were the keys to making their financials work.

Take a trip back to April 1963, when *Golfdom* spoke with R.J. Kearns, owner of Robert J. Kearns & Co., in Aurora Ill., to learn how his business helped superintendents. For the full article, visit golfdom.com/exclusive.

Can a country club afford data processing?

Q Mr. Kearns, most people think of data processing as a tool of big corporations. How can a private club afford a system that obviously is designed and priced for these giants?

They can't, but they don't have to. Big companies have big problems and the systems they use to solve them have captured the public imagination.

But smaller organizations use smaller systems. And organizations that cannot justify purchasing their own systems can buy services from processing specialists. We provide this service for many of our clients, including nine country clubs. We call it R/K Service.

Q What does R/K Service consist of? What do you do for the individual country club?

We offer a complete service covering all phases of bookkeeping and accounting needs. We process and mail the members' monthly statements, compute and write payroll and government

reports, maintain accounts payable and general account checks, post the general ledger and prepare monthly financial statements. Some clubs prefer to retain one or more of these functions. In such cases, we do only part of the job and bill the club accordingly.

Q What do you use as source material?

Once a week, the club sends us all its accumulated sales checks, invoices and other transaction records. A (worker) in our office reads the pertinent information from the records and enters it in a tape-punching adding machine.

When all the information is entered,

the records are returned to the club and the punched tape is filed away. At the end of the month, all of the tapes are processed on our NCR 390 computer to generate the desired reports and forms.

PEAKS AND VALLEYS

Q What is the primary advantage of this arrangement to the country club?

A country club, particularly in the North, has extreme fluctuation in its accounting workload. One of our clubs has 30,000 transactions in July and only 500 in January. An accounting department capable of handling the peak wastes many man hours during the lull. R/K Service levels off accounting personnel requirements to one person on a year-round basis. **G**



A computer operator (above) processes a club payroll on an NCR 390 machine. Four magnetic strips on back of ledger card is read by the computer while record of employee's earnings is kept on the front. (Right) Adding machine operator lists gross checks. As she punches keyboard, identical information is recorded on paper tape. When tape is processed by a computer it prints members' statements and updates accounts receivable.

the club accordingly.

Q. What do you use as source material?

A. Once a week, the club sends us all its accumulated saleschecks, invoices and other transaction records. A girl in our office reads the pertinent information from the records and enters it in a tape-punching adding machine. When all the information is entered, the records are returned to the club and the punched tape is filed away. At the end of the month all of the tapes are processed on our NCR 390 computer to generate the desired reports and forms.

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in January. An accounting department capable of handling the peak wastes many manhours during the lull. R/K Service levels off accounting personnel requirements to one person on a year-around basis.

Q. Must this one person have any special qualifications?

A. Not necessarily. An accounting back-

Golfdom

The Shop

// MUST-HAVE NEW PRODUCTS



1 | 525iDEPS pole saw

The 525iDEPS dielectric battery-powered pole saw from **HUSQVARNA** offers interchangeable shaft lengths at either 9 feet or 12.5 feet to help operators access hard-to-reach areas, minimizing repositioning and climbing aloft. The dielectric midsection can disconnect from the cutting and power heads for easy storage. The brushless motor of the battery-powered 525iDEPS coupled with a Husqvarna X-Cut chain on a 12-inch bar enables high, double-sided cutting capacity, balanced operation and optimal performance. Husqvarna says 525iDEPS is the first dielectric battery-powered pole saw to meet OSHA standard 1910.269.

[Husqvarna.com](https://www.husqvarna.com)

2 | Astria natural soil surfactant

Astria from **AQUATROLS** is derived from plant and microbiological components and combines sustainable chemistry with strong agronomic efficacy. The company says Astria, packaged in recyclable materials, supports uniform moisture from the surface to the root zone, enhances water infiltration in repellent soils and improves turf quality by reducing abiotic stress.

[Aquatrols.com](https://www.aquatrols.com)

3 | XUV835R/XUV865R Signature Edition

The **JOHN DEERE** XUV835R and XUV865R Signature Edition vehicles, launched in early 2022, feature new additions to the standard Deere features. The Signature Gator Utility Vehicles feature genuine leather seats and leather-wrapped handles, an integrated infotainment system, a seven-speaker sound system, a rear-facing camera, Bumper Pro Brush Guard, front roof-mounted LED driving lights and rear-sliding windows.

[Deere.com](https://www.deere.com)

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5



4



6

4 FX EVO engines

FX EVO engines from **KAWASAKI** are electronic fuel-injected (EFI) engines that offer increased power density and improved fuel efficiency. Kawasaki EFI integrates an electronic throttle control and an advanced electronic control unit to match mower engine power to cutting load and ground speed continuously. A compact layout allows for a more direct air path and the flow area has also been increased. The shorter path and larger area result in enhanced intake efficiency, which delivers higher performance and improved fuel economy.

KawasakiEnginesUSA.com

5 ShockWave linear decompactor

The ShockWave is a linear decompactor from **IMANTS** and **AQUA-AID SOLUTIONS** designed to both maintain proper soil porosity and bulk density during the growing season and revitalize heavy wear areas by relieving soil compaction, improving aeration and removing surface water. At a working depth of 4 1/2 to 10 or 15 inches, depending on the model, the ShockWave provides surface decompaction with minimal surface disruption. According to the company, all ShockWave models feature a no-chain, direct-drive design. The ShockWave also features overload protection by a torque-limiting PTO shaft.

AquaAidSolutions.com

6 Air Defender AM/FM

A new over-ear, noise-isolating hearing protection option from **ISOTUNES**, the Air Defender AM/FM includes the company's SafeMax Technology, which limits output volume to 85 decibels (dB), with a 60-hour playback time and a 300-hour standby time. The Bluetooth headphones also come with an auxiliary cable to plug into smartphones or other devices. Tactical control buttons on either side of the headphones make for easy handling and station changing, and the memory button allows easy tuning to saved stations. Air Defender AM/FM has a noise-reduction rating of 24 dB and is IPX4 rated for sweat and water resistance.

IsoTunes.com

The 19th Hole



Pete Wendt



CGCS, DIRECTOR OF GOLF COURSE AND GROUNDS // Congressional CC, Bethesda, Md.



Pete, drinks are on me ... what are you having? I'll take a Tito's and soda with a lime.



How have things been at Congressional lately? It has been great! We were under construction on our Blue Course from 2019 through the spring of 2021. Andrew Green (president of A.H. Green Design) did an amazing job with the transformation. It has been incredibly well received. We hosted the KPMG Women's PGA Championship last summer and it was a great week.

Tell me about your family. My wife Cindy is from the D.C. area. I met her while interning at Congressional through my good friend in the business, Curtis Tyrrell (CGCS, MG). My son Hunter is a junior at the University of Tennessee studying business and having

a blast. My daughter Claudia graduated from the University of Maryland last year and works in New York City as a consultant for Ernst & Young.

What do you all do for fun? We love to travel, and we love to ski. Probably our best trip was to Zermatt, Switzerland, a few years ago.

Nice! Is that the furthest you've ever been from home? No. I would say Lillehammer, Norway or Istanbul.

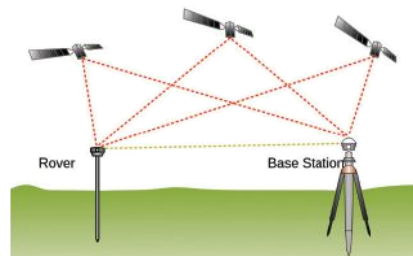
You're a Penn State grad. What's the best place in State College? Beaver Stadium. A close second was the Rathskeller, but it's closed down.

Give me some fun Congressional trivia. The first hole was originally a par 6, playing to what is now the second

green. During the renovation, we put over 37 miles of drainage and 47 miles of irrigation pipe in.

What is your favorite tool in the shop?

I would say a deep tine aerator. So great for all surfaces, especially fairways. Second to that is an RTK Rover that we used through construction — and all the time now — to mark everything that went in the ground and locate it as needed.



Do you have a most memorable day at work? The opening of the new Blue Course in 2021 was such a great day. Conversely, the hurricane that rolled through Kinloch (GC) in the early 2000s and took 600-plus large trees down was one that we would all like to forget.

Fill in the blank: My job is _____.
Fun! ... Stressful, but fun.

As interviewed by Seth Jones, May 9, 2023.

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