FLORIDA TURF DIGEST

FLORIDA TURFGRASS ASSOCIATION

VOL. 41 / NO. 1

Winter 2023

A Continued Investigation into Nutrient Use and Management on U.S. Golf Courses

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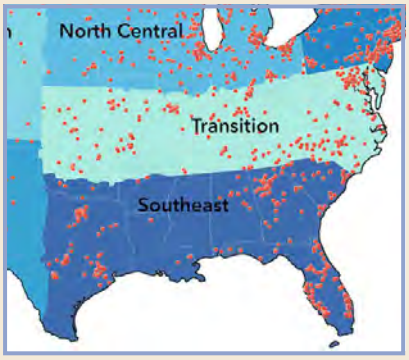

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FTGA MEMBERSHIP

The Florida Turfgrass Association is committed to provide services, communications and networking opportunities for professionals in and associated with the turfgrass industry.

Florida ranks No. 1 in the nation for turfgrass-related economic activity, with total revenues estimated at $7.82 billion and a total employment of more than 173,000 jobs. Today, the FTGA continues to advocate for and promote the turfgrass industry with extensive research, continuing education and opportunities for turfgrass professionals to network with their colleagues.

MEMBER BENEFITS INCLUDE

- ***Florida Turf Digest*** **Magazine**
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- **Regional Turf Seminars**
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MARCH
https://www.ftga.org/page/TurfSeminars

1 **FTGA Ft. Myers Turf Seminar**
2 **FTGA Port St. Lucie Turf Seminar**
7 **FTGA Tallahassee Turf Seminar**
8 **FTGA St. Augustine Turf Seminar**
14 **FTGA Ocala Turf Seminar**
31 **34th South Florida Turfgrass Field Day & Expo**

APRIL
24 **Jeff Hayden Memorial Envirotron Golf Classic**
27 **Florida Everglades GCSAA 31st Annual Spring Symposium**

JUNE
21 **Gulf Coast Turfgrass Expo & Field Day**

FOR UPDATED INFORMATION, VISIT
https://www.ftga.org/events/event_list.asp

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Jason Frank
FTGA President

"Smooth Seas Never Made a Skilled Sailor"[1]

To say the last three years have been challenging would be an understatement. In 2020 and 2021, we endured a worldwide pandemic, and in those times, compared to the rest of the country, most of us thought it was great to be a Florida resident. While the majority of the country was slow to get back to normal (whatever that means these days), Florida was the benchmark for reopening our economy and giving our citizens the freedom to make their own positive decisions to keep themselves safe. This sparked a period of pride to be a Florida resident and made us glad that we lived here. At least until September, when we were reminded of the ever-present challenge we face as Florida inhabitants when we endured the third most costly hurricane on record.

Hurricane Ian caused more than $113 million in damages to our state, left many without their homes, and even cost some their lives[2]. Even with this devastating storm creating turmoil throughout our state (especially in southwest Florida), Florida once again proved its spirit by banding together to quickly initiate the rebuilding process. Amid picking up the pieces, as Florida was attempting to get back on track, we all in the turf industry looked forward to seeing each other at the Annual Florida Turfgrass Association Conference to hopefully put the pandemics and natural disasters behind us, reset and focus on the future.

However, once again, nature saw it a different way. On the weekend before the conference, a storm started organizing in the tropics, and by the start of the first day of the conference on November 9, 2023, Hurricane Nicole, the third hurricane on record in November since record-keeping began in 1853, made landfall in Florida[3]. And if that wasn't enough, on the following day, the eye of the storm traveled right over where the conference was scheduled. With so many events like this piling up, it's easy to think this is bad luck, and it seems like we just can't catch a break.

Though this may be true, we at the FTGA think of a word that might be skimmed over in the face of the disaster of the last three years that describes all the men and women who consistently work toward rebuilding and restarting even when things fall apart. Resilience. All these challenges have inevitably made us stronger, and at the end of the day, we have made the best of every situation and are still standing, ready to take on the next challenge in front of us. So, we say 2023 is a year to refocus. We have all been through a lot, but times of challenge also provide us a time to reflect, grow stronger, and assess what is the most important to us.

At the FTGA, we continue to do this for our members and as a partner to the turfgrass industry at large. We have had to make some tough decisions to get through these challenging times, but we made it through. And with that, we have some big opportunities in 2023: to expand our partnership with the industry, to better serve our membership and to focus on our core elements of Advocacy, Communication, Education, Networking, and Research. I know the current board is up for this challenge, and we look to embrace what 2023 brings. We ask everyone to reflect and remember what the last three years have brought us and to embrace the opportunity it presents to make us all better and continue to unite on behalf of the industry we all love.

[1] *Quote by Franklin Roosevelt - Title*
[2] *Hurricane Ian - Wikipedia*
[3] *Hurricane Nicole to make Florida landfall Thursday morning - CBS Miami (cbsnews.com)*

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UF Faculty Awards & Accolades

Congratulations to Drs. Michael Dukes and J. Bryan Unruh, long-time supporters of FTGA

Dr. Michael D. Dukes Receives 2023 Royce J. Tipton Award

On January 12, 2023, Dr. Michael D. Dukes, Ph.D., P.E., F.EWRI of the Florida Section, was selected by ASCE's Environmental and Water Resources Institute to receive the 2023 Royce J. Tipton Award for work contributing to improving irrigation efficiency. This award was created to recognize contributions to the advancement of irrigation and drainage engineering. The award is made to a member of the American Society of Civil Engineers or member of the Environmental & Water Resources Institute who has made a definitive contribution to the advancement of irrigation and drainage engineering management, these contributions being made either in the form of papers or other written presentations, or through notable performance, long years of service, or specific actions which have served to advance the science of irrigation and drainage engineering.

This award will be presented at the Society's 2023 World Environmental and Water Resources Congress in Henderson, Nevada, May 21–24, 2023.

Dr. J. Bryan Unruh Awarded GCSAA President's Award

By Kirsten Romaguera, *UF/IFAS Communications*

The Golf Course Superintendents Association of America (GCSAA) announced its 2023 honoree of the President's Award for Environmental Stewardship, selecting Dr. J. Bryan Unruh, UF/IFAS West Florida Research and Education Center associate director and turfgrass scientist. The award was presented at the organization's annual conference in Orlando on February 8.

"The President's Award for Environmental Stewardship was established in 1991 to recognize an exceptional environmental contribution to the game of golf, a contribution that further exemplifies the golf course superintendent's image as a steward of the land. Dr. Unruh is one of only a few academics to receive the award in its history.

"Truly, I was shocked," Dr. Unruh said of the honor. "I don't do this work for the accolades. The fact that my goals to promote turfgrass science and protect the environment are matched by GCSAA and its members, I couldn't be more grateful."

The announcement also comes as the University of Florida's turfgrass science program marks 100 years of turfgrass teaching, research and Extension work. Another large component of Dr. Unruh's work is outreach efforts as the UF/IFAS Extension state turf specialist.

GCSAA recognized Dr. Unruh for his career accomplishments in expanding golf course environmental best management practices (BMPs) not just in Florida but also nationwide. After pioneering the first set of Florida guidelines, published in 2007, he championed the GCSAA's effort to establish BMP guidelines in all 50 states, with the final state achieving the goal in late 2020.

Earlier this year, Dr. Unruh achieved another success for the Florida BMP program when the guidelines became mandated by state law.

"Dr. Unruh has been instrumental in the development and expansion of golf course best management practices, which have truly been a game changer for the industry," said Rhett Evans, GCSAA CEO, in the press release. "His work has been invaluable to the game of golf and GCSAA members, and he personifies what the President's Award for Environmental Stewardship is all about."

UF UNIVERSITY of FLORIDA

A Continued Investigation Into Nutrient Use and Management on U.S. Golf Courses

U.S. golf courses continue to reduce their nutrient use with annual reductions since 2006

By **Dr. J. Bryan Unruh,** *University of Florida and*
Dr. Travis Shaddox, *Bluegrass Art and Science LLC, Lexington, Kentucky.*

Florida continues to lead the nation by having the highest number of golf courses. Beautifully woven in and along Florida's bountiful rivers, streams, wetlands, lakes, springs, aquifers, estuaries and coastlines, Florida's estimated 1,270 golf courses offer year-round golf for its citizens and visitors alike. Florida's golf course superintendents are tasked with being good stewards of Florida's natural resources and protecting water quality is chief among them. Water quality is often impacted by nutrient management, which is a key component of Florida's Golf Course Best Management Practices Program (http://flgolfbmp.com) that aims to enhance the environmental quality of Florida golf courses. The Golf Course Superintendents Association of America's Golf Course Environmental Profile Surveys provide key metrics on resource use and offers readers insight into conservation goal setting.

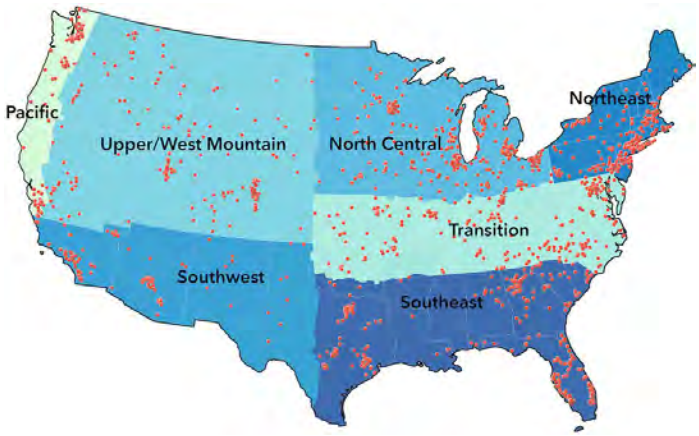

Figure 1. Geographical distribution of respondents to GCSAA's surveys and the designated agronomic regions.

Nutrient management is one of the most important components of a comprehensive best management practices (BMPs) program implemented on golf courses. Proper plant nutrition, often driven by fertilizer inputs, greatly impacts turfgrass health and performance. Nutrient use on golf courses is an important management practice that increases management cost and has the potential to influence ecosystems. Therefore, assessing nutrient use and management practices are critical to the development, teaching and adoption of BMPs.

In 2006, GCSAA initiated the Golf Course Environmental Profile (GCEP) Survey Series to develop a comprehensive environmental profile of golf courses in the United States. The objective was to establish baseline data on issues ranging from land use to regulations and practices governing water use, nutrients and pest control. A follow-up set of surveys was conducted starting in 2014 and provided scientifically valid measurements of industry change as it related to energy use and environmental practices on U.S. golf courses; land use characteristics and environmental stewardship programs on U.S. golf courses; pest management practices on U.S. golf courses; nutrient use and management on U.S. golf courses; and water use and conservation practices on U.S. golf courses.

The survey series, now in its third iteration, serves as the golf course management industry's benchmark by providing comprehensive data on the management practices, property features and environmental stewardship of U.S. golf courses. These survey results are frequently used by those interested in the golf course management industry to document changes in environmental practices over time; assist in determining the future direction of GCSAA environmental efforts and education; identify key issues for potential research projects; respond to governmental and public inquiries; promote the efforts superintendents are making on their golf courses; and provide a solid basis for comments on proposed regulatory issues.

Results from the surveys are available in online documents (https://www.gcsaa.org/Environment/golf-course-environmental-profile) and in GCM, and they are published in peer-reviewed scientific journals including *Crop, Forage and Turfgrass Management* (previously *Applied Turfgrass Science)* and *Hort-Technology,* benefiting scientists who routinely use the survey data to inform their research direction and regulators who support evidence-based decisions.

In this article, we summarize the results from the 2021 survey on nutrient use and management practices on U.S. golf courses and determine if changes have occurred since 2006.

METHODOLOGY

An electronic survey instrument was developed with questions that were identical to those used in 2006 and 2014 (7). A survey link was emailed to golf facilities using the mailing lists of the National Golf Foundation and GCSAA, which resulted in the link being sent to 14,033 golf facilities. A golf facility was defined as a business where golf could be played on one or more golf courses. The survey was available for completion for seven consecutive weeks beginning on April 1, 2022. Respondents remained anonymous, and 2021 data were merged with data from the same surveys conducted in 2006 and 2014 to allow for a measurement of change over time. Responses were received from 1,444 facilities, which represented 10.3% of the known total of U.S. golf facilities.

Respondents were asked to provide nutrient data according to the guaranteed analysis on the fertilizer label (1). Therefore, nitrogen, phosphorus and potassium were reported as N, P_2O_5 and K_2O.

Respondents were stratified by agronomic region (Figure 1). To provide a valid representation of U.S. golf courses, data were weighted. Responses were categorized into one of 35 categories depending upon the facility type (public or private), number of holes (9, 18 or 27 plus), and public green fee (less than $55 or greater than or equal to $55 per round). The weights were calculated by determining the proportion of each group within the total survey response.

Projected applied nutrients were determined by multiplying the number of golf facilities by the percentage that applied nutrients on a given course feature, and then multiplying that value by the average amount of nutrient applied. Projected fertilized acres were determined by dividing the total pounds of nutrients applied by the average pounds per 1,000 square feet and then converted to acres. Mean separations were not conducted on projected values.

To determine if survey responses changed over time, years were paired. Differences among all-pairwise comparisons were determined using the chi-square test at the 10% significance level.

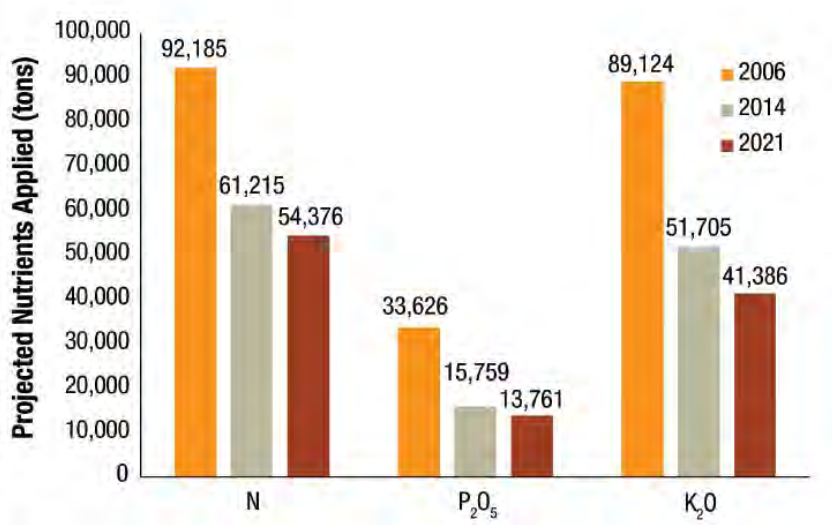

Figure 2. Projected N, P_2O_5 and K_2O applied on U.S. facilities in 2006, 2014 and 2021.

Projected N-P_2O_5-K_2O applied in 2006, '14 and '21

Region	2006	2014	2021	2006-2021
	Tons			Δ%
	N			
U.S.	92,185	61,215	54,376	-41.0
North Central	15,047	10,612	8,711	-42.1
Northeast	9,139	6,560	5,656	-38.1
Pacific	3,110	2,124	2,052	-34.0
Southeast	32,532	18,894	19,302	-40.7
Southwest	13,247	8,986	7,209	-45.6
Transition	13,600	9,688	7,982	-41.3
Upper West/Mountain	5,510	4,350	3,466	-37.1
	P_2O_5			
U.S.	33,626	15,759	13,761	-59.1
North Central	4,657	1,421	1,242	-73.3
Northeast	3,483	1,152	1,351	-61.2
Pacific	1,123	966	444	-60.5
Southeast	11,114	5,144	4,780	-57.0
Southwest	5,408	3,053	3,254	-39.8
Transition	5,876	3,064	1,924	-67.3
Upper West/Mountain	1,965	960	766	-61.0
	K_2O			
U.S.	89,124	51,705	41,386	-53.6
North Central	11,960	7,142	4,496	-62.4
Northeast	8,090	4,719	4,145	-48.8
Pacific	2,697	1,949	1,188	-55.9
Southeast	37,246	20,478	18,362	-50.7
Southwest	12,127	6,397	4,733	-61.0
Transition	12,670	8,354	6,383	-49.6
Upper West/Mountain	4,334	2,666	2,079	-52.0

Table 1. Projected nitrogen (N), available phosphorus (P_2O_5), and soluble potash (K_2O) applied to U.S. golf courses in 2006, 2014 and 2021.

U.S. golf facilities, change in nutrient use

Region	Golf facilities			Projected nutrient applied[i]		
	2006	2014	2021	N	P_2O_5	K_2O
	No.			Δ 2006-2021 (tons)		
U.S.	15,990	15,372	14,033	-5,027	-1,536	-3,952
North Central	4,123	3,920	3,555	-1,005	-130	-549
Northeast	2,739	2,690	2,470	-387	-117	-324
Pacific	629	615	565	-181	-51	-126
Southeast	3,216	3,020	2,737	-2,056	-694	-1,953
Southwest	1,221	1,208	1,138	-352	-216	-221
Transition	2,951	2,793	2,509	-975	-315	-735
Upper West/Mountain	1,111	1,125	1,059	-70	-13	-43

[i] Determined by multiplying the change in golf facilities from 2006 to 2021 by the average amount of N, P_2O_5, or K_2O applied.

Table 2. Number of U.S. golf facilities in 2006, 2014 and 2021 and the projected change in nutrient use.

Nutrient use rates by region

Year	U.S.	NC[i]	NE	Pac.	SE	SW	Trans.	UWM
	N (lbs. per 1,000 ft²)							
2006	2.30 a[ii]	1.77 a	1.89 a	2.26 a	3.56 a	3.79 a	2.05 a	2.28 a
2014	1.68 b	1.29 b	1.58 a	1.67 a	2.71 b	2.48 ab	1.57 b	1.73 ab
2021	1.58 b	1.36 b	1.54 a	2.35 a	2.24 b	1.10 b	1.35 b	1.32 b
	P_2O_5 (lbs. per 1,000 ft²)							
2006	0.76 a	0.57 a	0.69 a	0.98 a	0.91 a	2.13 a	0.87 a	0.93 a
2014	0.25 b	0.13 b	0.20 b	0.38 a	0.83 ab	0.55 b	0.26 b	0.40 b
2021	0.27 b	0.09 b	0.38 b	0.58 a	0.46 b	0.90 b	0.25 b	0.27 b
	K_2O (lbs. per 1,000 ft²)							
2006	1.95 a	1.42 a	1.58 a	1.93 a	3.29 a	3.19 a	1.86 a	1.76 a
2014	1.16 b	0.70 b	1.07 b	1.21 a	2.73 ab	1.17 b	1.16 b	1.10 ab
2021	1.06 b	0.64 b	1.08 b	1.26 a	1.91 b	1.52 b	0.77 c	0.64 b

[i] NC, North Central; NE, Northeast; Pac., Pacific; SE, Southeast; SW, Southwest; Trans., Transition; UWM, Upper West/Mountain.

[ii] Within columns, values followed by a common letter are not significantly different according to the Tukey-Kramer test at the 10% significance level.

Table 3. Nitrogen (N), available phosphorus (P_2O_5), and soluble potash (K_2O) use rates on U.S. golf facilities in 2006, 2014 and 2021.

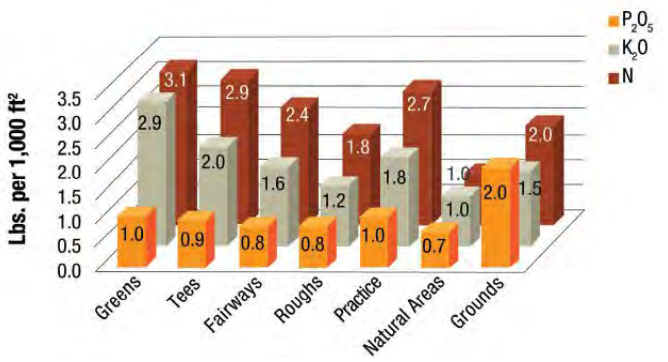

Figure 3. Application rates of N, P_2O_5 and K_2O on U.S. golf facilities by course feature in 2021.

RESULTS

Nutrient use

U.S. golf courses continue to reduce their nutrient use with annual reductions of 41% (37,809 tons) of nitrogen, 59% (19,865 tons) of phosphorus and 54% (47,738 tons) of potassium since 2006 (Figure 2).

Nutrient use reductions for all three macronutrients were observed in each of the seven agronomic regions and ranged from 34%-46% for nitrogen, 40%-73% for phosphorus and 49%-62% for potassium (Table 1). These reductions are attributed to several factors — golf facility closures, reductions in nutrient application rates and reductions in fertilized acreage.

Changes in nutrient use due to reductions in the number of golf facilities

Golf facility closures continue to outpace facility openings, resulting in a net reduction of golf facilities from 2006 to 2021 nationally (12%) and regionally (ranging from 5% in the Upper West/Mountain to 15% in the Southeast) (Table 2). Facility closures reduced applied nitrogen, phosphorus and potassium by 5,027, 1,536 and 3,952 tons, respectively.

Changes in nutrient use due to reductions in nutrient application rates

Nutrient application rates at operational golf facilities have declined since 2006. The nutrient application rate is possibly the most effective measurement of efficient nutrient usage because it is not affected by facility closures. Across all course features, the national median of nitrogen, phosphorus and potassium applied per 1,000 square feet per golf facility declined from 2006 to 2021 by 30%, 63% and 42% to 1.6, 0.3 and 1.1 pounds per 1,000 square feet respectively (Table 3).

Averaged across the U.S., golf course superintendents reported reduced nitrogen application rates on each course feature except on natural areas, which received the lowest nitrogen rate of any course feature (Figure 3). These rate reductions ranged from 18% to 28% depending upon the course feature.

Putting green nitrogen rates were reduced in all agronomic regions ranging from 24% to 31% (Table 4). Similarly, nitrogen rate reductions on tees ranged from 15% in the Upper West/Mountain to 31% in the Northeast and Southeast. Likewise, fairway nitrogen rates were

Nitrogen use rates

Year	U.S.	NC[i]	NE	Pac.	SE	SW	Trans.	UWM
	N (lbs. 1,000 ft $^{-2}$ yr $^{-1}$)							
	Total							
2006	2.3 a[ii]	1.8 a	1.9 a	2.3 a	3.6 a	3.8 a	2.0 a	2.3 a
2014	1.7 b	1.3 b	1.6 a	1.7 a	2.7 b	2.5 ab	1.6 b	1.7 ab
2021	1.6 b	1.4 b	1.5 a	2.4 a	2.2 b	1.1 b	1.4 b	1.3 b
	Greens							
2006	4.3 a	3.4 a	3.6 a	5.1 a	7.7 a	5.1 a	4.2 a	3.9 a
2014	3.8 b	2.8 b	3.2 b	4.0 b	5.9 b	5.1 a	4.0 a	3.5 b
2021	3.1 c	2.4 c	2.5 c	3.8 b	5.5 b	3.8 b	3.2 b	2.8 c
	Tees							
2006	3.9 a	3.4 a	3.6 a	4.6 a	5.8 a	4.9 a	3.4 a	3.4 a
2014	3.1 b	2.7 b	3.0 b	3.5 b	4.1 b	4.8 a	2.7 b	2.9 b
2021	2.9 c	2.6 b	2.5 c	3.9 ab	4.0 b	4.0 b	2.5 c	2.9 b
	Fairways							
2006	3.1 a	2.7 a	2.8 a	3.4 a	4.5 a	4.1 a	2.9 a	2.8 a
2014	2.6 b	2.1 b	2.3 b	2.8 ab	3.5 b	4.2 a	2.6 b	2.4 b
2021	2.4 c	2.0 b	1.9 c	2.7 b	3.5 b	3.7 a	2.3 c	2.4 b
	Roughs							
2006	2.4 a	1.7 a	1.9 a	2.6 a	4.0 a	3.2 a	2.1 a	2.3 a
2014	1.9 b	1.4 b	1.5 b	1.9 b	2.7 b	3.3 a	1.7 b	1.9 b
2021	1.8 b	1.3 b	1.4 b	2.0 b	2.6 b	2.8 a	1.7 b	2.1 ab
	Practice Areas							
2006	3.3 a	2.7 a	2.6 a	3.2 a	5.1 a	4.4 a	3.0 a	2.9 a
2014	2.8 b	2.5 ab	2.2 b	2.8 a	3.6 b	4.6 a	2.5 b	2.6 ab
2021	2.7 b	2.3 b	2.1 b	2.8 a	3.8 b	3.1 b	2.5 b	2.4 b
	Natural Areas							
2006	1.3 a	1.2 a	1.0 a	1.1 a	1.4 a	2.2 a	1.3 a	1.2 a
2014	1.1 b	0.8 ab	0.7 a	1.0 a	1.3 a	1.6 a	0.9 b	1.4 a
2021	1.0 ab	0.7 b	1.2 a	1.1 a	1.4 a	1.4 a	0.9 ab	0.8 a
	Grounds							
2006	2.6 a	2.3 a	2.2 a	3.4 a	3.8 a	3.1 ab	2.4 a	2.5 a
2014	2.2 b	2.0 b	1.9 b	2.9 a	2.8 b	3.8 a	1.8 b	2.4 a
2021	2.0 c	1.8 c	1.8 b	2.8 a	2.5 b	2.7 b	1.9 b	2.1 a

[i] NC, North Central; NE, Northeast; Pac., Pacific; SE, Southeast; SW, Southwest; Trans., Transition; UWM, Upper West/Mountain.

[ii] Within columns, values followed by a common letter are not significantly different according to the Tukey-Kramer test at the 10% significance level.

Table 4. Nitrogen (N) use rates on U.S. golf facilities in 2006, 2014 and 2021.

Phosphorus use rates

Year	U.S.	NC[i]	NE	Pac.	SE	SW	Trans.	UWM
	P_2O_5 (lbs. 1,000 ft $^{-2}$ yr $^{-1}$)							
	Total							
2006	0.8 a[ii]	0.6 a	0.7 a	1.0 a	0.9 a	2.1 a	0.9 a	0.9 a
2014	0.2 b	0.1 b	0.2 b	0.4 a	0.8 ab	0.6 b	0.3 b	0.4 b
2021	0.3 b	0.1 b	0.4 b	0.6 a	0.5 b	0.9 b	0.3 b	0.3 b
	Greens							
2006	1.5 a	1.0 a	1.2 a	1.7 a	2.2 a	2.1 a	1.6 a	1.3 a
2014	1.1 b	0.7 b	0.8 b	1.1 b	1.7 b	1.8 a	1.4 b	0.9 b
2021	1.0 c	0.6 b	0.8 b	1.0 b	1.8 b	1.7 a	1.0 c	0.7 c
	Tees							
2006	1.3 a	1.0 a	1.3 a	1.4 a	1.7 a	1.8 a	1.3 a	1.0 a
2014	1.0 b	0.7 b	0.9 b	1.1 a	1.3 b	1.5 a	1.0 b	0.8 b
2021	0.9 b	0.6 b	0.8 b	1.2 a	1.4 b	1.7 a	0.9 b	0.6 c
	Fairways							
2006	1.1 a	0.8 a	0.9 a	1.0 a	1.5 a	1.6 a	1.1 a	0.9 a
2014	0.9 b	0.5 b	0.6 b	0.9 a	1.2 b	1.4 a	1.0 a	0.7 ab
2021	0.8 b	0.5 b	0.7 b	0.9 a	1.2 b	1.6 a	0.7 b	0.5 b
	Roughs							
2006	0.9 a	0.5 a	0.7 a	0.8 a	1.4 a	1.5 a	0.9 a	0.8 a
2014	0.8 b	0.4 b	0.5 b	0.6 a	1.2 ab	1.3 a	0.8 ab	0.7 ab
2021	0.8 b	0.4 ab	0.7 ab	0.6 a	1.1 b	1.3 a	0.6 b	0.5 b
	Practice Areas							
2006	1.2 a	0.8 a	1.0 a	1.0 a	1.6 a	1.8 a	1.2 a	1.0 a
2014	1.0 b	0.8 a	0.6 b	0.9 a	1.1 b	1.6 a	1.0 b	0.8 ab
2021	1.0 b	0.9 a	1.0 a	0.9 a	1.3 ab	1.4 a	0.9 b	0.6 b
	Natural Areas							
2006	0.8 a	0.7 a	0.6 b	1.1 a	1.1 a	1.3 a	0.7 a	0.4 a
2014	0.7 a	0.0[iii]	0.5 ab	0.8 ab	0.6 a	1.1 a	0.6 a	0.6 a
2021	0.7 a	0.3 a	1.8 a	0.4 b	0.7 a	1.5 a	0.8 a	0.3 a
	Grounds							
2006	2.6 a	2.3 a	2.2 a	3.4 a	3.8 a	3.1 ab	2.4 a	2.5 a
2014	2.2 b	2.0 b	1.9 b	2.9 a	2.8 b	3.8 a	1.8 b	2.4 a
2021	2.0 c	1.8 c	1.8 b	2.8 a	2.5 b	2.7 b	1.9 b	2.1 a

[i] NC, North Central; NE, Northeast; Pac., Pacific; SE, Southeast; SW, Southwest; Trans., Transition; UWM, Upper West/Mountain.

[ii] Within columns, values followed by a common letter are not significantly different according to the Tukey-Kramer test at the 10% significance level.

[iii] Values without variability were not analyzed

Table 5. Available phosphorus (P_2O_5) use rates on U.S. golf facilities in 2006, 2014 and 2021.

Soluble potash use rates

Year	U.S.	NC[i]	NE	Pac.	SE	SW	Trans.	UWM
	K_2O (lbs. 1,000 ft $^{-2}$ yr $^{-1}$)							
	Total							
2006	1.9 a[ii]	1.4 a	1.6 a	1.9 a	3.3 a	3.2 a	1.9 a	1.8 a
2014	1.2 b	0.7 b	1.1 b	1.2 a	2.7 ab	1.2 b	1.2 b	1.1 ab
2021	1.1 b	0.6 b	1.1 b	1.3 a	1.9 b	1.5 b	0.8 c	0.6 b
	Greens							
2006	4.5 a	3.4 a	3.4 a	4.6 a	9.9 a	6.6 a	4.3 a	3.2 a
2014	3.6 b	2.4 b	2.7 b	3.2 b	7.8 b	5.0 b	4.2 a	3.0 a
2021	2.9 c	1.9 c	2.1 c	3.1 b	6.8 c	3.5 c	3.1 b	2.2 b
	Tees							
2006	3.3 a	2.8 a	3.1 a	3.6 a	5.8 a	4.0 a	2.9 a	2.2 a
2014	2.4 b	2.0 b	2.2 b	2.6 b	3.8 b	3.4 ab	2.3 b	2.0 ab
2021	2.0 c	1.6 c	1.6 c	2.3 b	3.8 b	2.9 b	1.8 c	1.7 b
	Fairways							
2006	2.6 a	2.1 a	2.3 a	2.6 a	4.6 a	3.0 a	2.5 a	1.9 a
2014	1.9 b	1.4 b	1.5 b	2.0 ab	3.3 b	2.8 a	2.0 b	1.6 ab
2021	1.6 c	1.1 c	1.3 c	1.7 b	3.1 b	2.4 a	1.6 c	1.4 b
	Roughs							
2006	1.9 a	1.2 a	1.5 a	2.0 a	4.1 a	2.3 a	1.8 a	1.7 a
2014	1.5 b	0.8 b	1.1 b	1.3 b	2.7 b	2.2 a	1.5 b	1.3 b
2021	1.2 c	0.6 c	0.9 b	1.1 b	2.6 b	1.8 a	1.2 c	1.2 b
	Practice Areas							
2006	2.9 a	2.1 a	2.3 a	2.4 a	5.2 a	3.6 a	2.6 a	2.3 a
2014	2.2 b	1.8 b	1.6 b	1.9 ab	3.4 b	2.9 ab	2.1 b	1.7 b
2021	1.8 c	1.2 c	1.6 b	1.7 b	3.2 b	2.2 b	1.6 c	1.3 b
	Natural Areas							
2006	1.1 a	1.0 a	0.9 a	1.2 a	1.7 a	1.2 a	1.1 a	0.8 a
2014	1.1 a	0.9 a	0.7 a	1.1 a	1.5 a	1.6 a	0.9 a	1.2 a
2021	1.0 a	0.6 a	0.8 a	1.1 a	1.7 a	1.4 a	0.9 a	0.6 a
	Grounds							
2006	2.2 a	1.8 a	1.8 a	2.5 a	3.5 a	2.3 a	2.0 a	1.9 a
2014	1.6 b	1.3 b	1.3 b	2.2 ab	2.5 b	2.5 a	1.5 b	1.6 ab
2021	1.5 c	0.9 c	1.2 b	1.7 b	2.6 b	2.3 a	1.5 b	1.3 b

[i] NC, North Central; NE, Northeast; Pac., Pacific; SE, Southeast; SW, Southwest; Trans., Transition; UWM, Upper West/Mountain.

[ii] Within columns, values followed by a common letter are not significantly different according to the Tukey-Kramer test at the 10% significance level.

Table 6. Soluble potash (K_2O) use rates on U.S. golf facilities in 2006, 2014 and 2021.

reduced in all regions except the Southwest and ranged from 14% to 32% in the Upper West/Mountain and Northeast, respectively. Nitrogen rate reductions on golf course roughs were reported in all regions except the Southwest.

Similarly, phosphorus and potassium application rates declined across the U.S. from 2006 to 2021 by 63% and 42%, respectively, and within each region except the Pacific (Tables 5 and 6). Nationally and regionally, the greatest phosphorus and potassium application rates were reported on putting greens and grounds. Reductions in phosphorus application rates have not changed from 2006 to 2021 for roughs, practice areas and natural areas in four of the seven regions.

With few exceptions, applied potassium reduction ranged from 23% to 50% for all course features in all regions except in natural areas, where no changes were reported.

Changes in nutrient use due to reductions in the number of fertilized acres

Another factor that likely influenced nutrient use reductions is the reduction in the number of acres fertilized with nitrogen, phosphorus and potassium, which declined by 25%, 53% and 32%, respectively, from 2006 to 2021 (Table 7). Nationally, the greatest decrease was with phosphorus, with which golf course superintendents fertilized approximately 530,000 fewer acres in 2021 compared to 2006.

Survey results revealed regional variation in the changes to the number of fertilized acres. Changes in acres fertilized with nitrogen ranged from 21% in the Upper West/Mountain to 37% in the Southwest. The reduction in acres fertilized with phosphorus was more variable and ranged from 31% in the Upper West/Mountain region to 70% in the North Central region. Similarly, fewer acres were fertilized with potassium,

Area fertilized

Region	2006	2014	2021	2006-2021
	Area (acres)			Δ%
	N			
U.S.	1,179,055	986,063	889,378	-24.6
North Central	279,185	230,025	206,284	-26.1
Northeast	161,846	134,774	125,551	-22.4
Pacific	42,969	34,707	33,458	-22.1
Southeast	280,685	234,015	213,414	-24.0
Southwest	118,683	93,383	80,850	-31.9
Transition	210,663	178,741	162,981	-22.6
Upper West/Mountain	85,023	80,419	66,840	-21.4
	P_2O_5			
U.S.	1,004,391	540,581	472,923	-52.9
North Central	222,890	87,951	66,723	-70.1
Northeast	143,916	57,360	50,298	-65.1
Pacific	41,553	27,546	20,789	-50.0
Southeast	237,648	138,002	134,054	-43.6
Southwest	99,658	75,983	63,323	-36.5
Transition	189,959	101,034	89,916	-52.7
Upper West/Mountain	68,766	52,704	47,819	-30.5
	K_2O			
U.S.	1,126,967	874,534	767,883	-31.9
North Central	264,087	199,216	166,854	-36.8
Northeast	157,981	121,645	110,601	-30.0
Pacific	42,467	31,495	28,117	-33.8
Southeast	268,337	219,974	194,550	-27.5
Southwest	113,167	81,642	67,637	-40.2
Transition	204,407	155,772	144,707	-29.2
Upper West/Mountain	76,520	64,791	55,417	-27.6

Table 7. Projected acres fertilized with nitrogen (N), available phosphorus (P_2O_5), and soluble potash (K_2O) on U.S. golf facilities in 2006, 2014 and 2021.

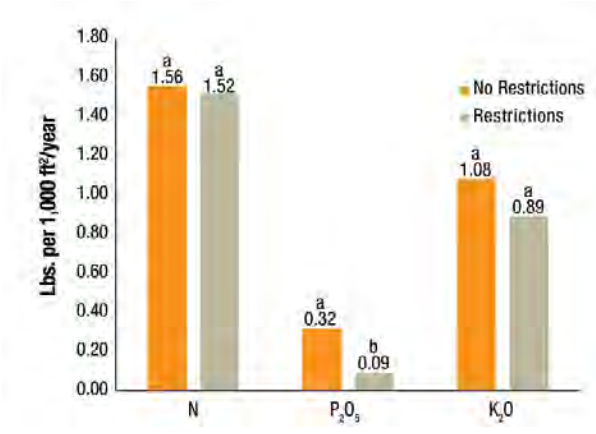

Figure 4. Application rates of N, P_2O_5 and K_2O on U.S. golf facilities associated with federal, state, tribal or local nutrient restrictions in 2021. Bars with a common letter are not significantly different according to the Tukey-Kramer test at the 10% significance level.

Nutrient application restrictions

Restriction Type	2006	2014	2021
Nutrient Restriction of Any Type	7 c	23 a	18 b
Phosphate (total yearly amount or amount per application)	5 c	20 a	15 b
Date restrictions for applications	<1 b	7 a	7 a
Required buffer strips	2 b	8 a	7 a
Nitrogen (total yearly amount or amount per application)	2 b	5 a	4 a
Regional / state stormwater management plan	1 b	4 a	4 a
No-apply zones	1 c	6 a	3 b
Potash (total yearly amount or amount per application)	<1 ab	<1 b	2 a

[i] Within rows, values followed by a common letter are not significantly different according to the χ^2 test at the 10% significance level.

Table 8. Frequency of federal, state, local government or tribal authority restrictions on nutrient applications on U.S. golf facilities in 2006, 2014 and 2021.

and reductions ranged from 28% in the Upper West/Mountain and Southeast to 40% in the Southwest.

When looking at course features, the greatest median fertilized acres were roughs, followed by fairways and natural areas. Pooled across the U.S., fertilized rough acreage remained unchanged from 2006-2021.

Superintendents reported increases in fertilized acres of natural areas (25%), greens (13%) and tees (9%) from 2006 to 2021. However, fertilized acres of fairways, practice areas and grounds were reduced by 9%, 27% and 35%, respectively, from 2006-2021. During this same time, in all regions of the U.S. (except the Pacific), fertilized acres were reduced (25% to 44%) in the non-play area denoted as “grounds."

Imposed restrictions on nutrient applications

The 2014 survey revealed a significant increase over the 2006 baseline survey in the frequency of federal, state, local government or tribal authority restrictions on nutrient applications. Interestingly, the frequency of such restrictions in 2021 was either diminished or remained the same as 2014 but were still greater than 2006 (Table 8). The impact of these restrictions can be observed, particularly with phosphorus applications. Between 2006 and 2021, the percentage of golf facilities that operate under phosphorus restrictions increased from 5% to 15% (Table 8). In 2006, 92% of golf facilities applied phosphorus to greens, whereas in 2021 that percentage declined to 75% (data not presented). Perhaps the most impactful change occurred on fairways and roughs, where the percentage of golf facilities applying phosphorus declined by nearly half from 2006 to 2021 (data not presented).

Additionally, in 2021, the phosphorus application rate on golf facilities that operated within phosphorus restrictions was 0.09 pounds per 1,000 square feet (4.39 kilograms per hectare) compared to 0.32 pounds per 1,000 square feet (15.62 kilograms per hectare) on facilities not governed by restrictions (Figure 4). Conversely, less than 4% of facilities were subjected to nitrogen or potassium restrictions, and no differences were measured between the rate of nitrogen and potassium applied on facilities subjected or not subjected to nutrient restrictions (data not presented).

Thus, mandated restrictions on phosphorus applications appear to have resulted in reduced amounts of phosphorus applied and have likely increased the percentage of golf facilities that eliminated phosphorus applications altogether.

Nutrient management practices

Survey respondents were asked about the management practices they used with the intent of reducing reliance upon applied nutrients (i.e., fertilizer) (Figure 5). Similar to the responses from the 2014 survey, the three most common management practices adopted by golf course superintendents as a means of reducing reliance upon applied nutrients were: 1. Fertilize based on soil test results; 2. Return clippings; and 3. Make precision fertilizer applications.

Consistent with 2014 survey results reported by Gelernter et al. (2), golf facilities that conduct soil tests applied more nitrogen and potassium to each course feature in 2021 except natural areas (Figure 6). Soil testing was less associated with phosphorus, as application rates were comparable between facilities that conducted soil tests and facilities that did not. Gelernter et al. (2) postulated that the higher rates used by those that soil test may be attributed to soil test interpretations that target nutrient levels higher than those required for acceptable turf growth. Though plausible, other factors may contribute to the increased application rates, necessitating further research to better understand the association of soil testing and applied nutrients.

Other notable survey results include the significant increase since 2014 in facilities that use plant growth models to determine fertilizer rate and frequency (25% in 2021 versus 19% in 2014) and the percentage of facilities that have stopped overseeding (10% in 2021 versus 8% in 2014).

One area needing improvement is related to the nutrient content in reclaimed water. Reclaimed water generally contains nitrogen and phosphorus, yet in 2021, fewer golf course superintendents indicated they considered the nutrients in reclaimed water with the intent of reducing reliance on applied nutrients (Figure 5). Furthermore, golf course superintendents ranked the nutrient content of the effluent water source as the third-least-important factor (out of 22) when making nutrient application decisions (Table 9). Considering that 13% of U.S. golf facilities used reclaimed water in 2020, accounting for 21% of irrigation water used on golf courses (6), greater attention needs to be given to accounting for this source of nutrients applied to golf courses.

Nutrient management plans and decision factors

Written nutrient management plans are important tools that guide nutrient applications, resulting in increased nutrient-use efficiency. Across the U.S., 43% of golf facilities reported having a written nutrient management plan, with the percentage varying across regions from 35% in the Northeast to 52% in the North Central (data not presented). The percentage of golf facilities using written nutrient management plans remained equivalent to those in 2006.

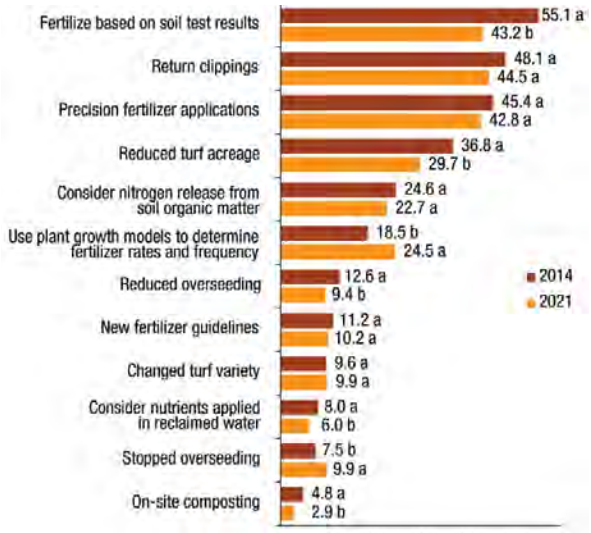

Figure 5. Frequency of management practices used on U.S. golf facilities with the intent of reducing reliance on applied nutrients in 2014 and 2021. Bars with a common letter are not significantly different according to the χ^2 test at the 10% significance level.

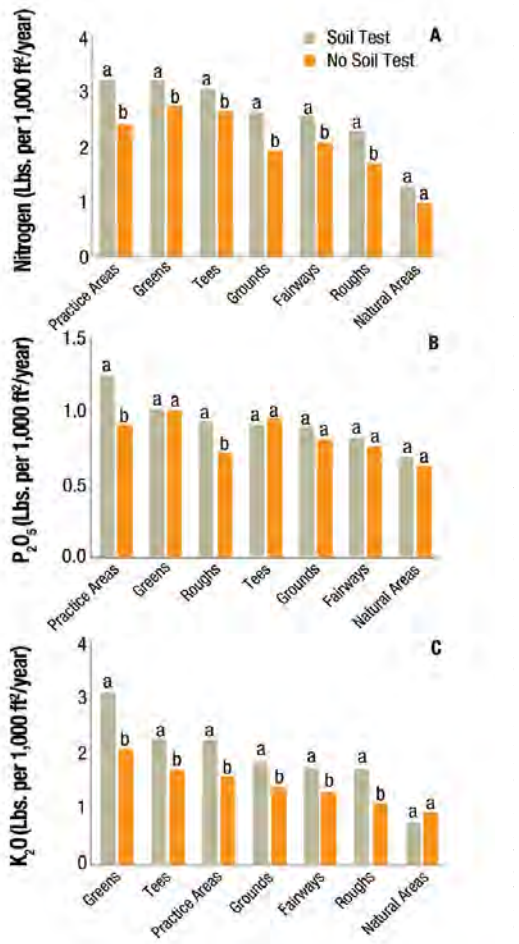

Figure 6. Use rates of A.) nitrogen, B.) available phosphorous (P_2O_5 and C.) soluble potash (K_2O) on U.S. golf facilities that soil tested or did not soil test in 2021. Bars with a common letter are not significantly different according to the Tukey-Kramer test at the 10% significance level.

Decision factors

Decision factor	2006	2014	2021
	Importance (1 to 5)[i]		
Visual observation / scouting	4.10 a[ii]	4.09 a	4.00 b
Precipitation / temperature / weather	4.12 a	4.14 a	3.99 b
Previous product performance on your established turf	4.08 a	4.09 a	3.98 b
Disease problems / pressure	4.06 a	3.98 b	3.90 c
Traffic / wear	3.77 b	3.88 a	3.89 a
Turf species	3.99 a	3.88 b	3.86 b
Soils / soil analysis	4.11 a	4.02 b	3.85 c
Golfers' expectations for turf performance	3.79 a	3.80 a	3.74 a
Cost of fertilizer	3.57 c	3.79 a	3.66 b
Length of growing season	3.77 a	3.74 a	3.63 b
Reduction of environmental impact	-[iii]	3.61 a	3.44 b
Clipping production	3.35 a	3.39 a	3.40 a
Golf events calendar	3.50 a	3.54 a	3.33 b
Regulatory requirements	2.65 c	3.04 a	2.90 b
Turf growth prediction models	2.75 b	2.83 ab	2.89 a
Manufacturer recommendations	2.80 ab	2.86 a	2.77 b
University recommendations	2.71 b	2.87 a	2.67 b
Consultant / service provider recommendations	2.62 a	2.54 ab	2.47 b
Tissue analysis	2.49 a	2.42 ab	2.35 b
Nutrient content of effluent water source	1.97 ab	1.89 b	2.01 a
Adjacent property owner's maintenance standards	1.77 c	1.96 a	1.85 b
Overseeding warm-season grasses with cool-season grasses	-	1.31 a	1.29 a

[i] Respondents rated factors on a 1–5 scale, where 1 = not important at all, and 5 = extremely important.
[ii] Within rows, values followed by a common letter are not significantly different according to the Tukey-Kramer test at the 10% significance level.
[iii] Not asked in 2006.

Table 9. Importance of factors when making nutrient application decisions on U.S. golf facilities in 2006, 2014 and 2021.

Organic nitrogen use frequency

Year	U.S.	NC[i]	NE	Pac.	SE	SW	Trans.	UWM
	Golf facilities (%)							
2006	64 a[ii]	56 a	75 a	66 a	67 a	56 a	65 a	57 a
2014	61 a	51 ab	74 a	61 a	64 a	67 a	64 ab	53 a
2021	54 b	47 b	56 b	56 a	62 a	36 b	55 b	62 a

[i] NC, North Central; NE, Northeast; Pac., Pacific; SE, Southeast; SW, Southwest; Trans., Transition; UWM, Upper West/Mountain.
[ii] Within columns, values followed by a common letter are not significantly different according to the χ^2 test at the 10% significance level.

Table 10. Frequency of natural organic nitrogen use on U.S. golf facilities in 2006, 2014 and 2021.

However, recent educational efforts have resulted in the development of state and facility-specific best management practices which may drive increased adoption of written nutrient management plans by GCSAA (3).

Consistent with results from prior surveys, the three most important factors used when making nutrient application decisions in 2021 were visual observation, weather and previous product performance (Table 9). Turfgrass wear, cost of fertilizer, regulatory requirements, growth prediction models and adjacent property owner's maintenance standards increased in importance from 2006 to 2021, whereas most of the remaining decision factors were rated less important in 2021 than in 2006.

Changes in fertilizer sources

Notable shifts in fertilizer sources used on golf courses were evident in 2021. Natural organic sources were used less nationally and within the North Central, Northeast, Southwest and Transition regions in 2021 (Table 10). Similarly, for the first time since 2006, the use of slow-release nitrogen declined nationally and within the North Central, Northeast, Southeast and Southwest regions (Table 11). In tandem, the use of quick-release nitrogen increased nationally and within the North Central, Northeast and Southeast regions. It is unknown what factors led to these changes. However, in November 2021, the cost of urea more than tripled compared to November 2020 and reached a historic high of $900 per metric ton (4). Furthermore, natural organic fertilizers may be as much as seven times more expensive than urea (5).

Soil amendments and supplements

The percentage of golf facilities using soil amendments continues to increase, with 84% reporting that at least one amendment was used on their facility (Table 12). The use of all amendments, except limestone, have increased since 2006. The most common soil amendments used were humic substances, amino acids and biostimulants, with 50% or more of golf facilities using at least one of the three.

Application frequency

The number of nutrient applications per year made to greens, tees and fairways increased from 2006 to 2021 (Table 13). More frequent applications afford golf course superintendents greater control over their turfgrass nutrition program. This likely explains much of the increase in application frequency. The previously noted reduction in slow-release nitrogen and concomitant increase in quick-release nitrogen supports this postulate. Liquid applications of soluble nitrogen sources generally provide greater application precision compared to granular fertilizers but necessitates lower rates to reduce the risk of injury. Consequently, liquid fertilizers are applied frequently but at low rates, which may explain the increase

in the number of nutrient applications. Additionally, the noted increase in usage of some amendments that are commonly in a liquid form, such as amino acids, may also play a role in the increase in nutrient applications.

Calibrated equipment and fertilizer storage

Spreader calibration is a vital component of efficient nutrient management. Nationally, and in most regions, the percentage of nutrient applications made with calibrated equipment decreased on each course feature, and no region reported an increase since 2006 or 2014 (data not presented). Nationally, approximately one-half of nutrient applications made on golf facilities are made with calibrated equipment, which, in turn, indicates the remaining half is not.

Improperly stored fertilizer represents potential point-source pollution, as any mishap can be traced back to that specific location. It appears U.S. golf facilities recognize this concern, as the percentage of facilities that have storage appropriate for fertilizer has increased in every region except the Southwest since 2006 (Table 14).

The impact of a pandemic on golf course nutrient use

The GCEP Nutrient Use and Management Practices on U.S. Golf Courses survey solicited data from years impacted by the COVID-19 pandemic. It was reported by 76% of facilities that nutrient use did not change because of the COVID-19 pandemic (data not presented). Of the 15% and 9% of facilities that reported an increase or decrease, respectively, in applied nutrients resulting from the COVID-19 pandemic, 53% indicated the cause was due to more rounds played, followed by 29% reporting the cause was related to budget (data not presented).

CONCLUSIONS AND RECOMMENDATIONS

Significant reductions in nutrient use have occurred since the baseline survey in 2006. These reductions are a result of reduced application rates of nitrogen, phosphorus and potassium and fertilized acres.

The most significant nutrient reduction occurred with applied phosphorus and appears to be at least partially a result of mandated phosphorus restrictions, which was the most common restriction reported by facilities. Because phosphorus is an element of potential environmental impairment, superintendents are encouraged to opt out of phosphorus application and reintroduce it only after a soil test or turfgrass response validates the need. Whether voluntary or mandated, this recommendation appears to be followed by more facilities year-over-year as evidenced by the finding that more facilities did not apply any phosphorus in 2021 than in both 2014 and 2006.

Golf facilities interested in reducing fertilized acres may consider reducing fertilization of out-of-play roughs and natural areas, which may further contribute to an overall reduction of applied nutrients and potentially result in improved efficiencies, reduced environmental risk and reduced maintenance costs.

Slow-, quick-release nitrogen % applied

Year	U.S.	NC[i]	NE	Pac.	SE	SW	Trans.	UWM
	Slow-Release Nitrogen (%)							
2006	66 a[ii]	70 a	69 a	60 a	65 a	57 a	62 a	65 a
2014	65 a	69 ab	71 a	59 a	62 ab	49 b	61 a	68 a
2021	62 b	66 b	63 b	54 a	60 b	48 b	61 a	68 a
	Quick-Release Nitrogen (%)							
2006	31 b	28 b	29 b	35 a	31 b	42 b	34 a	33 a
2014	32 b	29 b	28 b	38 a	33 ab	49 a	36 a	29 a
2021	35 a	32 a	35 a	42 a	36 a	49 ab	35 a	30 a

[i] NC, North Central; NE, Northeast; Pac., Pacific; SE, Southeast; SW, Southwest; Trans., Transition; UWM, Upper West/Mountain.
[ii] Within columns, values followed by a common letter are not significantly different according to the Tukey-Kramer test at the 10% significance level.

Table 11. Percentage of slow and quick-release nitrogen applied on U.S. golf facilities in 2006, 2014 and 2021.

Soil amendment use frequency

Soil Amendment	2006	2014	2021
	Golf facilities (%)		
Used at least one amendment	76 b[i]	83 a	84 a
Humic materials	41 c	53 b	58 a
Amino acids/proteins	38 b	49 a	52 a
Biostimulants	43 b	48 a	50 a
Gypsum	34 c	49 a	44 b
Sulfur	8 b	27 a	25 a
Limestone	22 b	26 a	22 b
Sugars (sucrose, molasses, etc.)	14 b	18 a	18 a
Microbial inoculants	14 b	20 a	18 a
Compost	13 b	14 ab	16 a
Biocontrol agents	6 b	8 a	10 a
Calcium chloride	5 b	9 a	8 a
Compost teas	3 c	8 a	6 b

[i] Within rows, values followed by a common letter are not significantly different according to the χ^2 test at the 10% significance level.

Table 12. Frequency of soil amendment and supplement use on U.S. golf courses in 2006, 2014 and 2021.

Nutrient applications

Year	U.S.	NC[i]	NE	Pac.	SE	SW	Trans.	UWM
	Nutrient applications yr^{-1}							
	Greens							
2006	11.9 c[ii]	8.9 b	9.3 c	16.1 b	20.0 b	17.2 b	12.1 b	9.5 b
2014	14.4 b	9.7 b	10.6 b	20.7 a	30.3 a	22.2 a	14.2 a	13.7 a
2021	16.3 a	11.0 a	13.7 a	22.2 a	31.8 a	23.5 a	15.7 a	16.3 a
	Tees							
2006	5.4 b	5.2 b	5.7 b	6.7 a	6.5 b	5.9 b	4.7 a	3.8 b
2014	5.5 b	5.1 b	5.4 b	7.2 a	7.7 a	8.8 a	4.3 a	4.3 ab
2021	6.2 a	5.8 a	7.1 a	7.5 a	7.7 a	7.7 a	4.6 a	4.6 a
	Fairways							
2006	3.5 c	3.2 b	3.1 b	4.0 a	4.4 b	5.0 b	3.4 b	2.6 b
2014	4.0 b	3.5 ab	3.5 b	5.3 a	5.7 a	6.3 ab	3.9 a	3.0 b
2021	4.6 a	3.9 a	4.6 a	4.5 a	6.5 a	7.9 a	3.6 ab	4.1 a
	Roughs							
2006	2.6 a	1.8 a	2.0 a	3.0 a	3.9 a	4.4 a	2.4 a	2.1 a
2014	2.5 a	1.9 a	2.1 a	2.4 a	3.7 a	4.8 a	2.3 a	2.1 a
2021	2.6 a	2.0 a	2.1 a	2.8 a	3.9 a	4.4 a	2.2 a	2.5 a

[i] NC, North Central; NE, Northeast; Pac., Pacific; SE, Southeast; SW, Southwest; Trans., Transition; UWM, Upper West/Mountain.

[ii] Within columns, values followed by a common letter are not significantly different according to the Tukey-Kramer test at the 10% signifi cance level.

Table 13. Number of nutrient applications made annually on U.S. golf facilities in 2006, 2014 and 2021.

The RESEARCH SAYS

- Significant reductions in nutrient use have occurred since the inaugural baseline survey in 2006.
- Golf facilities interested in reducing fertilized acres may consider reducing fertilization of out-of-play roughs and natural areas.
- Soil testing should result in a more efficient use of applied nutrients and remains a common nutrient management tool.
- It is recommended that facilities take the time to calibrate equipment prior to applications.
- It is recommended that facilities continue to invest in infrastructure that allows for the proper fertilizer storage at their locations.

Soil testing should result in a more efficient use of applied nutrients and remains a common nutrient management tool. It is an important factor when making nutrient application decisions. However, soil testing was the only management practice associated with increases in applied nutrients. This association does not denote causality but should be investigated further to determine the cause more confidently and potentially refine the soil testing and application process. It is recommended that superintendents contact their state's land-grant university for accurate soil-testing information specific to turfgrass grown in their location.

It is recommended that facilities take the time to calibrate equipment prior to applications. Although this process may require additional time, the potential money savings and increased risk mitigation justifies the process. Similarly, it is recommended that facilities continue to invest in infrastructure that allows for the proper fertilizer storage at their locations.

FUNDING

The third phase of the Golf Course Environmental Profile was funded in part by the USGA through the GCSAA Foundation.

Secured fertilizer storage facilities

Year	U.S.	NC[i]	NE	Pac.	SE	SW	Trans.	UWM
	Golf facilities (%)							
2006	51 b[ii]	43 b	49 b	62 b	59 b	65 a	49 b	41 b
2014	63 a	59 a	64 a	72 ab	66 ab	72 a	58 ab	66 a
2021	64 a	58 a	65 a	81 a	72 a	48 b	64 a	66 a

[i] NC, North Central; NE, Northeast; Pac., Pacific; SE, Southeast; SW, Southwest; Trans., Transition; UWM, Upper West/Mountain.

[ii] Within columns, values followed by a common letter are not significantly different according to the χ^2 test at the 10% significance level.

Table 14. Frequency of U.S. golf facilities that used fertilizer storage that, at a minimum, had an impervious floor and roof, ventilation, security (locked with access restricted) and containment features to prevent loss to the environment and/or contamination from run off in 2006, 2014 and 2021.

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MARCH

Port St. Lucie—Wednesday, March 2
Port St. Lucie Community Center | 2195 SE Airoso Blvd | Port St. Lucie, FL 34984

Tallahassee—Tuesday, March 7
FSU Rec SportPlex | 3950 Tyson Rd | Tallahassee, FL 32312

St. Augustine—Wednesday, March 8
St. John County Ag Center | 3125 Agricultural Center Dr | St. Augustine, FL 32092

Ocala—Tuesday, March 14
Marion County Extension | 2232 NE Jacksonville Rd | Ocala, FL 34470

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FORT MYERS – Wednesday, March 1

SOLD OUT

Southwestern State College | 8099 College Pkwy, Room U-102 | Fort Myers, Florida 33919

TIME	SPEAKER | TOPIC

PORT ST. LUCIE – Thursday, March 2

PSL Community Center | 2195 SE Airoso Blvd | Port St Lucie, FL 34984

TIME	SPEAKER | TOPIC
9:00 a.m. – 9:30 a.m.	**Check-In**
9:30 a.m. – 10:00 a.m.	**Introduction**
10:00 a.m. – 10:50 a.m.	**Dr. Bonnie Wells,** *Brevard County Extension* | **Recordkeeping Requirements & Proper Disposal of Pesticides in Turfgrass Management** The Florida Pesticide Law requires all licensed pesticide applicators to keep records of pesticides applied. However, a recent needs assessment revealed that some pesticide applicators in the turfgrass management industry could benefit from clarification on these requirements, as well as the requirements for proper pesticide disposal. This presentation will outline the compliance requirements and benefits for recordkeeping and proper disposal of pesticides in detail. We will discuss restricted-use pesticide recordkeeping vs. general use pesticide requirements, what information must be recorded, requirements for record access, enforcement, violations and more. We will discuss the FDACS disposal program, Operation Cleansweep and other contracted hazardous disposal programs that may be useful for turfgrass management facilities.
11:00 a.m. – 11:50 a.m.	**Yvette Goodiel,** *Martin County Extension,* **Henry Mayer,** *Miami-Dade County Extension* | **Climate Change & the Green Industry** In 2022, UF/IFAS Extension surveyed green industry professionals throughout the state about climate change. The professionals we surveyed generally expressed an interest in learning more about climate change and the ways the green industry can play a role in reducing its effects. We will share the results of the survey and discuss some of the actions green industry professionals can take to reduce climate impacts. We will also present research on the role of turfgrass in sequestering carbon and ways to maximize those benefits to mitigate climate change impacts.
Noon – 12:30 p.m.	**Lunch**
12:30 p.m. – 1:20 p.m.	**Dr. Pawel Petelewicz,** *University of Florida* | **Strategies to Tackle Common Weed Challenges in Florida Turf** This presentation will focus on an overview of various strategies to tackle some of the most troublesome and/or common weeds occurring in various Florida turfgrass situations, including tropical signalgrass *(Urochloa subquadripara),* doveweed *(Murdannia nudiflora)* and/or others. Content will include the important identification traits and biology of discussed species, as well as currently available options for their control. This presentation will embrace the principals of IPM and herbicide resistance management as well as the importance of proper turfgrass management practices, aiming to enhance weed control efficacy and reduce environmental impacts. Updates on research conducted at the UF will also be included.
1:30 p.m. – 2:20 p.m.	**Grantly Rickett,** *St. Lucie County Extension* | **Insects & Diseases of Lawns** Participants will learn to identify insects, their feeding habits and their habitats. They will also learn control strategies and common turf diseases, their control and best management practices.
2:30 p.m.	**CEU Distribution**

TALLAHASSEE – Wednesday, March 7

FSU Rec SportPlex | 3950 Tyson Rd | Tallahassee, FL 32312

TIME	SPEAKER | TOPIC
9:00 a.m. – 9:30 a.m.	**Check-In**
9:30 a.m. – 10:00 a.m.	**Introduction**
10:00 a.m. – 10:50 a.m.	**Mark Tancig,** *Leon County Extension* | **Is It Really a Pest: Importance of Identifying Abiotic vs. Biotic Stressors for Effective IPM** This presentation will review pesticide safety concerns for pesticide applicators, including how to tell the differences among types of harmful pesticide effects, common pesticide exposure routes and PPE used to minimize exposure to pesticides, how to recognize symptoms of pesticide exposure, and how to best be prepared to handle spills.
11:00 a.m. – 11:50 a.m.	**Dr. Pawel Petelewicz,** *University of Florida* | **Strategies to Tackle Common Weed Challenges in Florida Turf** This presentation will focus on an overview of various strategies to tackle some of the most troublesome and/or common weeds occurring in various Florida turfgrass situations, including tropical signalgrass *(Urochloa subquadripara),* doveweed *(Murdannia nudiflora)* and/or others. Content will include the important identification traits and biology of discussed species, as well as currently available options for their control. This presentation will embrace the principals of IPM and herbicide resistance management as well as the importance of proper turfgrass management practices, aiming to enhance weed control efficacy and reduce environmental impacts. Updates on research conducted at the UF will also be included.
Noon – 12:30 p.m.	**Lunch**
12:30 p.m. – 1:20 p.m.	**Paul Mitola,** *FDACS* | **Pesticide Safety Outline** This presentation will cover pesticide safety, better understanding of a pesticide label, the proper PPE, how to handle spill control and safety data sheets.
1:30 p.m. – 2:20 p.m.	**Dr. Bonnie Wells,** *Brevard County Extension* | **Recordkeeping Requirements & Proper Disposal of Pesticides in Turfgrass Management** The Florida Pesticide Law requires all licensed pesticide applicators to keep records of pesticides applied. However, a recent needs assessment revealed that some pesticide applicators in the turfgrass management industry could benefit from clarification on these requirements, as well as the requirements for proper pesticide disposal. This presentation will outline the compliance requirements and benefits for recordkeeping and proper disposal of pesticides in detail. We will discuss restricted-use pesticide recordkeeping vs. general use pesticide requirements, what information must be recorded, requirements for record access, enforcement, violations and more. We will discuss the FDACS disposal program, Operation Cleansweep and other contracted hazardous disposal programs that may be useful for turfgrass management facilities.
2:30 p.m.	**CEU Distribution**

ST. AUGUSTINE – Wednesday, March 8

St. John County Ag Center | 3125 Agricultural Center Dr | St. Augustine FL 32092

TIME	SPEAKER | TOPIC
9:00 a.m. – 9:30 a.m.	**Check-In**
9:30 a.m. – 10:00 a.m.	**Introduction**
10:00 a.m. – 10:50 a.m.	**Prissy Fletcher,** *St. John's County Extension* | **Pesticide & Soil Interactions** Soil science is such a broad topic but understanding your soil's properties can help improve pesticide management, while learning how natural processes can break down these products. A review will be given of soil physical and chemical properties and how they impact pesticides' fate in the environment. There will also be a tutorial of the Web Soil Survey and how the information relates to pesticides as well as examples of labeling requirements for specific soil types.
11:00 a.m. – 11:50 a.m.	**Paul Mitola,** *FDACS* | **Pesticide Safety Outline** This presentation will cover pesticide safety, better understanding of a pesticide label, the proper PPE, how to handle spill control and safety data sheets.
Noon – 12:30 p.m.	**Lunch**
12:30 p.m. – 1:20 p.m.	**Dr. Billy Crow,** *University of Florida* | **Nematicide Modes of Action** Recent research on nematicide resistance in turfgrass nematodes highlights the need to rotate modes of action. The modes of action of current and upcoming nematode management products and their efficacy against common turfgrass nematodes will be discussed in detail. Methods for mitigating resistance and preserving nematicide efficacy by product rotation will be provided.
1:30 p.m. – 2:20 p.m.	**Dr. Adam Dale,** *University of Florida* | **Integrating Pest & Pollinator Management in Residential Landscapes** Many ornamental plants support beneficial insects of conservation interest. However, many of those plants are also commonly attacked by insect pests. During this session we will discuss the management of pests on wildlife-friendly plants in urban and residential landscapes. This will include the latest university research evidence and recommendations for IPM on wildlife-friendly plants that protect beneficial wildlife.
2:30 p.m.	**CEU Distribution**

OCALA – Tuesday, March 14

Marion County Extension Office | 2232 NE Jacksonville Rd | Ocala, FL 34470

TIME	SPEAKER | TOPIC
9:00 a.m. – 9:30 a.m.	**Check-In**
9:30 a.m. – 10:00 a.m.	**Introduction**
10:00 a.m. – 10:50 a.m.	**Maxine Hunter,** *Marion County Extension* | **IPM: Intro to Modes of Action** Introduction to applying integrated pest management principles and pesticide modes of action. Additionally this presentation will cover interactions between pest insects and beneficials and wildlife species in Central Florida.
11:00 a.m. – 11:50 a.m.	**Dr. Billy Crow,** *University of Florida* | **Nematicide Modes of Action** Recent research on nematicide resistance in turfgrass nematodes highlights the need to rotate modes of action. The modes of action of current and upcoming nematode management products and their efficacy against common turfgrass nematodes will be discussed in detail. Methods for mitigating resistance and preserving nematicide efficacy by product rotation will be provided.
Noon – 12:30 p.m.	**Lunch**
12:30 p.m. – 1:20 p.m.	**Dr. Adam Dale,** *University of Florida* | **Insect Management in Florida Lawns** During this session, we will discuss the identification, biology, and integrated pest management of key insect pests of turfgrasses in residential lawns. Pests discussed will include the southern chinch bug, caterpillar pests, Tuttle mealybug, and other emerging turfgrass pests. We will discuss insecticide recommendations, cultural practices that influence pest performance, and the latest IPM research.
1:30 p.m. – 2:20 p.m.	**Dr. Norma Samuel,** *Sumter County Extension* | **Weeds as Indicator Species** Participants will learn how weed species can be predictors of certain environmental conditions in Florida lawns and best management practices to prevent these weeds from thriving.
2:30 p.m.	**CEU Distribution**

ORLANDO – Wednesday, March 15

Orange County Extension Office | 6021 S Conway Rd | Orlando FL 32812

SOLD OUT

TIME	SPEAKER | TOPIC

	FDACS									GCSAA	FNGLA
SEMINAR	CORE 487	CORE 482	PRIVATE APPLICATOR AG	ORNAMENTAL & TURF	LIMITED URBAN FERTILIZER	LIMITED LANDSCAPE MAINTENANCE	LIMITED LAWN & ORNAMENTAL	COMMERCIAL LAWN & ORNAMENTAL	MAX CEUS EARNED PER SESSION		
New Port Richey	2	2	2	2	2	2	2	2	4	.40	5
Plant City	2	2	2	2	0	2	2	2	4	.40	5
Lake Worth	2	2	2	2	0	2	2	2	4	.40	5
Ft. Myers	2	2	2	2	0	2	2	2	4	.40	5
Port St. Lucie	2	2	2	2	0	2	2	2	4	.40	5
Tallahassee	2	2	2	2	0	2	2	2	4	.40	5
St. Augustine	2	2	2	2	1	2	2	2	4	.40	5
Ocala	2	2	2	2	0	2	2	2	4	.40	5
Orlando	2	2	2	2	2	2	2	2	4	.40	5

Wildlife Management on Golf Courses is a Balance Between CONSERVATION & CONTROL

Brevard county has 25 golf courses, and each one of them is a unique ecosystem. Photo by Bonnie Wells.

By **Dr. Bonnie Wells,** *Commercial Horticulture Extension Agent, UF/IFAS Extension Brevard County*

Editor's Note: Please tweet or post your wildlife control methods on Twitter, Facebook and Instagram, and we'll compile and publish them.

Out and about viewing golf greens is where I've been lately as the commercial horticulture Extension agent in Brevard County. Here in the county is where you will find 25 golf courses across the 1,557 square miles of land space that is bordered on the east by the Atlantic Ocean. The area is affectionately known as the Space Coast.

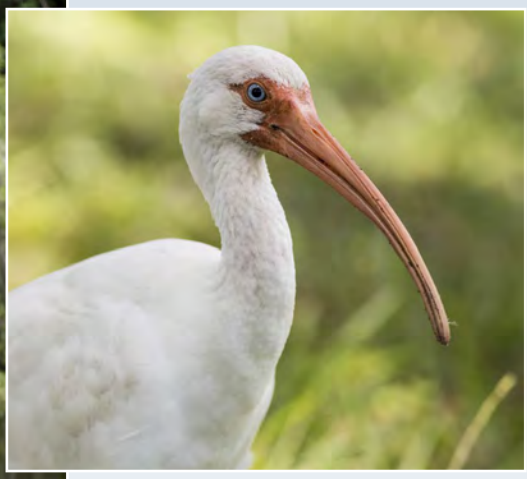
What has surprised and delighted me most about the courses I have visited so far is the biological diversity and the amount of wildlife you can find there, as well as how different each of these golf course ecosystems are compared to one another.

In just the short time, and through the courses that I have visited so far, I've had the pleasure of witnessing an abundance of bird species, from Sandhill Cranes, Ibises, Egrets, Cormorants, and several other species that are likely taking advantage of the coastal area to rest and feed along their journey on the Atlantic Flyway.

One of the most notable encounters I had was with a red-tailed hawk that swooped down in front of the golf cart and strategically plucked a mole cricket from the ground with its talons for a quick bite! I've seen baby alligators sunning on the edge of ponds and little scurrying field mice living among

The foyer at a community center at one golf course in Brevard County proudly displays the bird species that can be found on the course. Photo by Bonnie Wells.

Florida has more than 500 species of native birds. During fall and winter, many migrating birds will stop over to use the coastal areas to rest and feed along their 3,000-mile journeys across the Atlantic Flyway. UF/IFAS Stock Photo.



Many species of wading birds, such as the Ibis, can be found on Brevard golf courses. UF/IFAS Stock Photo.

the tall grassy areas bordering the well-maintained greens and fairways. I've seen a small dolphin pod enjoying the waters of the Indian River Lagoon that some courses are lucky enough to border. Who wouldn't love spending their days riding a cart around the greens having fun playing golf and taking in the beautiful surroundings it has to offer?

But I've also witnessed the struggle these golf courses have with controlling invasive species such as cogongrass, Brazilian pepper tree, and the Australian pine that was once purposely planted throughout Florida without expectations of the resulting consequences. I've seen the incredible damage raccoons can do when looking for grubs under the greens, in a fashion not so graceful and helpful as the hawk in getting his mole cricket meal.

I've been impressed with some of the creative and respectful efforts of controlling the damage that occurs by native wildlife, such as on one course where an innocuous fence was placed around a high-value green that was continually under threat by the grub search by resident sandhill cranes. It turns out that, at least on this one course, the cranes are not equally as smart as they are beautiful, and they do not know they can just skip right over the fence with their long legs or wings.

There is a fine balance between the conservation and control of wildlife on golf courses. The need for these approaches to be integrated is crucial for a healthy and thriving golf course ecosystem.

Invasive species management is probably the

Indian River Lagoon views are a plus for any golf course in Brevard County. In this shot, you can see recently planted mangroves along the banks. It's a great spot for viewing dolphins. Photo by Bonnie Wells.

Cogongrass is a very aggressive invasive weed that is a constant struggle to control on golf courses. Photo by Bonnie Wells.

Raccoons damage turf while digging in the ground searching for a grub meal. Photo by Bonnie Wells.

cornerstone of this approach, as these non-native species crowd out and threaten the natural resources on golf courses that provide necessary habitat and food for our native wildlife.

The use of fertilizers, pesticides, water and other important resources used to maintain the pristine golfing conditions we enjoy often result in golf courses being criticized for potentially threatening our environmental quality. While this is a concern for any system that relies on inputs for high-quality production, such as farms, ranches and nurseries, this public concern creates a unique opportunity for golf course superintendents to be recognized as stewards of the land by protecting and enhancing their course's ecosystem by providing critical natural areas that benefit wildlife and people throughout the increasingly urbanized communities across Florida, the nation and beyond.

One course I visited has been very active in efforts to increase its environmental stewardship. The team transformed a low-lying, continuously saturated green that had once been exceptionally problematic to manage—because of the constantly elevated disease and weed pressure—into a one-half-acre wetland to support native wildlife. Native wetland grasses and plants, such as cordgrass, cattails, pickerelweed and spike rush, were planted; pesticide use was eliminated; and a beautiful Florida wetland has been established. This was once a constant and expensive challenge to maintain properly, and it has been restored and is alive with the sounds and sights of native wildlife. Now that's what I call Florida Friendly!

Commercial Horticulture Extension Agent ***Dr. Bonnie Wells*** *is a Doctor of Plant Medicine in Brevard County, based in Cocoa, Florida. She is a lover of all things insects and fungi. Follow her Twitter feed at https://twitter.com/BrevardPlantDr.*

Notice the fence around the well-maintained green in this photo. Sandhill cranes are a beautiful site on golf courses but can do considerable damage with their beaks when digging for grubs. The fence eliminated that problem for this course. Photo by Bonnie Wells.

Australian pine, which is not really a pine but a *Casaurina* species, is an invasive tree that was once planted deliberately for erosion control along waterways in Florida. This invasive is becoming the dominant species where planted. Photo by Bonnie Wells.

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USING PLUGS

By **Valerie Smith,** Sod Solutions

One of the most frequently asked questions we receive at Sod University is which grasses grow best in shady areas. There isn't a real straight answer to handling shade in a landscape because there are many variables that go into it. These factors include:

- If the area is located in the warm-season, cool-season or transition zone.
- The number of hours of sunlight the area receives.
- If the shade is coming from a tree that can be delimbed or adjusted for more sunlight, or if the shade is from something permanent like a building.

A good way to see if a turfgrass variety works in the area of the home or facility, especially in a cooler USDA Hardiness Zone, is by using warm-season grass plugs to test for shade tolerance.

Some turfgrass managers are not able to say how many hours of sunlight their turf gets and are left feeling uncertain about what they can do to problem-solve. In general, if the shaded area does not receive at least four hours of sunlight, it will be difficult to grow thriving grass. Purchasing a few slabs of sod to use for a trial is a great way to see if the grass will thrive in a given area—but this isn't always possible because some grass varieties are not always available in big box stores or local businesses. However, this is where grass plugs can help.

Oftentimes, grass plugs can be used to repair damaged areas on an already existing area, or to establish a small area when sod is not readily available or practical. **However, purchasing grass plugs is a good way to see how well a specific turfgrass cultivar will perform in shady areas. It's cheaper than investing in a full sod installation and reduces the amount of commitment (and risk) that comes with buying sod that might not perform well.** A cultivar is a specific kind of grass within a species. For example, Floratam and Palmetto® St. Augustine are both St. Augustinesgrasses but different cultivars.

The relative shade tolerance of the most popular warm-season turfgrasses from greatest to least are as follows:

- St. Augustinegrass
- Zoysiagrass
- Bermudagrass

Using St. Augustine Grass Plugs to Test Shade Tolerance

The best warm-season turfgrass varieties for shade tolerance are CitraBlue® St. Augustine (https://bit.ly/3RX2BdR) and Palmetto St. Augustine. While there are many shade tolerant cultivars of St. Augustine, Palmetto has shown to be one of the best grass cultivars for shade among all St. Augustinegrasses. The University of Florida recently released a new St. Augustinegrass, CitraBlue that is now available throughout Florida as sod and as grass plugs. CitraBlue exhibits greater shade tolerance and resistance to certain diseases including gray leaf spot, a common St. Augustinegrass disease, compared to Floratam. If you are looking for a shade-tolerant turfgrass, St. Augustine grass plugs are usually your best option. Palmetto St. Augustine and CitraBlue St. Augustine rank near the top for shade tolerance.

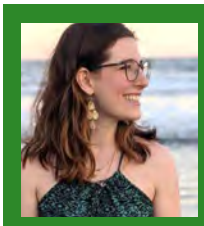
Using Zoysia Grass Plugs to Test Shade Tolerance

If you are specifically looking for a zoysiagrass, know that the finer the leaf blade, the more shade tolerant the zoysiagrass. For example, EMPIRE® Zoysia is a coarser-bladed grass with moderate shade tolerance while Innovation® and CitraZoy® Zoysia are finer-bladed zoysiagrasses and are slightly more shade tolerant.

Using Bermudagrass Plugs to Test Shade Tolerance

If you are looking for a bermudagrass, Celebration® and Latitude® 36 Bermudagrass are shade-tolerant bermudagrasses, but they aren't as shade tolerant as St. Augustine or zoysia varieties. Bermudagrass is the least shade tolerant of all grass species, but these two cultivars rank near the top for shade tolerance compared to other bermudagrasses.

Purchasing grass plugs is a good way to see how well a specific turfgrass cultivar will perform in shady areas. Our best recommendation is to buy a plug tray, water it in and see how it does. If it really starts to thrive, you know you have an option that works for shade in your area. If the turfgrass survives but doesn't really thrive or doesn't perform well, you've saved money for your facility by not purchasing a full order of sod that doesn't work for your area.



***Valerie Smith** is the content strategist with Sod Solutions Inc. and the writer for the Sod Solutions educational lawn and garden blogging platform Sod University (https://sodsolutions.com/sod-university). Sod Solutions has helped successfully develop and release over 20 different turfgrass varieties to the market over the past 27 years including Palmetto and CitraBlue St. Augustine, EMPIRE® and Innovation™ Zoysia and Celebration® and Latitude 36®. Sod Solutions is based in the Charleston, SC area.*

New User-Friendly Soil Test Kit to Improve Florida Landscapes

By **Kirsten Romaguera,** *UF/IFAS Communications*

- **The University of Florida partners with AgriTech Corp. to offer a UF/IFAS-branded Soil Test Kit Powered by SoilKit®, tailored for Florida soils.**
- **Easy-to-understand results help homeowners, landscapers and municipalities provide the proper nutrition to Florida lawns.**
- **Over time, UF/IFAS scientists plan to use artificial intelligence along with geolocation and soil results to target and improve recommendations statewide.**

Florida homeowners, landscapers and municipalities now have an easy-to-use, research-based tool to improve growing conditions for lawns and landscapes.

The new UF/IFAS-branded Soil Test Kit Powered by SoilKit®, the result of a University of Florida partnership with AgriTech Corp., puts UF/IFAS turfgrass science and tailored nutrient recommendations in the hands of users. Available starting February 15, each kit includes a prepaid shipping label, soil bag, QR code to a collection instruction video and a customer care card.

There are two ways to acquire a kit, with either option costing users $29.95 as an introductory special. The kit is ordinarily $31.95. Each UF/IFAS Extension office will be stocked with a limited quantity of kits at no upfront cost; users pay upon registering their kit. It is suggested that residents contact their local office to inquire about the current stock levels. SoilKit.com/Florida will also sell the kits online, and users pay no additional fees to send in their sample.

"The results users receive are not just tailored to their exact landscape, but it also takes into account their broader location, so that information like local fertilizer ban periods are accounted for," said Dr. J. Bryan Unruh, UF/IFAS turfgrass scientist and Extension specialist. "We want Florida's lawns and landscapes to thrive in a way that also protects our waterways and environment."

In addition to the SoilKit®s available at local UF/IFAS Extension offices and the SoilKit® website, the kits will soon be available at additional retailers.

Using the kit is simple and helped by the instructional video at turf.ifas.ufl.edu/soilkit. Users first register their kits at SoilKit.com, which helps target location-based requirements in addition to allowing the user to provide the needed contact information for receiving the results. The next step is to collect the soil sample in the provided bag before sending it to the testing laboratory for analysis. After the lab receives the sample, results are returned via email within one to two business days.

"It is important that AgriTech partner with Florida scientists who specialize in the unique growing conditions of Florida," said Christina Woerner McInnis, CEO of AgriTech Corp. "UF/IFAS Extension already reaches every corner of the state, and now we're able to bring SoilKit® and appropriate plant nutrition to the people who want to best care for their lawns and landscapes."

Dr. Unruh, who is also associate director of the UF/IFAS West Florida Research and Education Center, sees another advantage to widespread participation in the new program: research.

"As we collect results for individual yards across the state, we are building a dataset of the soil conditions," he says, adding that user information will not be identifiable in the larger collection. "Users will receive UF/IFAS turfgrass science-backed information as we know it now, but as we go forward, artificial intelligence can help us target and improve recommendations based on factors like soil composition, age of landscape and climate."

Portions of the kit's proceeds are allocated to the UF/IFAS Turfgrass Science Program and the Florida-Friendly Landscaping Program to support graduate student education and in-service training of county Extension agents and program assistants.

***Kirsten Romaguera** is a public relations specialist at UF/IFAS Communications and a Louisiana native, so she's right at home in swampy Gainesville. You can contact her at kromaguera@ufl.edu.*

OPERATION CLEANSWEEP

The Operation Cleansweep program is funded for 2022–2023. For information about participating, review the image (full-size image at https://bit.ly/3lBeV7f) to see if your company is eligible. Pesticide collection will be done at the participant's site by a hazardous waste contractor according to a pick-up plan that will be developed as approved participants' locations are mapped.

Operation Cleansweep provides Florida Turfgrass Association companies, farmers, nursery operators, golf course operators and pest control services, and others as listed in the image below a one-time safe and economical way to dispose of their canceled, suspended and unusable pesticides. Some of these materials are very old and in containers that are deteriorating. Some, such as chlordane and DDT, are so toxic to humans and hazardous to the environment that they are no longer allowed to be used. Proper disposal can be costly and a regulatory burden for small farmers and other pesticide users. Operation Cleansweep offers an opportunity to avoid these formidable barriers and to promote safe and environmentally sound pesticide use, handling and disposal. Operation Cleansweep began in 1995 with a statewide collection of more than 70,000 pounds of lead arsenate, a widely used pesticide for citrus operations that was banned from use by the EPA.

Through June 2022, Operation Cleansweep collected and disposed of more than 2,122,000 pounds (1,061 tons) of canceled, suspended and unusable pesticides from more than 2,900 participants in all 67 counties. For more information, call 877-851-5285 or Cleansweep@freshfromflorida.com, the updated email address per the phone number's voice mail.

FLORIDA TURFGRASS ASSOCIATION

MEMBER PROFILE:

Bryce Gibson, CGCS

Interlachen Country Club.

Bryce Gibson, CGCS (L) and Head Golf Professional John Ernst (R) after their win at this year's Stuart Leventhal, CGCS, Turfgrass Research Tournament. This is the first time in the 35 years of the event that a team from Interlachen has won.

Bryce Gibson, CGCS and FTGA director, might have taken a different career path if his parents hadn't sold their Upstate New York family farm during his sophomore year in college. "I needed a new summer job, and I liked to golf. I knew how to operate equipment and was used to waking up early, so stopping by the local semi-private club made sense," says Bryce. Still in New York and within two months of starting the summer job at the golf course, Superintendent Tom Corcoran started to mentor him and make him think about his future career path.

At the time, Bryce was studying to become a schoolteacher. When his parents eliminated his summer job after selling the family farm, he discovered his passion for golf course maintenance. That led him to transfer to SUNY and change his course of study to turfgrass science. His advisor was GCSAA Col. John Morley award recipient Robert (Bob) Emmons, and he encouraged students to join the GCSAA on the first day of class.

Today, Bryce is the certified golf course superintendent at Interlachen Country Club. "Some call our property the 'Sanctuary in the City' due to its isolation and natural land among thousands of homes. I manage a crew of 27 employees to prepare the 18-hole private golf course, grounds and native areas for members' use. Our team looks after 270 acres of land in the Metro Orlando town of Winter Park, Florida."

Bryce spends his days working with Assistant Superintendent George Long to coordinate tasks and projects for the crew and with Horticulturalist Emi Sakiyama on common area maintenance and improvements. The job also includes communicating and planning long-range improvements with the club's General Manager Barry Herman and the board. He says, "The most gratifying element of the job is the ability to prepare an enjoyable golf course for the members and their guests while building a strong team to perform the tasks needed to produce the desired conditions."

Personal and professional growth are the hallmarks of leaders in the industry. Bryce understands that turfgrass professionals must be adaptable and open to change, and he leads by example. "I continue to learn every day;

Interlachen Grounds Team.

however, I have grown the most at working with the environment and enhancing stewardship to protect and coexist with our surroundings. Over the past few years, we have reduced fertilizer and pesticide inputs as well as water usage."

The Interlachen team has not only educated themselves on environmental stewardship, but they also educate club members on its importance. "With the much-needed inception of the Best Management Practices (BMPs) certification program in Florida and now nationwide, our profession has become more visible to the public. With this evolution, we must use BMPs to educate and create guidelines to work with the land successfully. Many tools are being implemented to monitor our properties for best management. At Interlachen, we use moisture meters to track water needs, stay current with education in new pesticide technology from synthetic to natural pesticides and use our property for education through member activities like the semi-annual Interlachen Bird Walks."

Regarding industry challenges, Bryce says, "I still see our industry struggling with involvement. I remember, as a teen, seeing how my father put in his time with the State of New York Farm Bureau. Even as he operated his family farm, he took the time to attend meetings, drive to Albany to meet government officials and encourage other farmers to be involved. We also volunteered our time to help others in need. Our industry is at a point where some believe things will fix themselves; this is irresponsible to assume as others are pushing for change that will negatively impact the industry.

"I try to be involved as time allows. The past four years have been difficult with some life situations and the COVID-19 pandemic, but I am now able to become more engaged again. We need to ensure that everyone understands that if we want to protect our way of life, people need to be involved through personal or monetary contributions. From the top owners down to the entry-level employees, volunteering, paying memberships and educating people are vital to the stability and growth of our industry.

"Our club demonstrates its commitment to us by hosting the 35-year-running Stuart Leventhal, CGCS, Turfgrass Research Tournament. Spearheaded by Stuart Leventhal, CGCS, to help and give to the industry, Interlachen holds to their commitment even after Stuart's retirement."

Bryce has been an FTGA member for 17 years and, most recently, serves on the board. He has been fortunate that all his employers have considered association membership important and have financed his participation. They have encouraged him to educate himself and take advantage of all the member benefits.

"In my first year on the board, I am still learning about the association. As a long-time member, I know the benefits; as a board member, I am still figuring out how to contribute and help strengthen the industry. If you are passionate about your turfgrass career or want to protect your livelihood, it is essential to be involved. Participation allows you to meet so many people, learn new things, gain pride in our industry and represent your employer in a positive light.

"You might be wondering how you can get involved. I am a Grassroots Ambassador for the GCSAA and am the Central Florida Chapter Representative on the FGCSA Government Relations Committee. I also stay involved locally on the Seminole County Parks and Preservation Advisory Committee.

"You can start by attending local meetings and events and making your voice heard. Over the years,

I have attended county and city commission meetings about local fertilizer ordinances. I have met with both Florida District 7 Congress Representatives John Mica and Stephanie Murphy during my tenure as a grassroots ambassador and attended National Golf Day in Washington D.C. Meeting these officials enables me to be in contact with them and help them learn about the importance of turfgrass and the measures we take to be the best stewards of our environment," Bryce says.

Bryce grew up on a dairy farm in Dundee, New York, and has been a Florida Gator fan since he was 12 years old, which he feels is odd being from upstate New York. He entered the golf industry by circumstance and did what every Gator fan dreams of doing. He came to Florida! In 2005, he interned at Card Sound Golf Club and never returned to live in his home state. In addition to his passions for golf and golf architecture, he enjoys fishing and boating with family, and he's starting to travel more as a new chapter in life has started with his wife Valerie and stepchildren Andrew, Jackson and Katelyn.

Taking a lesson from the restaurant industry, Bryce offers this advice: "Leave your properties every once in a while. Visit another local facility and ask some people out for a drink. Trust your subordinates to take care of the property without you. Get involved and communicate to your superiors the importance of involvement; it also pays dividends for them."

Marketplace

Ideas, People, Events, Products, Promotions, Sound Bytes, Etc.

UNSUNG HERO SPOTLIGHT

Spotlight on Maxine Hunter, Marion County

Maxine Hunter is the Agriculture and Natural Resource Extension agent at UF/IFAS Extension Marion County. Maxine has been an Extension agent since 2014 and enjoys working with the people of Marion County and her co-workers. She says, "My favorite part of working for UF/IFAS Extension is that no two days are the same, and I am always learning something new." Maxine teaches research-based best management practices to a wide variety of audiences including turf, landscape and pest management professionals, natural resource managers and equine enthusiasts. Additionally, she is an International Society of Arboriculture Tree Risk Assessment Qualification or ISA TRAQ certified arborist; she helps evaluate tree risk for both residential and commercial farm owners. She has fun identifying plant diseases and pest issues and helping develop management plans to resolve them.

Maxine grew up in North Florida near Jacksonville and spent much of her youth hunting and fishing with her dad. She went to UF to get her bachelor's degree in wildlife ecology and conservation, and she still enjoys the outdoors as a Florida wildlife enthusiast. After graduating, Maxine was able to get a job with an environmental firm that worked with the St. Johns River Water Management District. She says, "This was a wonderful opportunity for me to do field work and get a better understanding of some of the challenges we face with our natural resources in North Central Florida." She is thankful she gets to incorporate these experiences and her passion into her work with Extension. "With so many new people moving to Florida from other areas, it is easy to forget the amount of habitat loss we are experiencing; a lot of people really don't understand the needs of Florida's wildlife."

Maxine received her master's degree in agriculture education and communication in 2014 and is now working on her Ph.D. in entomology. She is researching water quality effects on chironomid midges in storm water ponds and loves working with many different types of insects. She says, "I'm definitely a bug nerd, when you do things you like, it makes for easy work." She hopes to graduate at the end of 2024. Maxine is a busy mom of two, and has a small farm with three dogs, two horses, rabbits and chickens. She enjoys 4-H events with her kids and going fishing with her husband and kids. She also enjoys working with her animals, especially her Jack Russel, Molly, on agility training and hopes to start competing soon.

Maxine collecting chironomid midge eggs from inside a manatee rehabilitation pool.

FTGA NEWS & EVENTS

FTGA Ramps Up Social Media Presence

Life comes at your fast—faster than we can get out magazines and newsletters. It's a challenge to keep up with all the FTGA and industry comings and goings, but we have a solution: social media. Please follow us on Twitter at https://twitter.com/FloridaTGA, on Facebook at https://www.facebook.com/FloridaTGA and on Instagram at https://www.instagram.com/floridatga.

Please like, share and repost our content. Also, when you register for an event, please include a hashtag such as #Seeyouatthe[location]FTGATurfSeminar or #SeeyouattheFTGAConference, it will generate interest, and you can search on the hashtag to find friends and colleagues who are also registered.

PEOPLE & ACCOLADES

Mike Caprio is on the Move

Mike Caprio has moved to Nufarm and accepted the position of key account manager. He says, "I could not be more excited to start this next chapter in my career, and I'm looking forward to joining the Nufarm team." You can follow Mike on Twitter at @mike_caprio.

A Heart-felt Thank-you to Darren J. Davis, CGCS, for once again serving as our guest editor. For those who do not know, EIC MJ Plaster says, "I served as Darren's managing editor in the 2000s and learned everything I know about magazine editing thanks to Darren." Follow Darren on Twitter at https://twitter.com/DarrenJDavisGCS.

Tim Hiers Honored as a Legend

FTGA member Tim Hiers was honored by Anuvia Plant Nutrients at the GCSAA Conference and Trade Show. Anuvia named him the 2022 Legend Honoree. There's no doubt Tim is a legend in the industry, and it was great to see him honored for his work, his knowledge and his commitment to the industry. To see more, visit Golfdom's article at https://bit.ly/3DV4kuo.

Dave Nowakowski Receives Recognition

FTGA member Dave Nowakowski of Harrell's LLC Turf Florida has been named one of Harrell's LLC 2022 Sales Professionals of the Year (SPOTY). The SPOTY is the most prestigious award a territory manager can achieve at Harrell's.

PRODUCTS

Harrell's LLC Announces Collaboration with GreenSight Inc for New Application Planning Feature Inside TurfCloud

GreenSight Inc. is excited to announce a collaboration with Harrell's LLC and the addition of a new application planning feature inside TurfCloud. The application planner debuted at the 2023 GCSAA Conference and Tradeshow.

GreenSight's TurfCloud is an online platform founded in 2015 to help golf course superintendents manage their turf and teams. The program uses the integration of robotics, AI-driven automated data analysis and cloud-based planning tools to provide actionable data to decision-makers and day-to-day operators.

It integrates seamlessly with job assignments and inventory planning, allowing the superintendent to view available stock when planning applications and easily assign the application to crew members.

Additionally, spray tank mix lists and inventory reports can be exported or printed directly from the application planner.

The service is free to the end user. For more information visit https://bit.ly/3jlvxJT.

IN MEMORIAM

Harvey L. Massey, retired Chairman and CEO of Massey Services, passed away peacefully on Tuesday, January 24, at the age of 81.

Harvey L. Massey was born in the small town of Melville, Louisiana, a grandson of Italian immigrants and Missouri farmers. At the age of 18, he joined the U.S. Army Security, where he served for three years before he was honorably discharged. While serving his country, Harvey met the love of his life, Carol Nisula and they married on August 24, 1963.

Harvey Massey worked for Orkin and Terminix, two of the largest companies in the pest management industry, for over 22 years. In 1985, with two kids in college and one entering high school, he put everything at risk, moved to Orlando from Memphis and bought a stagnant 50-year-old pest and termite company for $3.9 million. Under his leadership, the company, Massey Services, has grown to a $350 million business.

Harvey was an entrepreneur, philanthropist and rancher. He was an accomplished musician and could break into a song at the slightest provocation. His larger-than-life presence lit up the room and it's been said: "He never met a stranger." When asked how he was on any given day, he always responded, "On a scale of 1–10, I'm an 11."

He believed his faith was the compass that provided him with the right direction and often said, "The three most important things in his life are family, faith and vocation." Not surprisingly, his favorite saying was "Blessed are those who can give without remembering and receive without forgetting."

Harvey was an acknowledged leader in the pest management industry and in the community. He served on the Board of Directors of the National Pest Management Association and was the first Chairman of the Professional Pest Management Alliance. In 2018, he was awarded the Pinnacle Award, which recognizes outstanding contributions to the industry. He also gave tirelessly of his time and expertise in the community and had served on many boards, including Board of Governors for Stetson University; Board of Directors of Pontifical Irish College of Rome, Italy; Board Chairman of Rollins College Center for the Advanced Entrepreneurship Program; Board of Directors for Florida Citrus Sports; Orlando Chamber of Commerce; Enterprise Florida; and Edyth Bush Charitable Foundation, to name a few. In recognition of his outstanding contributions, Harvey received countless awards including, Mennello Museum's Distinguished Service Award, Laureate in Junior Achievement Hall of Fame, Orlando's Most Influential Citizen, Economic Development Commission's James B. Greene Award, the H. Clifford Lee Lifetime Achievement Award from the Association of Fundraising Professionals and the Ernst and Young Entrepreneur of the Year. In 2016, he received the prestigious Horatio Alger Association of Distinguished Americans Award in Washington, D.C.

An unwavering philanthropist, Harvey, along with his wife Carol, formed the Harvey and Carol Massey Foundation to solidify their commitment to being contributing members of the Central Florida community. The foundation has made major contributions to the Dr. Phillips Performing Arts Center, the Nemours Children's Hospital for early childhood autism research, Central Florida Veterans Memorial, a music room for Rollins College and the American Heart Association.

Harvey leaves a legacy of service, care and accomplishments. He was a man known for his thoughtful leadership, drive and compassion. He was a mentor to many, a friend to all and a beloved husband, father and grandfather.

He is survived by his wife of 59 years, Carol Massey; their three children: Angela Rignanese (husband Shane), Tony Massey (wife Jann) and Andrea Massey-Farrell (husband James); their 10 grandchildren (Kallie, Sean, Ashley, Ryan, Colin, Bryan, Jackson, Aidan, Ethan and Edward).

Funeral services were held at St. Margaret Mary Catholic Church in Winter Park on Saturday, January 28, at 10:00 a.m., where Harvey's life and generosity were celebrated.

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