Systematic improvement of golf course conditions

Micah Woods

April 3, 2024

Asian Turfgrass Center
www.asianturfgrass.com
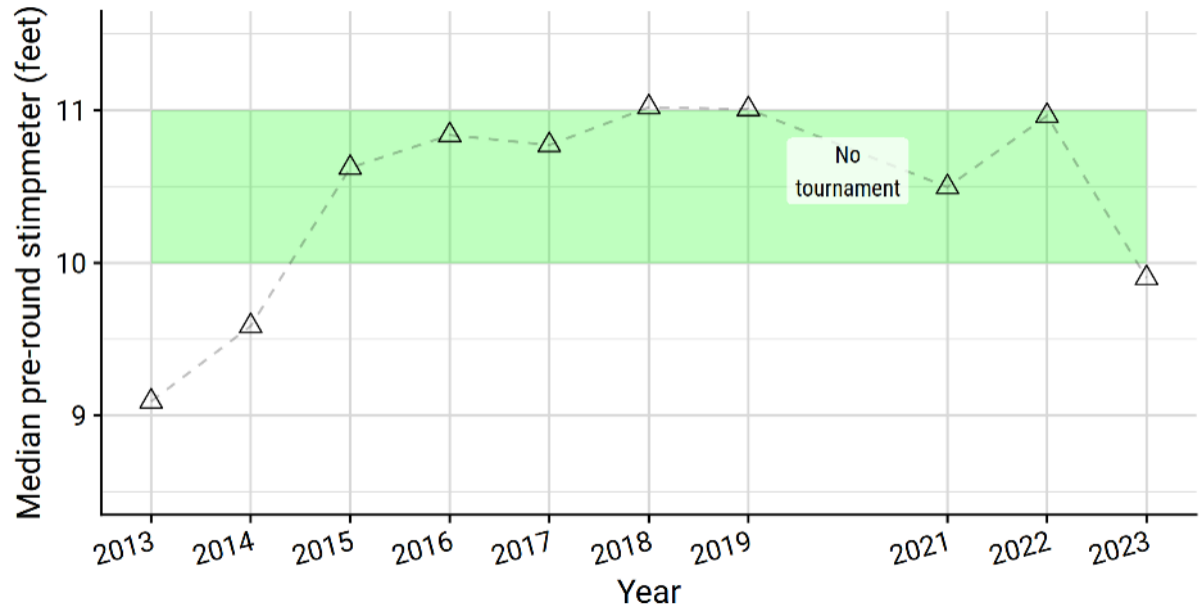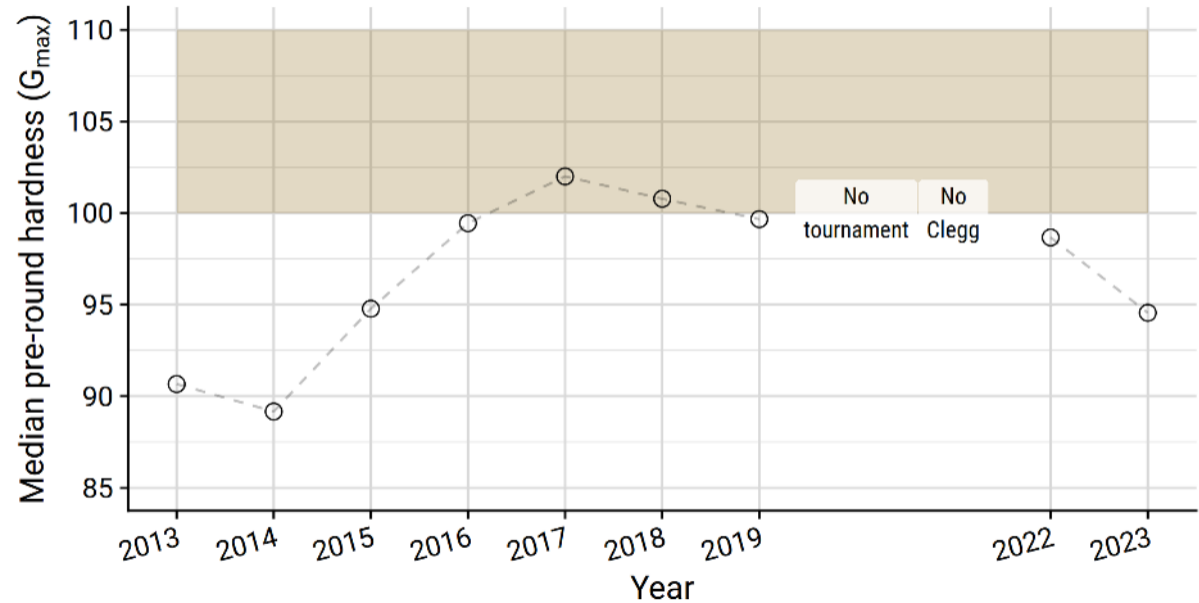
PACE Turf
www.paceturf.org

Measure playing conditions

What to measure?

- Stimpmeter
- Bobble test (smoothness, trueness)
- Surface hardness (firmness)

KBC Augusta tournament week green speed

Median pre-round stimpmeter (feet) vs Year

No tournament

KBC Augusta tournament week surface hardness

Y-axis: Median pre-round hardness (G_{max})

X-axis: Year

No tournament | No Clegg

Comparing Three Methods to Measure Putting Green Trueness

Douglas T. Linde,★ Andrew D. Mitchell, and Brendan Hannan

D.T. Linde, Plant Science Dep., Delaware Valley Univ., 700 E. Butler Ave., Doylestown, PA 18901; A.D. Mitchell and B. Hannan, New Zealand Sports Turf Institute, P.O. Box 347, Palmerston North, NZ 4440. Received 12 May 2016. Accepted 6 June 2017. ★Corresponding author (douglas.linde@delval.edu). Assigned to Associate Editor Scott Ebdon.

ABSTRACT

Since there was not a standard method to measure putting green trueness, a golf course and plot study were conducted to compare three methods to measure putting green trueness. In 2013, the Royal & Ancient (R&A) "Holing Out Test" (HOT), a visual bobble test, and a ball spread test were conducted on 150 greens from 50 New Zealand golf courses. In 2015, a plot study was conducted to compare the methods
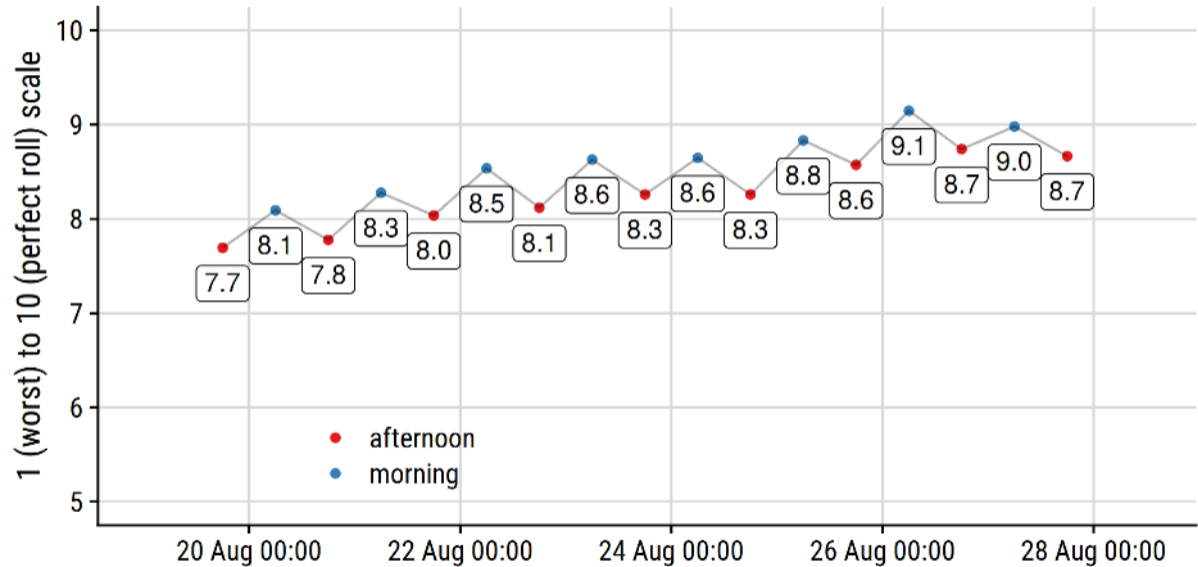
least putts on a core-aerated green without topdressing. Based on the survey, most golfers assessed trueness visually by how many times the ball bounces as it rolls. However, the similar ranking of the photos by most respondents indicated that golfers also assessed trueness based on the appearance of the surface.

The golf course and plot studies had similar results. Both had weak correlations and a large difference in sensitivity between the HOT and the other methods. Thus, the HOT was not measuring the same characteristics as the other methods. The bobble test was the easiest method to administer, took the least time to conduct, and measured a wide range of trueness. The HOT was the least effective method to measure trueness and was difficult to administer. On many of the greens tested, rolled balls

Average bobble test

Chart plotting "1 (worst) to 10 (perfect roll) scale" on the y-axis (5 to 10) against dates from 20 Aug 00:00 to 28 Aug 00:00 on the x-axis.

Data labels: 7.7, 8.1, 7.8, 8.3, 8.0, 8.5, 8.1, 8.6, 8.3, 8.6, 8.3, 8.8, 8.6, 9.1, 8.7, 9.0, 8.7

Legend:
- afternoon (red)
- morning (blue)

KBCオーガスタ 2023

KBC Augusta tournament week surface smoothness & trueness

Median pre-round bobble score (y-axis, range 6 to 10) vs Year (x-axis, 2013 to 2023)

No bobble test measurements 2013 to 2021
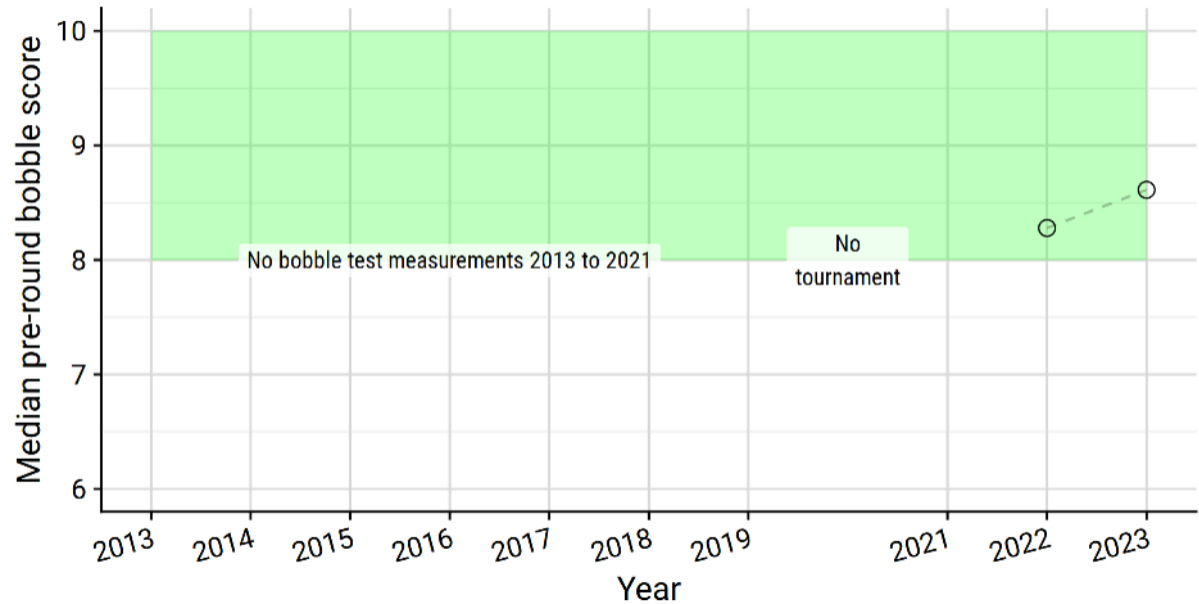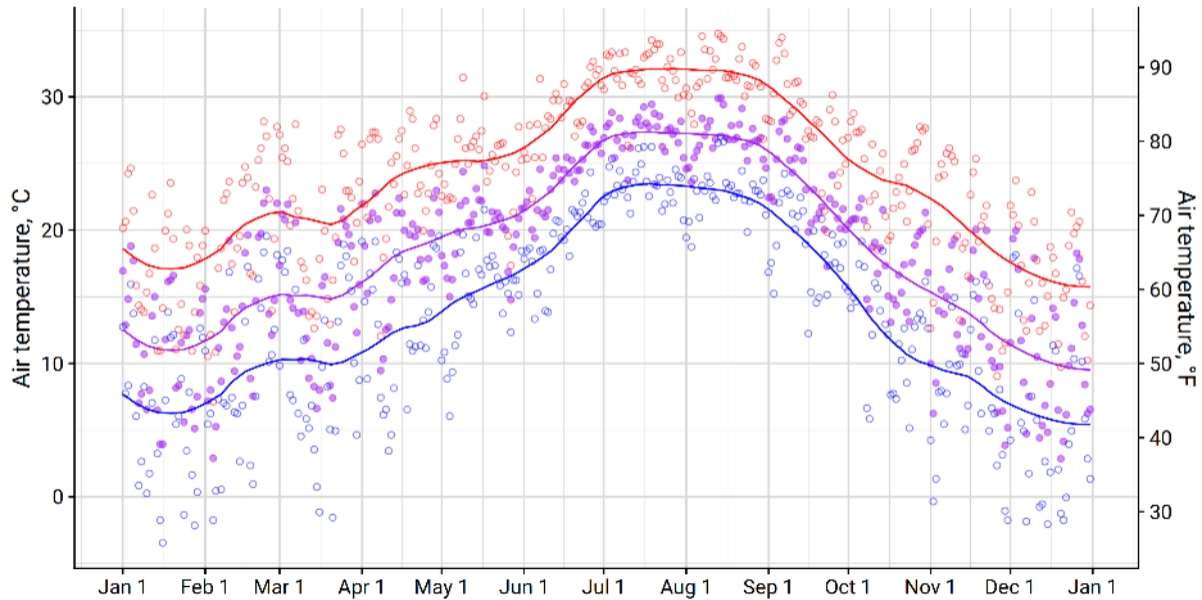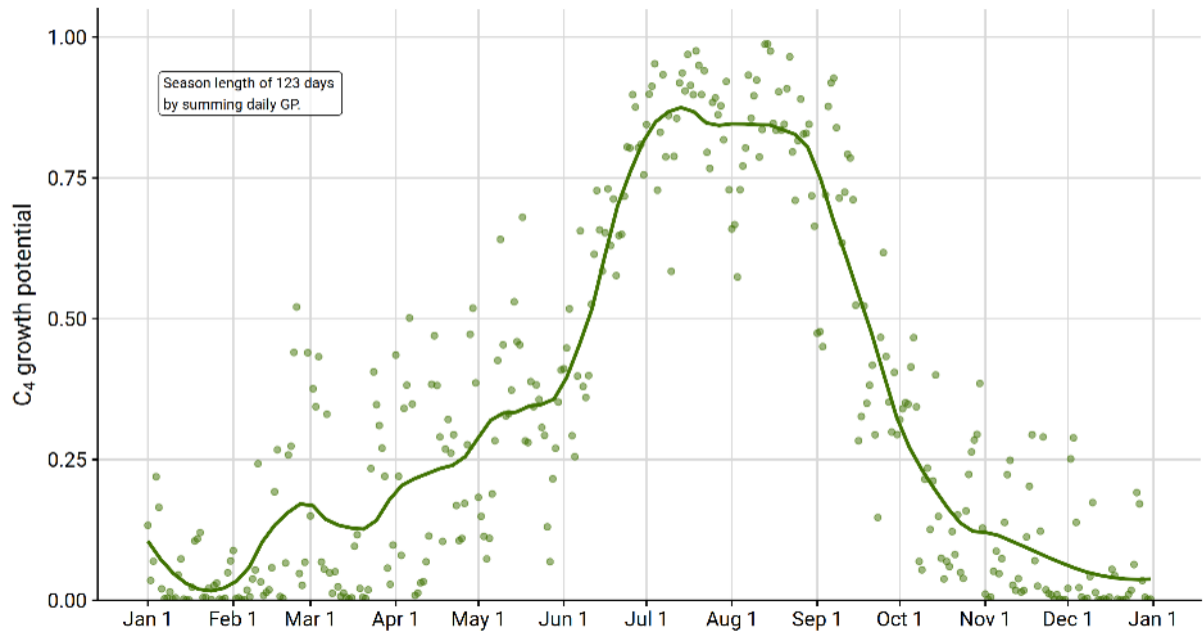
No tournament

Know (and question) the N rate

Daily temperature summary in 2023
Horry-Georgetown Technical College

Growth potential at Horry-Georgetown Technical College in 2023

Season length of 123 days by summing daily GP.

C_4 growth potential

Predicted daily N by GP at Horry-Georgetown Technical College in 2023

month	grams
1	0.2
2	0.4
3	0.5
4	1
5	1.3
6	2.4
7	3.5
8	3.4
9	2.1
10	0.9
11	0.3
12	0.2

Total annual N of 16 g by summing daily GP × max daily N

N, g/m²/d

Monthly maximum N set at 4 g (0.8 lbs)
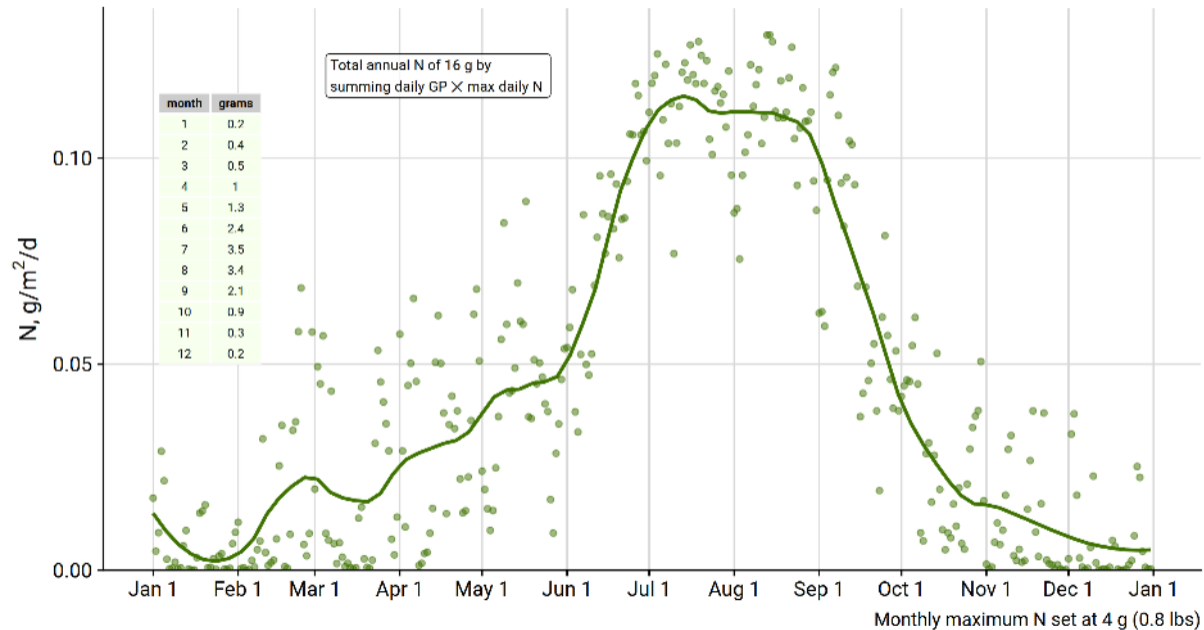
Use PGRs with purpose

Getting answers to *all* my PGR questions

Bill Kreuser, Ph.D.

Golf Course Superintendent at Ager Jr. GC

Measure the clipping volume
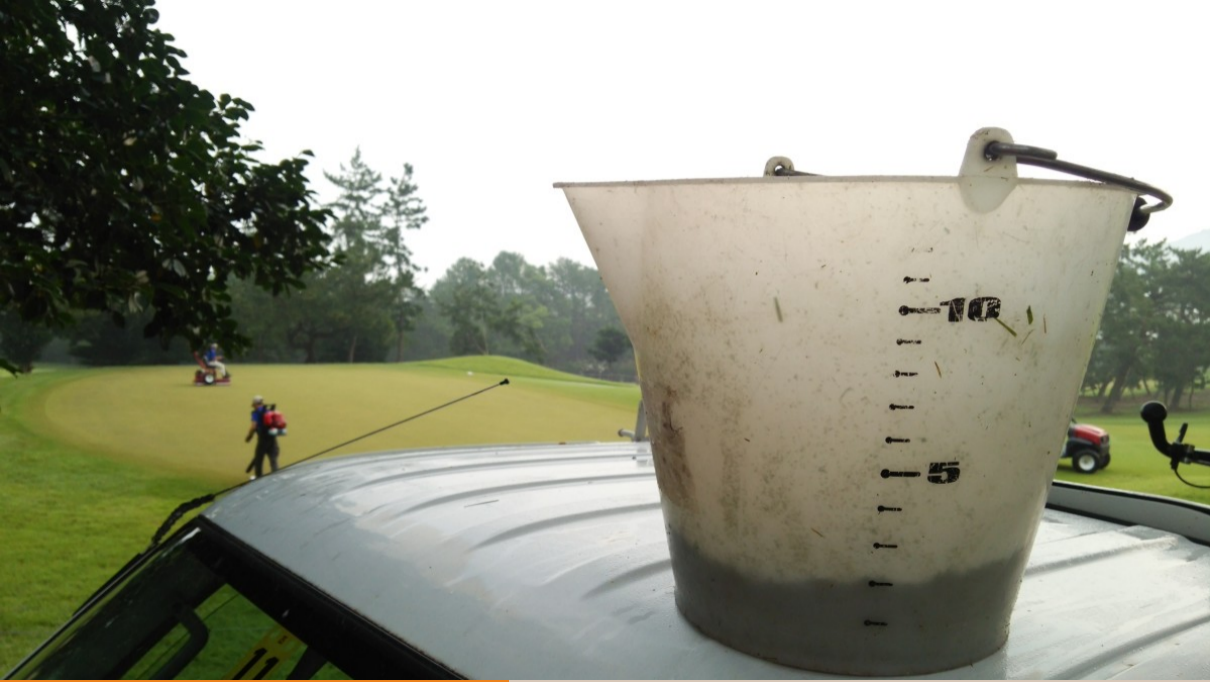
Christofer Andersson
@ChristoferAnde1

Easy way of measuring clippings. Picture uploaded to Slack. 3 man operation, 4 greens every time the mow.

4:30 AM · Nov 1, 2022 · Twitter for Android

Example uses for the data

- Fine tune nutrient supply based on harvest
- When to mow again based on growth
- Growth regulator effect
- Topdressing requirement

Expected clipping volume for Horry-Georgetown Technical College in 2023

based on a growth ratio of 0.5

Total annual ClipVol of 1235 mL by summing daily GP × 10 (GR = 0.5)

month	mL
1	14
2	32
3	42
4	76
5	99
6	183
7	268
8	256
9	162
10	65
11	22
12	16

Cumulative clipping volume

2023 in black

Cumulative clipping volume

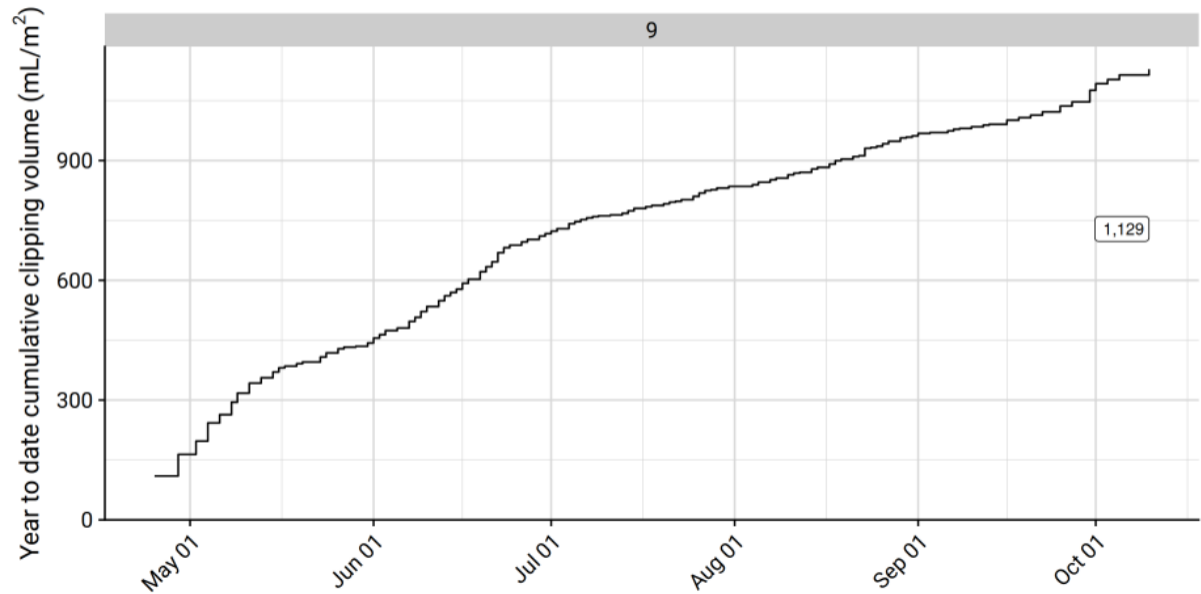2023 in black, and the 2023 average across all holes in green.
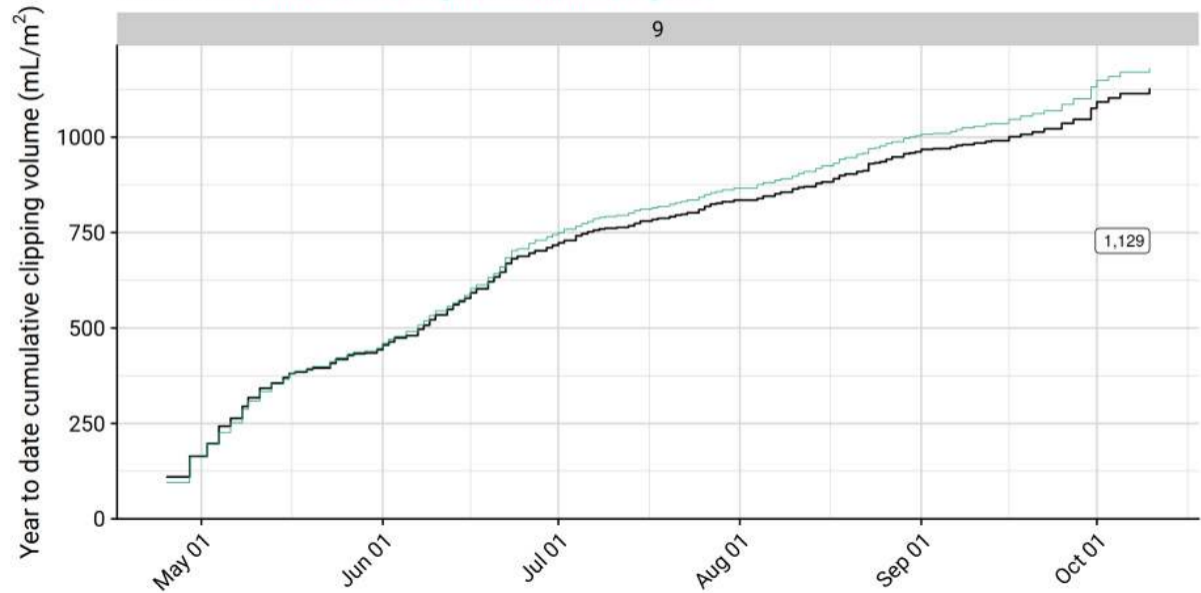
Figure: Year to date cumulative clipping volume (mL/m²) for hole 9. The panel shows 2023 in black and the 2023 average across all holes in green, from May 01 through October 01. The 2023 line ends at 1,129.

Cumulative clipping volume

2023 in black, 2022 in pink, and the 2023 average across all holes in green.

Y-axis: Year to date cumulative clipping volume (mL/m²)

Panel label: 9

Annotations: 1,492 (pink), 1,129 (black)
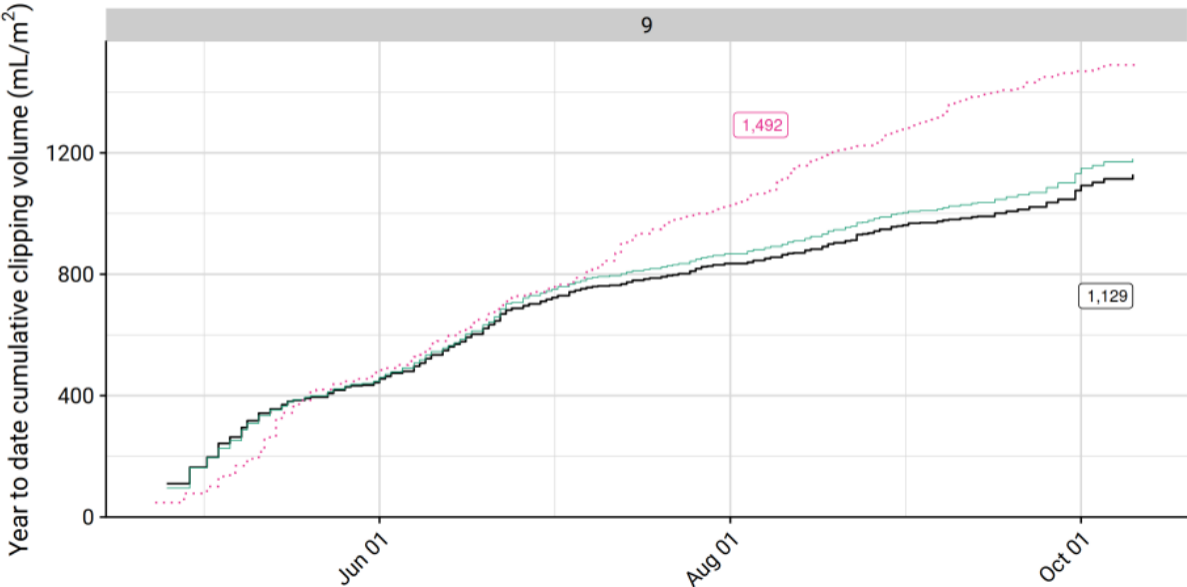
Cumulative clipping volume green by green

2023 in black, 2022 in pink, and the 2023 average across all holes in green.

Know the water use

each color represents a different golf course
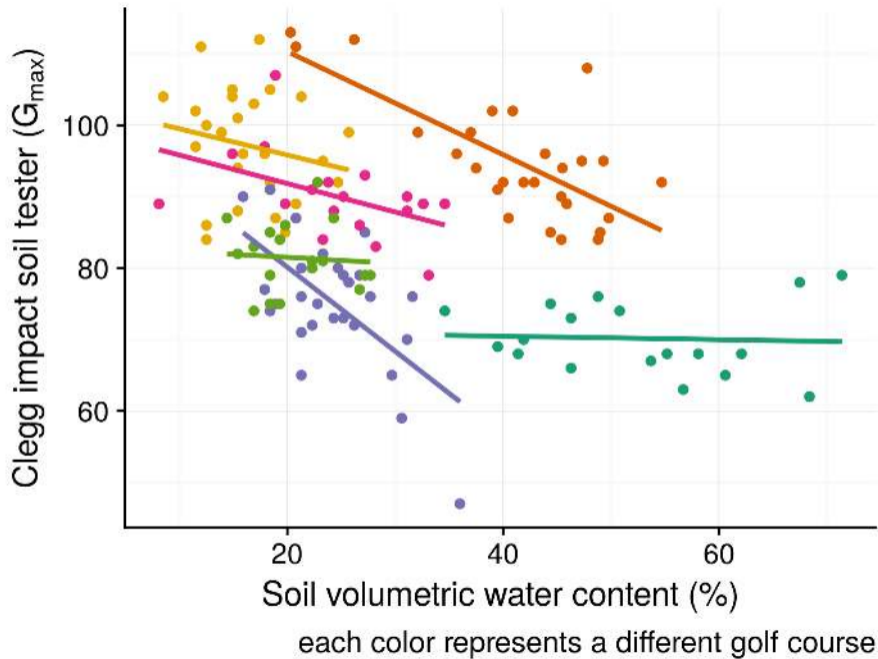
Know the water use

- How many liters (or m^3, gallons, or acre/feet) of water was used?
- What was the irrigated area?

Use a water budget

Micah Woods   Member No.
lat,lon = 13.912,100.591   FC = 27   WP = 18
2017   Irrigation   Total = 768 (mm)

2018   Irrigation   Total = 816 (mm)

2019   Irrigation   Total = 1088 (mm)

PACE TURF
INFORMATION CENTER

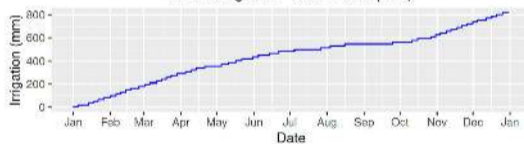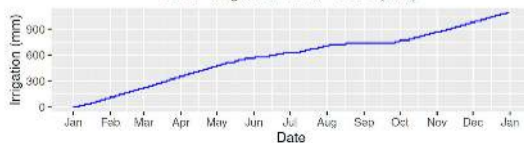**Thursday, April 21, 2022**

Easy tool for monitoring water use

Thursday, April 21, 2022 | Permalink | Water.

As the drought persists, water restrictions are again on the horizon. In an effort to assist in estimating water budgets, the PACE water budget spreadsheet and the new PACE Evapotranspiration and Irrigation estimates provided on your Weather page will come in handy. Evapotranspiration (ET) is estimated using the same method we implemented for the GCSAA Water Survey. Estimated irrigation is computed using rainfall, soil water holding capacity and ET. Your PACE Weather page provides links to the past five years of ET and Irrigation data. These data make calculating water budgets easy and provide assistance in communication to members and regulators. An example has been provided below.

Most turf managers are expected to create, and to follow financial budgets each year. But water budgets are still very rare — at least for now. However, water budgets may become more common in the near future. Whether you are suffering in a drought-affected area, or you are trying to comply with water use regulations, or just want to save on your water bills, a water budget can be a useful and important part of your management program.

We have created an easy to use water budget spreadsheet that will estimate how much irrigation water it was at your location. By calculating water budgets for previous years, you can get an idea of whether you are over using irrigation water, or whether you are staying within generally acceptable guidelines. If you need to reduce water consumption in the future, some suggestions for reducing water use are described here.

Instructions for completing the water budget spreadsheet. This should take you less than 10 minutes to complete. Here are the factors you need to provide:

- **Number of square feet of turf, and number of square feet of landscape**
- **Landscape factor (LF)**: This is a number used by many regulatory agencies to determine the maximum volume of water to be used in specific areas. Typically, a factor of 1.0 is used for golf course greens, tees, fairways and roughs. This means that these areas are usually allowed to use the full reference evapotranspiration (ET). A factor of 0.8 is typically used for landscaped areas that are not high performance turf.
- **Drought factor (DF)**: In areas where drought is an issue, a mandatory or voluntary reduction in water budgets is sometimes applied. If your region has not been assigned a drought factor by regulatory agencies, you can set this value to zero.

Search PACE Turf

Recent Entries

- Nitrogen harvested in clippings: calculation update for 2024
- A clipping volume recommendation
- MLSN test on half the course
- Normal leaf nitrogen content for putting green grasses
- Seashore paspalum tissue guidelines
- All about OM246 testing for soil organic material
- El Niño southern oscillation forecast update
- The NC State Turf Diagnostics Lab year in review 2023
- Humic and fulvic acid application "had no effect"
- Particle size distribution curve
- Six systematic ways to adjust the N rate
- The USGA's standard organic matter test recommendation
- Improved climate appraisal spreadsheet
- Favoring creeping bentgrass or Poa annua with P fertilizer
- A compact height of cut gauge with a laser

- For each previous year of interest, enter the annual irrigation (inches) from your PACE Weather Irrigation estimate for your location. The Irrigation estimate takes into account rainfall throughout the year.
- The spreadsheet will calculate the total estimated water use for the year, and will then calculate your water budget for each year that you entered data for. The budget appears in the red box on the right side of the spreadsheet. Variables that will be calculated include:
  - Number of gallons used on turf
  - Number of gallons used on landscaped areas
  - Total gallons used
  - Total hundred cubic feet of water used
  - Total acre feet of water used

A	B	C	D	E	F	G	H	I	J	K
		Sq Ft.	Landscape Factor	Drought Factor % Reduction		Location:	Example San Diego golf location, 120 irrigated acres of turf, 15 acres landscape			
	Turfgrass	5,227,200	1	0						
	Landscape	653,400	0.8	0						
						Water Budget				
	Evapotranspiration (in)			Turf Gallons	Landscape Gallons	Total Gallons	Total HCF	Total Acre feet		
	Year	Total								
	2017	35.0		113,979,096	11,397,910	125,377,006	167616	384.77		
	2018	35.0		113,979,096	11,397,910	125,377,006	167616	384.77		
	2019	30.0		97,696,368	9,769,637	107,466,005	143671	329.80		
	2020	34.0		110,722,550	11,072,255	121,794,805	162827	373.77		
	2021	30.0		97,696,368	9,769,637	107,466,005	143671	329.80		
	Average	32.8								

Larry Stowell Member No. 10
lat,lon = 32.813,–117.246
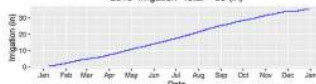2017 Evapotranspiration Total = 42 (in)

Larry Stowell Member No. 10
lat,lon = 32.813,–117.246 FC = 27 WP = 18
2017 Irrigation Total = 35 (in)
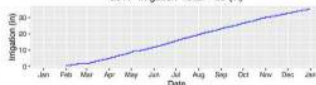
2018 Evapotranspiration Total = 41 (in)

2018 Irrigation Total = 35 (in)

Measure soil nutrients

Results of effective soil testing

1. You apply the correct fertilizer.
2. The grass is supplied with all the nutrients it can use.
3. Unnecessary fertilizer applications are eliminated.
4. Reduced risk of N & P pollution.

Potassium (K)

Phosphorus (P)

mg/kg

Date	Value
2013-05-13	169
2014-07-08	186
2015-06-10	117
2016-05-13	146
2017-08-09	112
2018-06-06	95
2019-05-16	70
2020-04-22	69
2021-04-01	57
2022-02-21	59
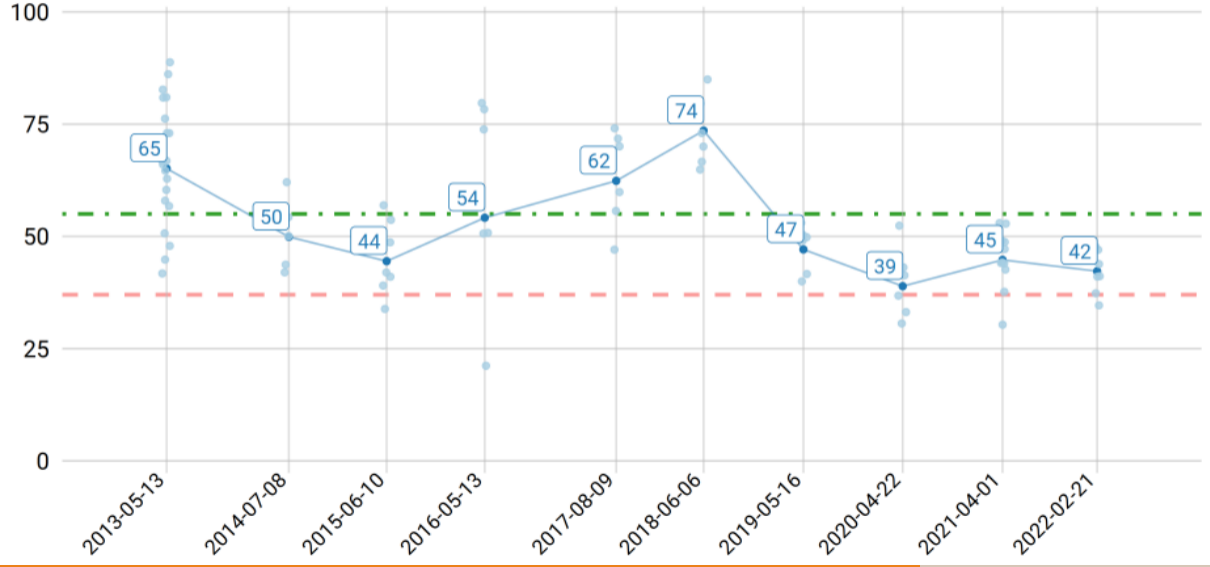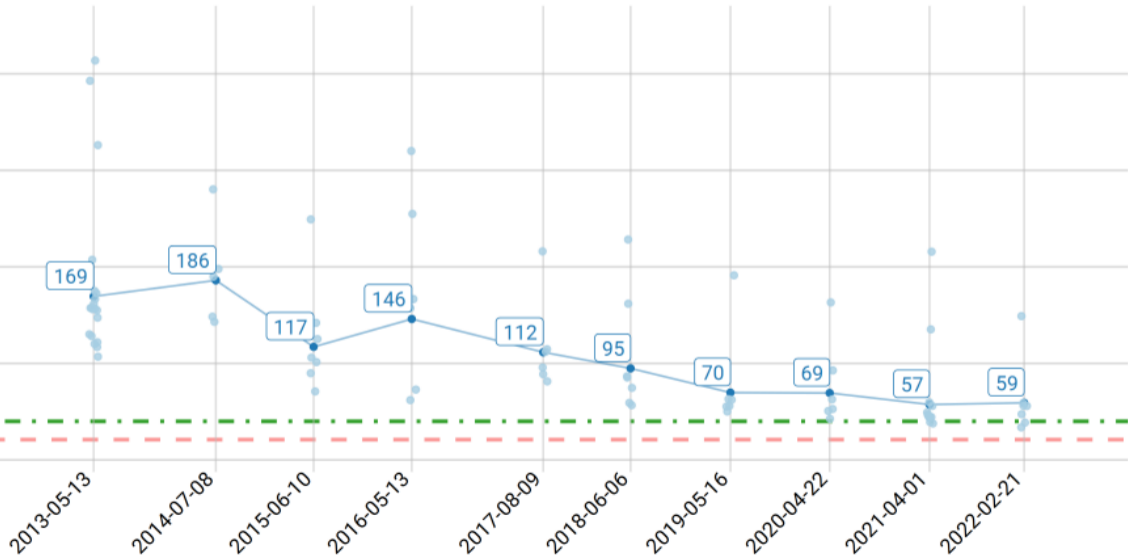
Fertilize sensibly

Normal nutrient content of bermudagrass leaves

element	25th percentile	Median (%)	75th percentile
N	3.4	3.7	4.6
P	0.34	0.39	0.47
K	1.1	1.3	1.7
Ca	0.28	0.34	0.38
Mg	0.15	0.18	0.19
S	0.35	0.39	0.45

Normal nutrient content of zoysiagrass leaves

element	25th percentile	Median (%)	75th percentile
N	2.0	2.2	2.5
P	0.18	0.25	0.33
K	0.83	1.0	1.2
Ca	0.18	0.21	0.27
Mg	0.08	0.10	0.13
S	0.27	0.29	0.32

Know the sand application rate

Temperature-based growth potential prediction of sand topdressing

| Atlanta, GA | Hong Kong | Jacksonville, FL | Knoxville, TN |
| 3.3 mm/year | 6.6 mm/year | 4.7 mm/year | 2.6 mm/year |

| Miami, FL | Myrtle Beach 2023 | New Orleans, LA | Tokyo |
| 7.6 mm/year | 3.7 mm/year | 4.9 mm/year | 3 mm/year |

Sand amount (mm)

Month
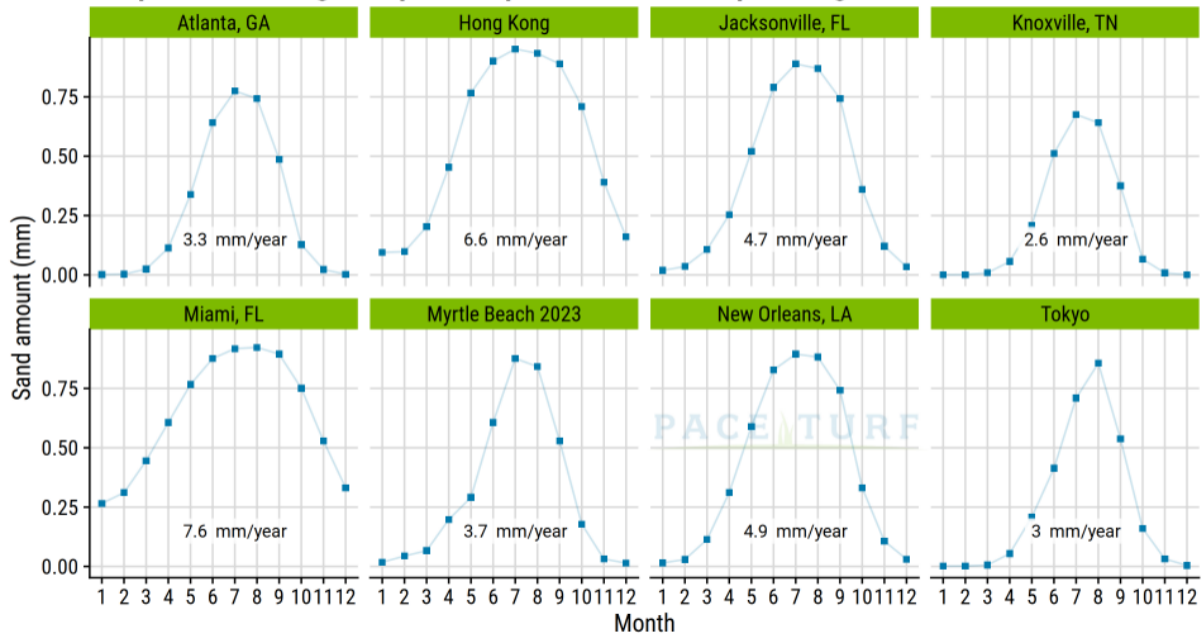
$$1 \text{ mm} \approx 300 \text{ lb}/1{,}000 \text{ ft}^2$$

$$1 \text{ mm} \approx 3.3 \text{ ft}^3/1{,}000 \text{ ft}^2$$

Measure total organic material (OM246)
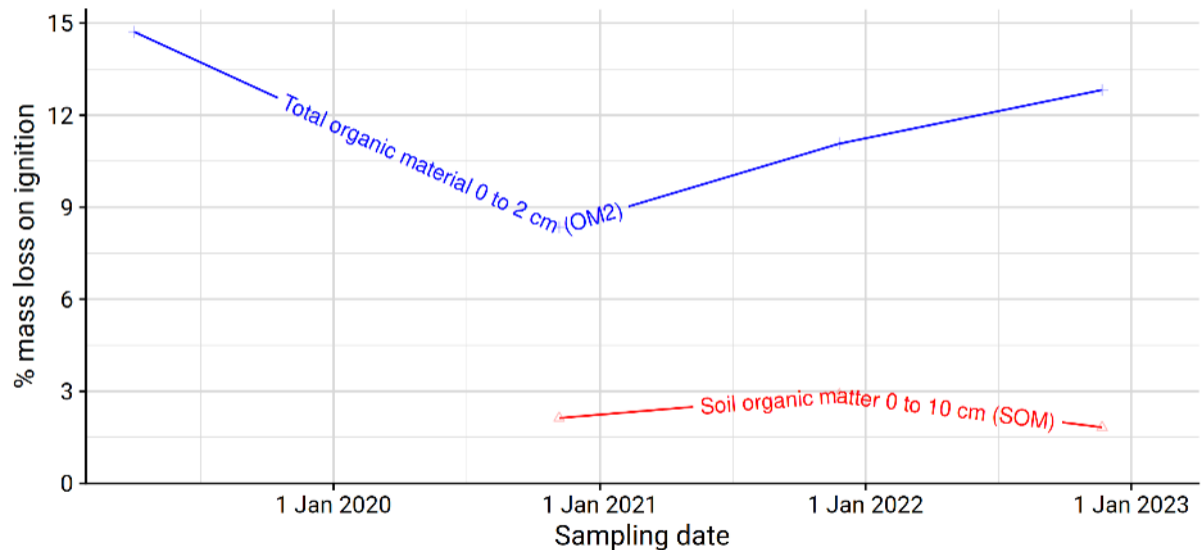
0 to 0.8 inches

0.8 to 1.6 inches

1.6 to 2.4 inches

0 to 2 cm OM2

2 to 4 cm OM4

4 to 6 cm OM6

Tifeagle putting greens
samples from Bangsai CC

% mass loss on ignition (y-axis), **Sampling date** (x-axis)

Total organic material 0 to 2 cm (OM2)

Soil organic matter 0 to 10 cm (SOM)

All soil tests conducted at Brookside Labs

Continuous improvement system components

- Measure playing conditions
- Know (and question) the N rate
- Use PGRs with purpose
- Measure the clipping volume
- Know the water use
- Measure soil nutrients
- Know the sand application rate
- Measure total organic material (OM246)

Online handout with slides & more info

www.asianturfgrass.com

www.paceturf.org