



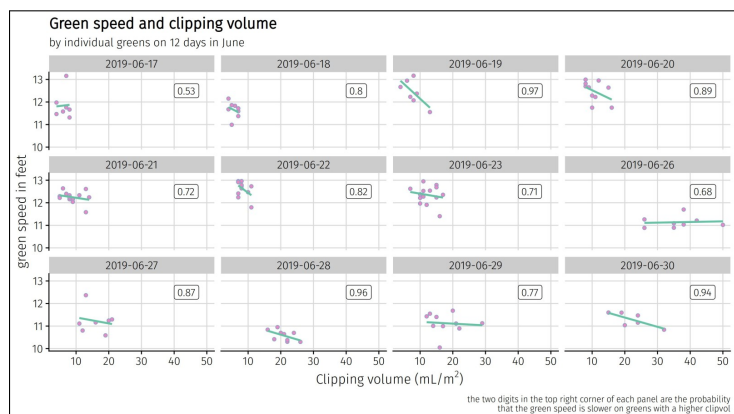
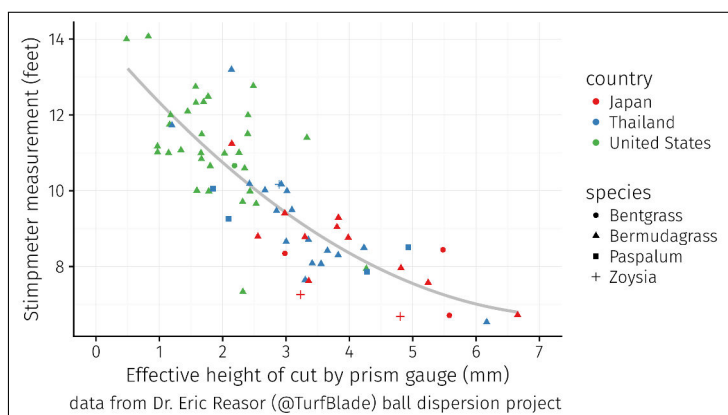
## Harmonizing turf growth, soil organic matter, and surface performance

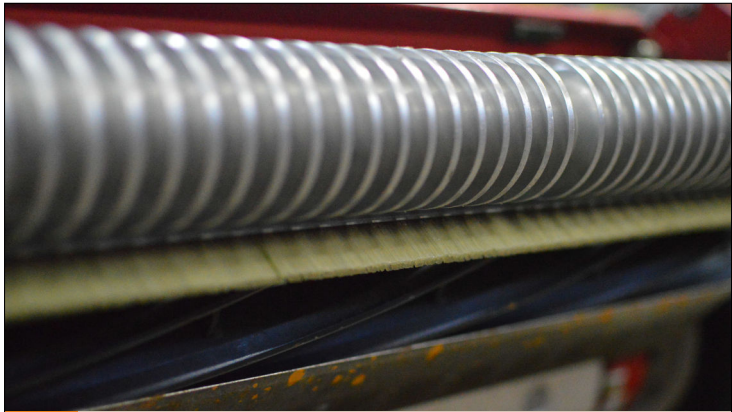
Micah Woods, Ph.D.

February 3, 2025

Asian Turfgrass Center  
[www.asianturfgrass.com](http://www.asianturfgrass.com)

PACE Turf  
[www.paceturf.org](http://www.paceturf.org)





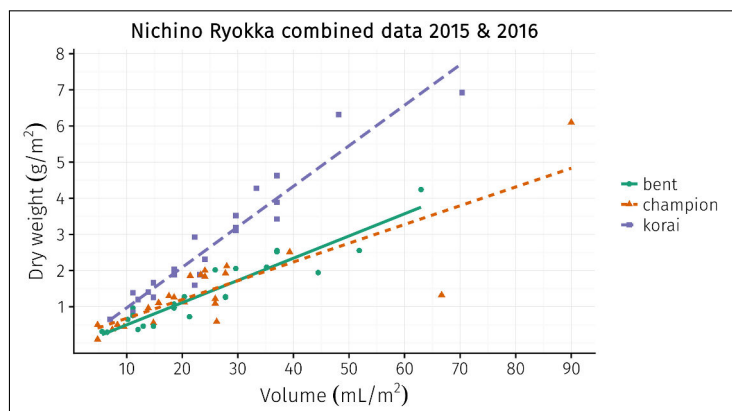
Video time stamp: 10 seconds



Estimate dry mass as 6.3% of the fresh clipvol



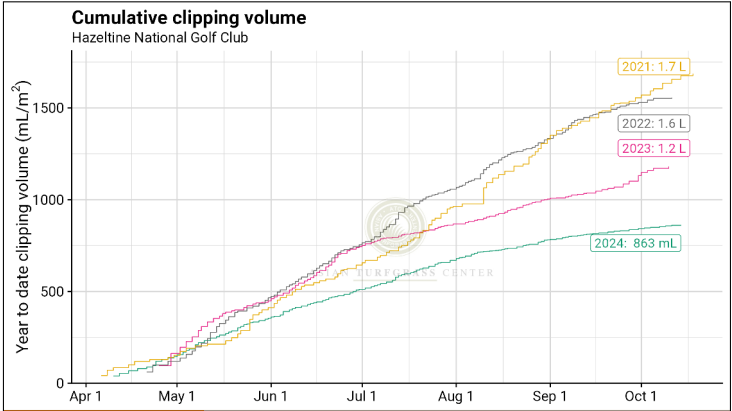
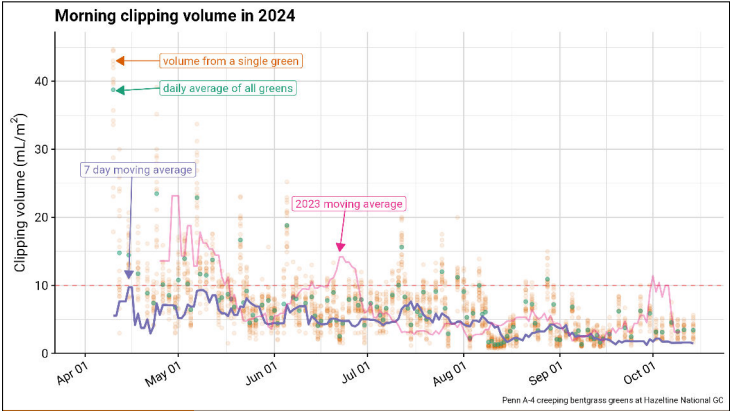
I estimate 1 L of fresh clippings, when dried, will have a mass of 63 g.





| Normal nutrient content of bentgrass leaves |                             |            |                             |
|---------------------------------------------|-----------------------------|------------|-----------------------------|
| element                                     | 25 <sup>th</sup> percentile | Median (%) | 75 <sup>th</sup> percentile |
| N                                           | 4.3                         | 4.8        | 5.3                         |
| P                                           | 0.5                         | 0.6        | 0.6                         |
| K                                           | 1.8                         | 1.9        | 2.0                         |
| Ca                                          | 0.5                         | 0.6        | 0.7                         |
| Mg                                          | 0.2                         | 0.2        | 0.3                         |
| S                                           | 0.5                         | 0.5        | 0.6                         |

| Normal nutrient content of bermudagrass leaves |                             |            |                             |
|------------------------------------------------|-----------------------------|------------|-----------------------------|
| element                                        | 25 <sup>th</sup> percentile | Median (%) | 75 <sup>th</sup> 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                        |





Organizing ClipVol data

date 1 | time | 1 | 2 | 3 | 4 | 5 | 6 | ... | 18 | avg | sd | notes  
date 2 ...  
date 3 ...  
...  
Last mow

One Bucket at a Time

A guide to rapid measurement of clipping volume with various permutations, applications, and implications

Micah Woods

Contents

Preface 7

Why read this book? 7

Acknowledgments 8

About the Author 9

1 Measuring and tracking grass clippings 11

2 More about the measurement of grass clippings 15

3 Clipping volume, or clipping weight? 19

4 Units of measurement 23

4.1 Not about units 23

4.2 Something new 24

5 Measuring clipping yield from putting greens 25

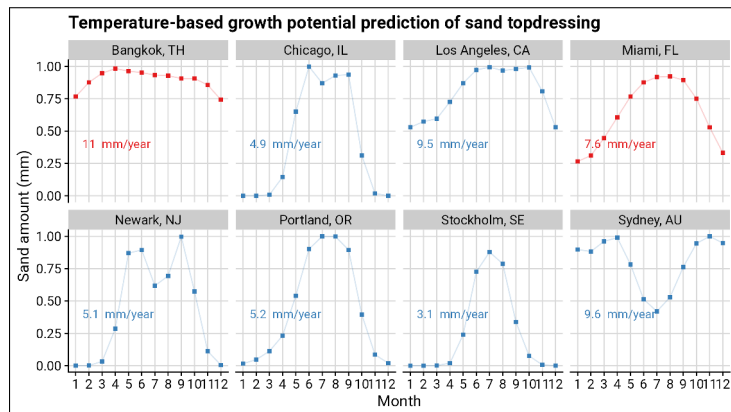
6 Tournament week clipping volume 27

7 Clipping volume variation from green to green 33

Soil Organic Material

Know the sand application rate





$1 \text{ mm} \approx 320 \text{ lbs}/1,000 \text{ ft}^2$   
 $1 \text{ mm} \approx 3.3 \text{ ft}^3/1,000 \text{ ft}^2$   
 $1 \text{ mm} \approx 16 \text{ tons/ha}$

Measure total organic material (OM246)



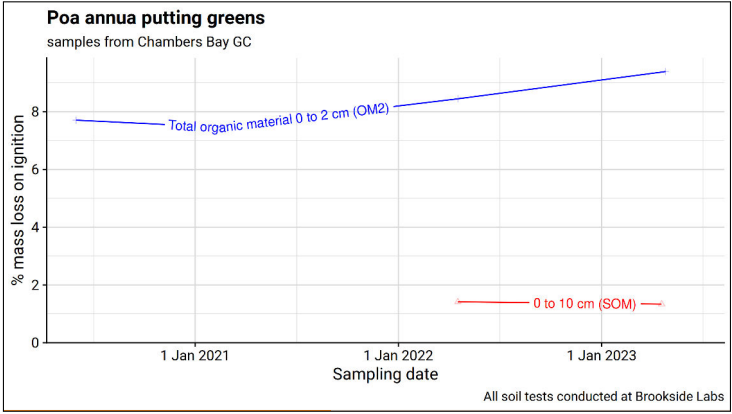
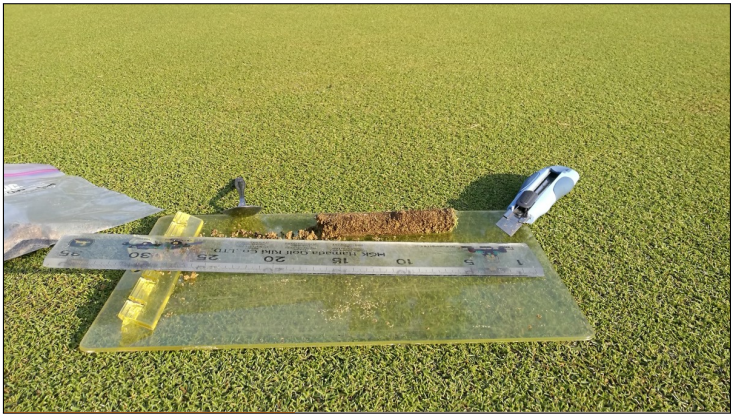
**The definition of soil organic matter**

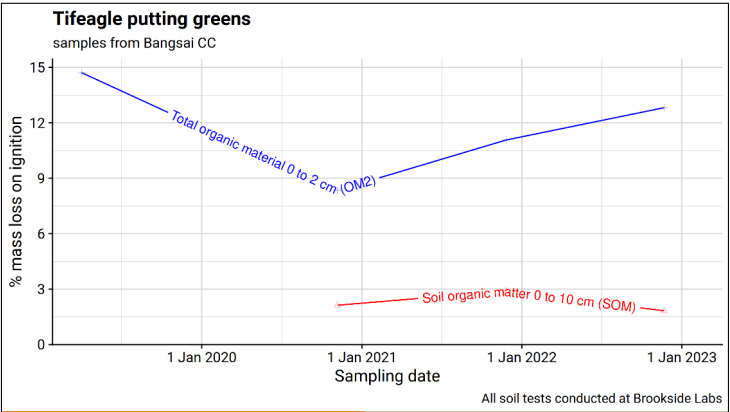
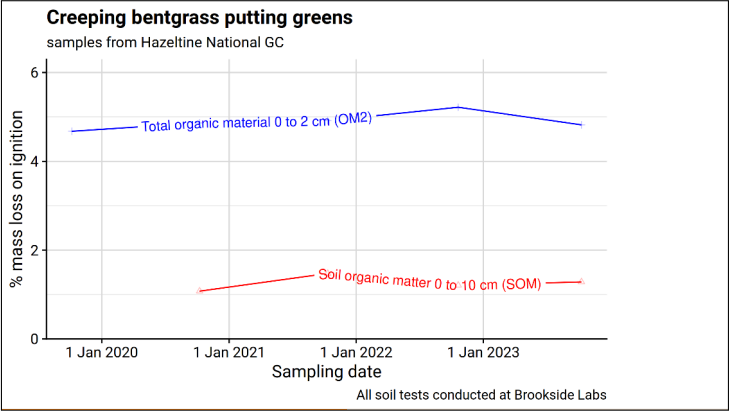
**soil organic matter:** The organic fraction of the soil exclusive of undecayed plant and animal residues. See also humus.

**humus:** the well decomposed, more or less stable part of the organic matter in mineral soils.

Total organic material

**total organic material:** organic material in a soil sample that has not passed through a sieve. This test is conducted on the sample as it is received at the laboratory, with no removal of living or dead plant material prior to testing.





Getting started

OM accumulation rate

Sand requirement

Unit conversions

Details

Depth of soil layer (cm)

2

Starting OM %

8

Ending OM %

8

Date range (starting OM% & ending OM%)

2024-02-03

to

2025-02-03

Sand added (mm)

4

If you have applied 4 mm of sand to a 2 cm layer of the rootzone with a starting OM of 8% on 2024-02-03 and ending OM of 8% on 2025-02-03, the total organic material accumulation rate is:

21.62 grams per kg of soil per year



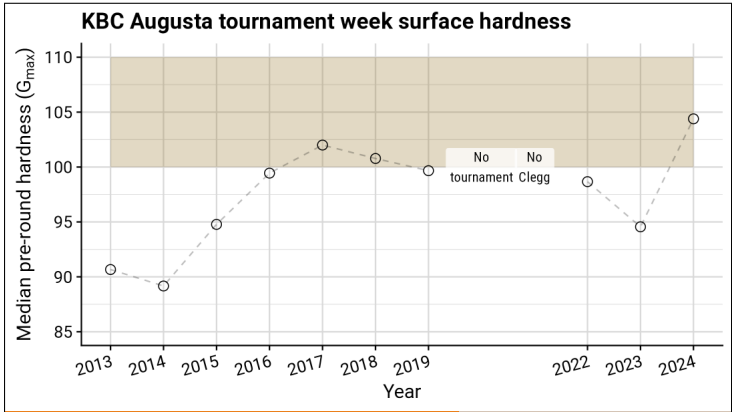
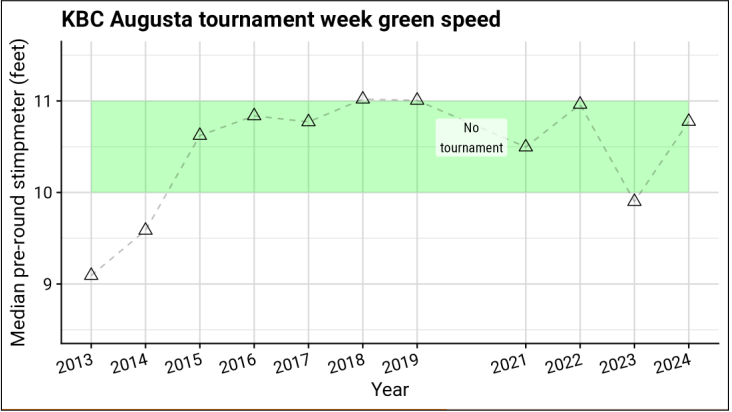


## Playing conditions



## What to measure?

- Stimp meter
- Bobble test (smoothness, trueness)
- Surface hardness (firmness)



RESEARCH

## Comparing Three Methods to Measure Putting Green Trueness

Douglas T. Linde,\* Andrew D. Mitchell, and Brendan Hannan

**ABSTRACT**

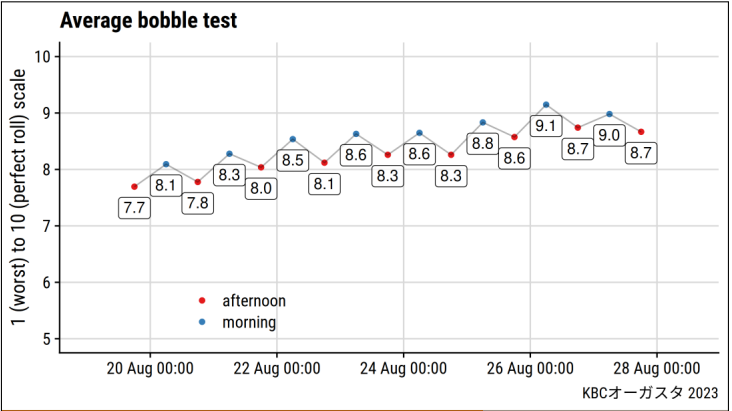
Since there was not a standard method to measure putting green trueness, a golf course and plot study were conducted to compare three methods to measure putting green trueness. In 2013, the Royal & Ancient (R&A) "Holing Out Test" (HOT), a visual bobble test, and a ball spread test were conducted on 150 greens from 50 New Zealand golf courses. In 2015, a plot study was conducted to compare the methods

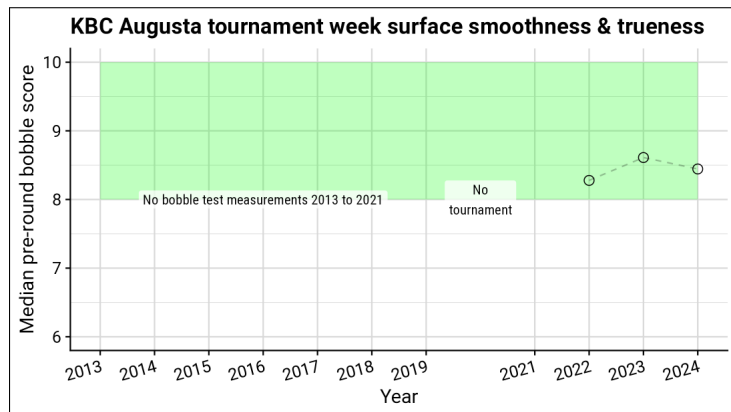
D.T. Linde, Plant Science Dep., Delaware Valley Univ., 700 E. Butler Ave., Doylestown, PA 18901; A.D. Mitchell and B. Hannan, New Zealand Sports Turf Institute, P.O. Box 347, Palmerston North, NZ 4440. Received 12 May 2016. Accepted 6 June 2017. \*Corresponding author (douglas.linde@delval.edu). Assigned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

**Abbreviations:** HOT, Holing Out Test; NZSTI, New Zealand Sports Turf Institute; PGA, Professional Golfers Association of America; R&A, Royal & Ancient; STRI, Sports Turf Research Institute; USGA, United States Golf Association.

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





Harmonization with the Turf GvX

The **Turf GvX** is the actual growth of the grass compared to the expected growth of the grass.

Use the GvX for ...

- adjusting N fertilizer
- adjusting plant growth regulators

## Results may include ...

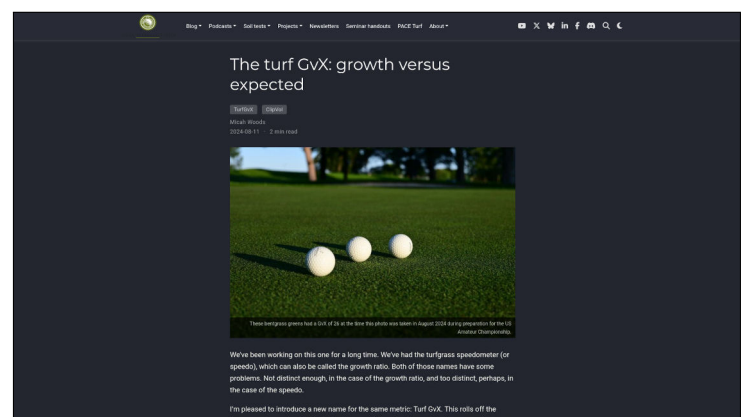
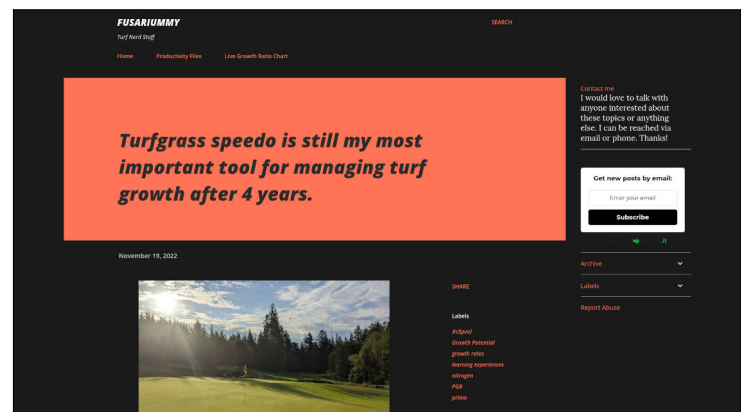
- Improved playing conditions
- Fewer inputs (N, sand, mowing)
- Species composition improvements

The **Turf GvX** is the actual growth of the grass compared to the expected growth of the grass.

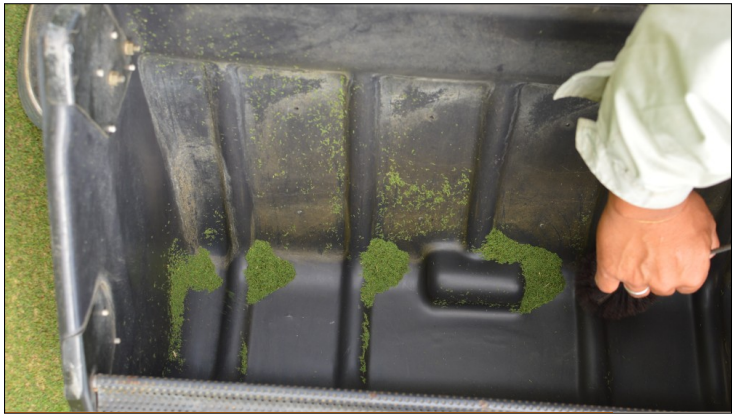


The screenshot shows the top navigation bar of the PACE Turf website. The title "What should my ClipVol be?" is prominently displayed in the center. Below the title, there are three buttons: "Turf Dots", "ClipVol", and "growth potential". The "ClipVol" button is highlighted with a yellow circle. The website's header includes a logo on the left and a navigation menu on the right with links for "Blog", "Podcasts", "Soft tests", "Projects", "Newsletters", "Seminar handouts", "PACE Turf", and "About". The main content area below the title discusses the importance of clipping volume for turf growth and provides a link to a "Turf Dots" article.

[illegible]

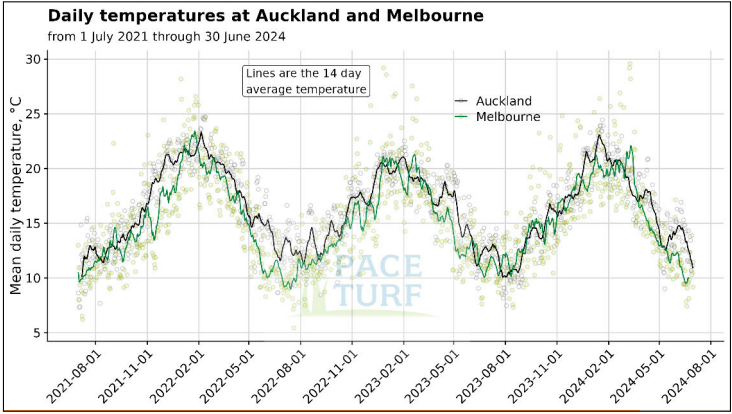


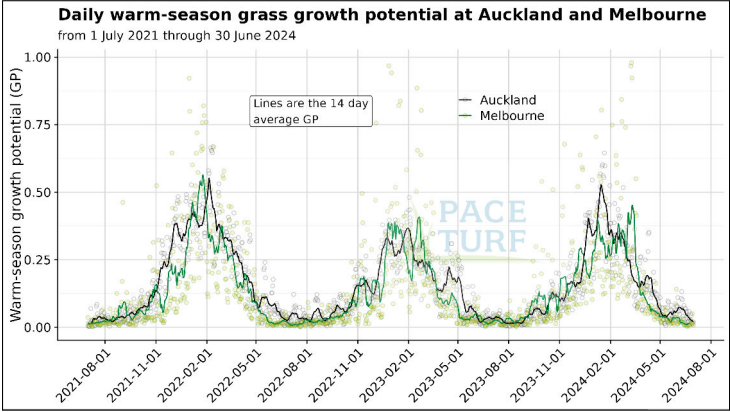
A close-up photograph showing a person's legs and white sneakers standing on grass. They are using a mechanical press to extract green biomass from a white bucket. The press is a dark metal device with a handle and a collection tube. The bucket is filled with a thick, green, fibrous material. The person is holding the handle of the press, and the collection tube is positioned over the bucket. The background is a grassy field.



The standard units for clipping volume (ClipVol) are mL/m<sup>2</sup> or L/1000 m<sup>2</sup>.

Expected growth



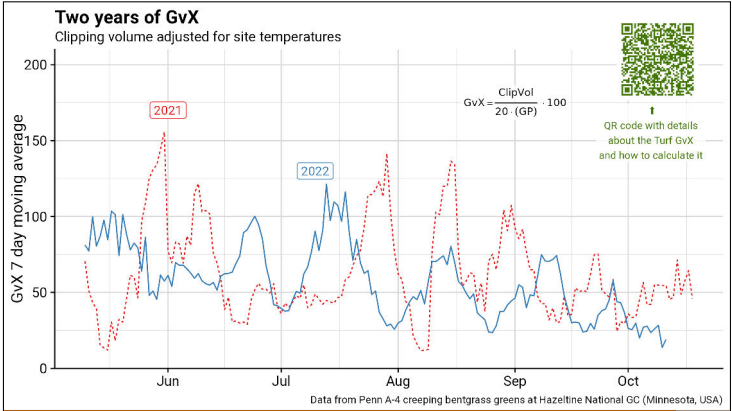
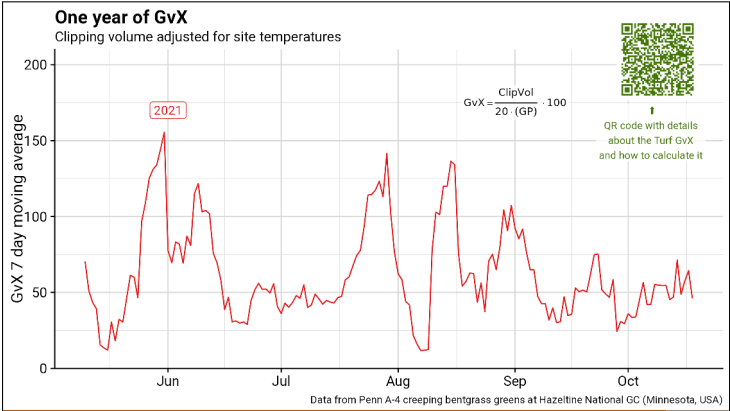


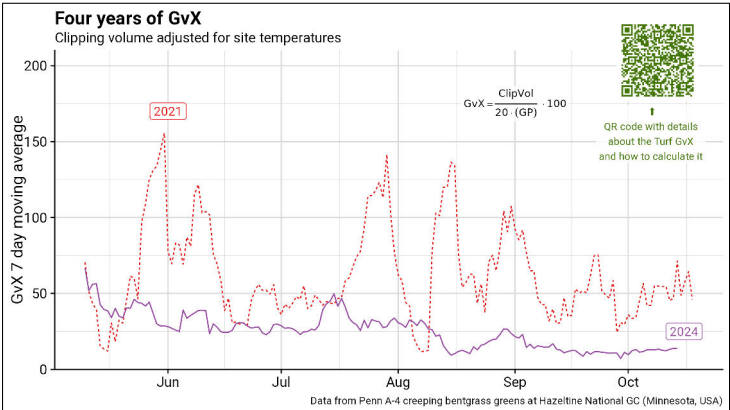
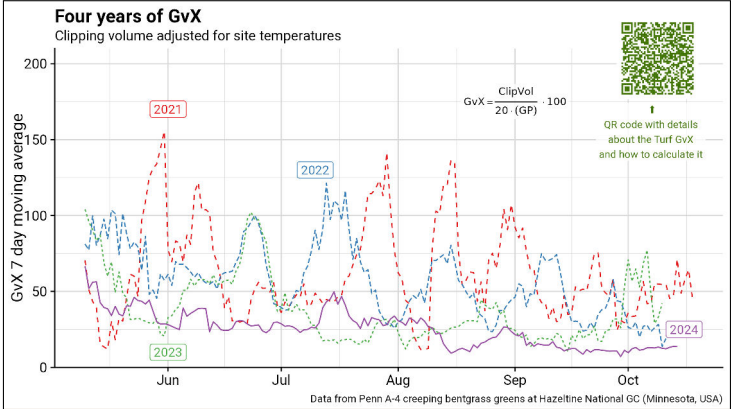
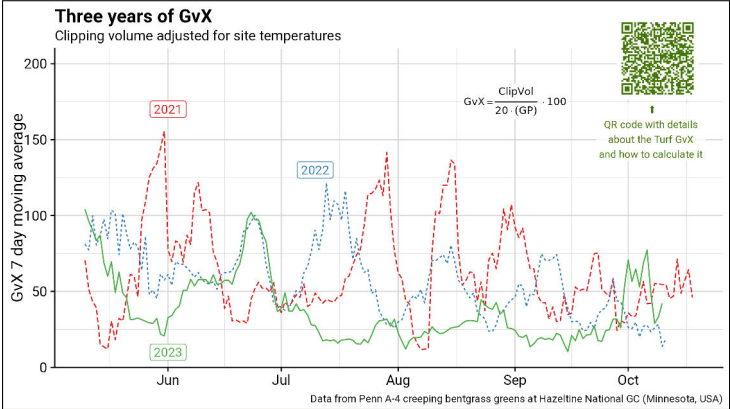
## Calculating the GvX

$$GvX = \frac{ClipVol_{14}}{20 \times GP_{14}} \times 100$$

where  $ClipVol_{14}$  is the 14 day average of clipping volume and  $GP_{14}$  is the 14 day growth potential average.

## Using the GvX





Online handout with slides & more info

[www.asianturfgrass.com](http://www.asianturfgrass.com)  
[www.paceturf.org](http://www.paceturf.org)