Organic matter research & management

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Turfgrass Science
University of Nebraska

LANDSCAPES UNLIMITED

2021 Superintendents Education Session
October 19, 2021
Lincoln , Nebraska

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Heads up!

- Presentation
- Supplemental reading
- Access by QR code
- Use your phone to access and download or save the image.

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RESEARCH LETTER

Estimating economic minimums of mowing, fertilizing, and irrigating turfgrass

Douglas J. Soldat | James T. Brosnan | Ambika Chandra | Roch E. Gaussoin | Alec Kowalewski | Bernd Leinauer | Frank S. Rossi | John C. Stier | J. Bryan Unruh

COMMENTARY

A justification for continued management of turfgrass during economic contraction

James T. Brosnan | Ambika Chandra | Roch E. Gaussoin | Alec Kowalewski | Bernd Leinauer | Frank S. Rossi | Douglas J. Soldat | John C. Stier | J. Bryan Unruh

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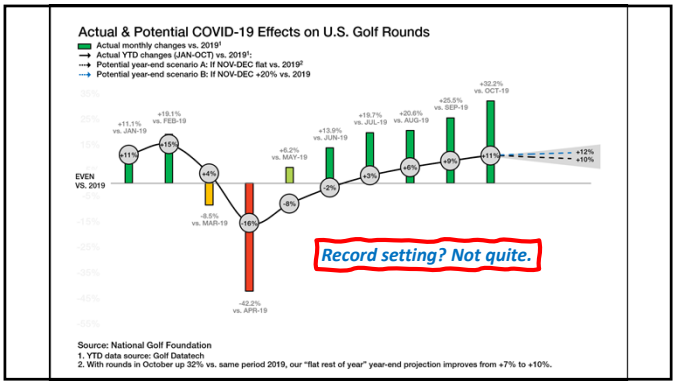

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What Year exceeded 2020 golf rounds increase?

1. 2004
2. 1995
3. 1997
4. 2012

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Organic Matter Management

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~~The~~ *My* organic matter journey……

- USGA/EIFG Greens Study (9 years).
- People a lot brighter than me
  - "Talking Turf" GCSAA conversation.
  - Paul Rieke, USGA visit
  - Conversation with Paul Vermeulen. Director, Competitions Agronomy at PGA TOUR, former USGA Agronomist.
- Great funding/time support from USGA/EIFG (initially), NE-GCSA, GCSA of SD, Peaks and Prairies GCSA, industry and a slew of GC supers.
- Road Show.

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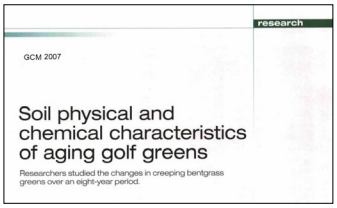
Where it all started

- **Gaussoin, R., R. Shearman, L. Wit, T. McClellan, and J. Lewis. 2007. Soil physical and chemical characteristics of aging golf greens. *GCM* 75(1):p. 161-165.**



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Objectives

- Develop a better understanding of the impact of grow-in procedures on putting green establishment and performance.
- Investigate temporal changes in the soil physical properties of USGA putting greens.

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Materials and Methods

- Field experiment initiated in 1997
- Greens constructed every year for four years
- Two rootzone mixtures
  - 80:20 Sand:Peat (v:v)
  - 80:15:5 Sand:Peat:Soil (v:v:v)
- Two establishment treatments
  - Accelerated
  - Controlled

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Soil Parameters

Sample	% Soil Separates			Saturated Conductivity	%OM
	Sand	Silt	Clay	cm/hr	
80-20	98.9	0.8	0.3	31	1.04
80-5-15	97.4	2.2	0.4	20.7	0.75
USGA Specs		<5%	<3%	14-56	0.7-3

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Project Schedule (Phase I)

1996 | 1997 | 1998 | 1999 | 2000

Greens construction (one set per year)

Seeding

Data collection on soil physical, chemical, and microbial characteristics influenced by root zone materials and grow-in procedures.

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Project Schedule (Phase II)

2002 | 2003 | 2004 | 2005

Data collection on soil physical and chemical characteristics as influenced by age, root zone materials and grow-in procedures

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Data Collection

- Soil Physical
  - Ksat, bulk density etc.
- Soil Chemical
- Soil Microbial
  - biomass, stability
- Agronomic
  - surface hardness, ball roll, quality etc.

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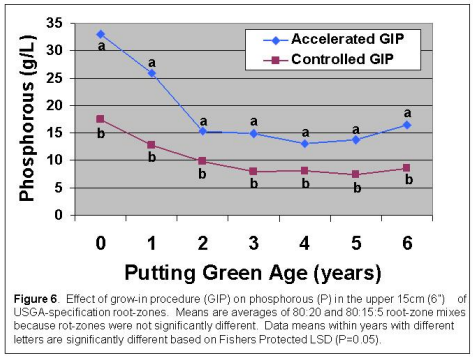

Figure 6. Effect of grow-in procedure (GIP) on phosphorous (P) in the upper 15cm (6") of USGA-specification root-zones. Means are averages of 80:20 and 80:15:5 root-zone mixes because rot-zones were not significantly different. Data means within years with different letters are significantly different based on Fishers Protected LSD (P=0.05).

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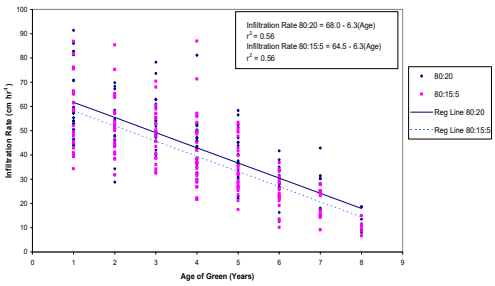

Figure 1. Data points and regression lines of infiltration rate decline on USGA specification putting greens at Mead, NE. Rootzones were an 80:20 (v:v) sand, and sphagnum peat mixture and an 80:15:5 (v:v) sand, and sphagnum peat, soil (Tomek silty clay loam) mixture.

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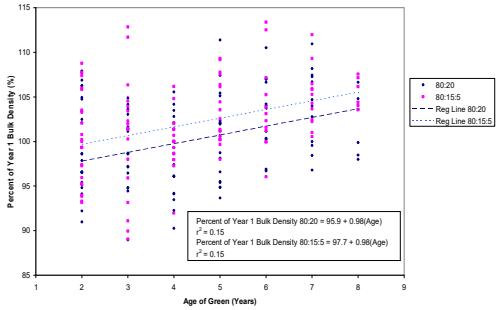

Figure 2. Data points and regression lines of the percent change of bulk density compared to year 1 values of USGA specification putting greens rootzones at Mead, NE. Rootzones mixtures were an 80:20 (v:v) sand, and sphagnum peat mixture and an 80:15:5 (v:v) sand, sphagnum peat, and soil (Tomek silty clay loam) mixture.

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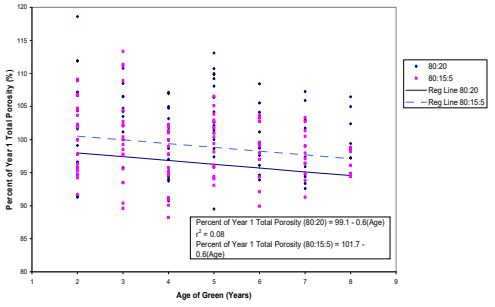

Figure 4. Data points and regression lines of the percent change of total porosity compared to year 1 values of USGA specification putting green rootzones at Mead, NE. Rootzones were an 80:20 (v:v) sand, and sphagnum peat mixture and an 80:15:5 (v:v) sand, sphagnum peat, and soil (Tomek silty clay loam) mixture.

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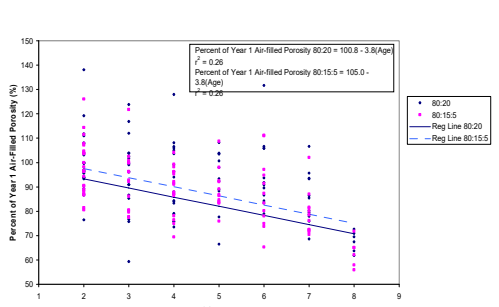

Figure 3. Data points and regression lines of the percent change of air-filled porosity compared to year 1 values of USGA specification putting green rootzones at Mead, NE. Rootzones mixtures were an 80:20 (v:v) sand, and sphagnum peat mixture and an 80:15:5 (v:v) sand, sphagnum peat, and soil (Tomek silty clay loam) mixture.

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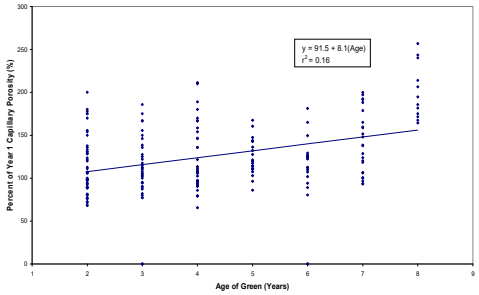

Figure 5. Data points and regression line of the percent change of capillary porosity compared to year 1 values of rootzones of USGA specification putting greens located at Mead, NE. Rootzones were an 80:20 (v:v) sand, and sphagnum peat mixture and an 80:15:5 (v:v) sand, sphagnum peat, and soil (Tomek silty clay loam) mixture. Rootzone material was not significantly different for percent change of year one capillary porosity (p=0.05).

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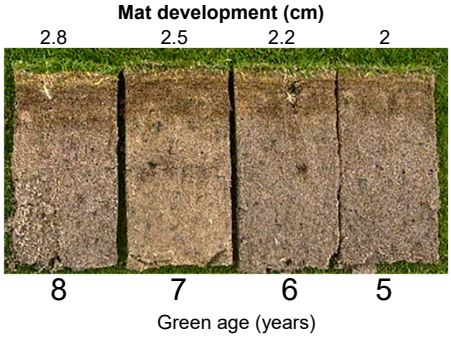

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Formation of Mat

- Formation of mat layer currently increasing approximately 0.65 cm annually (following establishment year).
- No visible layering, only a transition is evident between mat and original rootzone.
- Topdressing program
  - Light, Frequent
    - every 10-14 days (depending on growth) and combined with verticutting
  - Heavy, Infrequent
    - 2x annually (spring/fall) and combined with aerification

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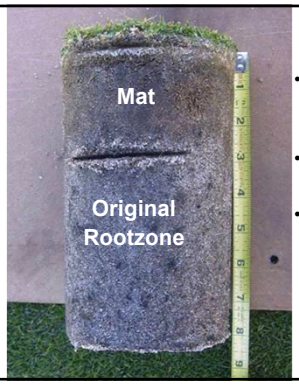

- 2004 USGA research committee site visit
- original rootzone
- mat development

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Materials and Methods

- 2004 rootzone samples taken below mat layer from each soil treatment and sent to Hummel labs for Quality Control Test (24 total samples)
- Tested against original quality control test (z-score).

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Change in Rootzone Particle Size Distribution

- All rootzones tested in 2004 showed increased proportion of fine sand (0.15 – 0.25 mm) with decreased proportion of gravel (> 2.0 mm) and very coarse sand (2.0 – 1.0 mm).
- 5 of 8 rootzones were significant (z-score) for increased fine sand content.

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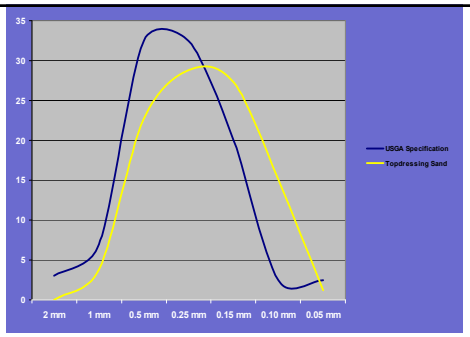

USGA sand specifications compared to sand used in topdressing program for USGA plots at Mead, NE.

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Conclusions

- Based on *in situ* green testing K_{SAT} decreased over time due to organic matter accumulation above the original rootzone.
- Original rootzone K_{SAT} decreased over time due to increased fine sand content originating from topdressing sand.

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Root Zone: Mat vs. Original

- pH:
  - Mat < Original for all USGA and California Greens.
- CEC, OM, and all Nutrients tested:
  - Mat > Original for all USGA and California Greens.

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Organic Matter Management

- Is accumulation a "bad" thing??
- Is core aeration the answer??

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- **National Survey**
  - **Determine cause and effect relationship among management practices and their interactions relative to surface OM accumulation**

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117 courses,
> 1600 samples

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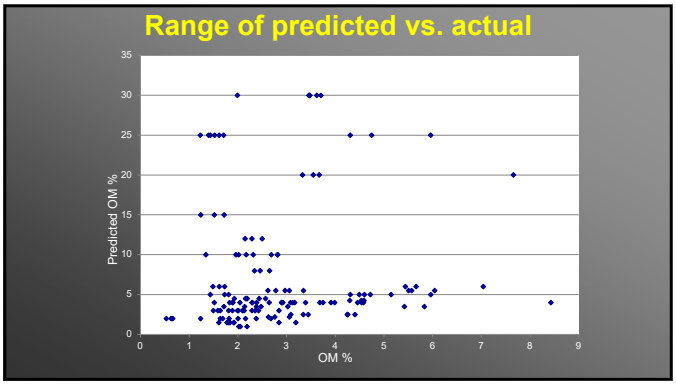

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Why the disconnect?

- Construction values are based on volume ratios
  - *80/20 = 8 buckets of sand: 2 buckets of organic material*
- Organic Matter is reported as a % from a lab analysis measured by weight
  - *3.5% OM X 10 = 35 grams OM/kg soil*

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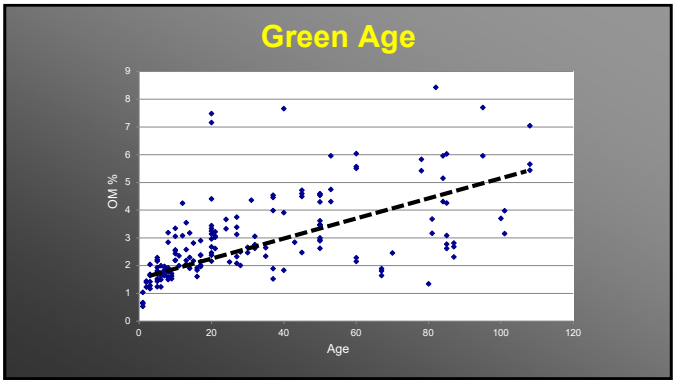

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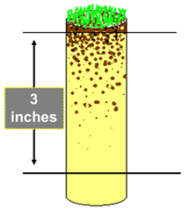
Is the age effect misleading?

- **Sampling issue:**
  - **Mat depth increases as green ages resulting in more OM in the same volume soil.**



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Mat Development with Age

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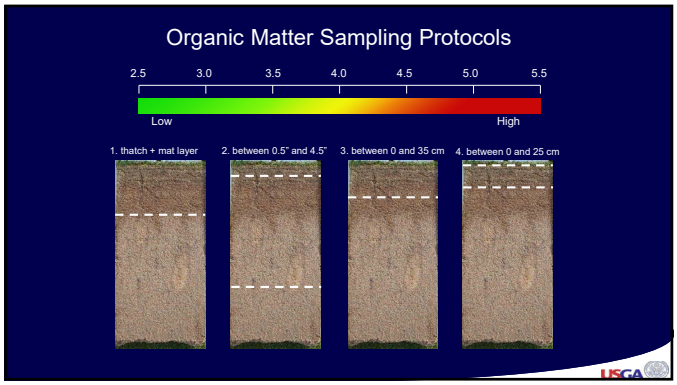
Organic Matter Sampling Protocols



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#OM246 Putting Green Organic Matter by Depth

- Micah Woods, Asian Turfgrass Center
  - Asianturfgrass.com

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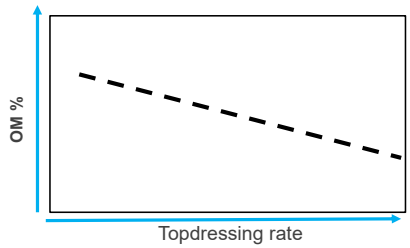
Topdressing



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Survey Summary

- **None of the variables collected, by themselves, or in combination with others, *predicted* OM**
- **Courses using >18 cubic ft*/M of topdressing with or without "venting" had lower OM**
- **Of the *known* cultivars, no differences in OM were evident**

**1 ft³ = 100 lbs of dry sand; yd³ = 2700 lbs*

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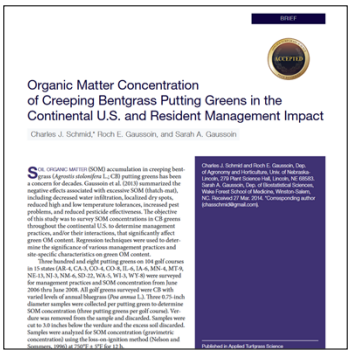
BRIEF

Organic Matter Concentration of Creeping Bentgrass Putting Greens in the Continental U.S. and Resident Management Impact

Charles J. Schmid,* Roch E. Gaussoin, and Sarah A. Gaussoin

SOIL ORGANIC MATTER (SOM) accumulation in creeping bentgrass (*Agrostis stolonifera* L.; CB) putting greens has been a concern for decades. Gaussoin et al. (2013) summarized the negative effects associated with excessive SOM (thatch-mat), including decreased water infiltration, localized dry spots, reduced high and low temperature tolerances, increased pest problems, and reduced pesticide effectiveness. The objective of this study was to survey SOM concentrations in CB greens throughout the continental U.S. to determine management practices, and/or their interactions, that significantly affect green OM content. Regression techniques were used to determine the significance of various management practices and site-specific characteristics on green OM content.

Three hundred and eight putting greens on 104 golf courses in 15 states (AR-4, CA-3, CO-4, CO-8, IL-4, IA-4, MN-4, MT-4, NE-13, NJ-3, NM-4, SD-22, WA-5, WI-3, WY-8) were surveyed for management practices and SOM concentration from June 2006 thru June 2008. All golf greens surveyed were CB with varied levels of annual bluegrass (*Poa annua* L.). Three 0.75-inch diameter samples were collected per putting green to determine SOM concentration (three putting greens per golf course). Verdure was removed from the sample and discarded. Samples were cut to 3.0 inches below the verdure and the excess soil discarded. Samples were analyzed for SOM concentration (gravimetric concentration) using the loss-on-ignition method (Nelson and Sommers, 1996) at 360°C x 3°F for 4 h.

Charles J. Schmid and Roch E. Gaussoin, Dep. of Agronomy and Horticulture, Univ. of Nebraska-Lincoln, 279 Plant Science Hall, Lincoln, NE 68583; Sarah A. Gaussoin, Dep. of Biostatistical Sciences, Wake Forest School of Medicine, Winston-Salem, NC. Received 27 Mar. 2014. *Corresponding author (rhaschmid@gmail.com).

Published in Applied Turfgrass Science

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Organic Matter Management Study

Objectives

1. **Determine if conventional hollow tine is more effective than solid tine aerification at managing organic matter accumulation**
2. **Determine if venting methods are effective at managing OM accumulation**

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Treatments

Tine Treatment
None
2X Hollow tine
2x Solid tine

Venting Treatment
None
PlanetAir
Hydroject
Bayonet tine
Needle tine

*All **possible** combinations = 180 treatments, applied for 2 consecutive years*

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All treatments received the same topdressing quantity (22 ft^3/M*) but different frequency

Equilibrated to identify differences of the practices in question

**1 ft^3 = 100 lbs of dry sand; yd^3 = 2700 lbs*

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OM Data Analysis Year 2

- **No differences between green age except for higher % in older green**
- **No differences among venting methods**
- **No differences among solid/hollow/none**

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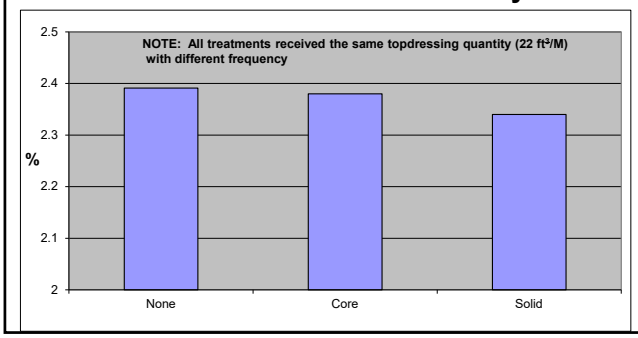
Effect of Tines on OM after 2 yrs



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Let's take a quick look at that…

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What these data do/don't suggest

- Cultivation, when topdressing quantity was equal, was insignificant in affecting OM
- Superintendents, however, must use whatever tools they have at their disposal to ensure sand is making it into the profile and not the mower buckets

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*Topdressing interval relative to Tine/Venting combinations (22 cu ft/M)**

- **NONE/NONE**
  - **5-10 days**
- **Solid & Hollow/NONE**
  - **7-14 days**
- **Solid & Hollow/Venting**
  - **14-18 days**

Observed and calculated based on displacement and surface area opened

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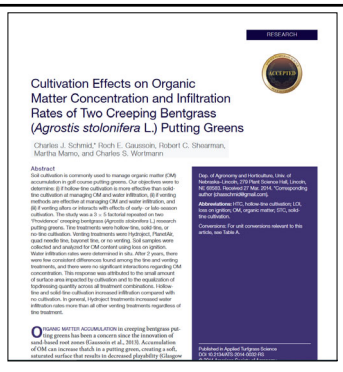

Cultivation Effects on Organic Matter Concentration and Infiltration Rates of Two Creeping Bentgrass (*Agrostis stolonifera* L.) Putting Greens

Charles J. Schmid,* Roch E. Gaussoin, Robert C. Shearman, Martha Mamo, and Charles S. Wortmann

https://turf.unl.edu/

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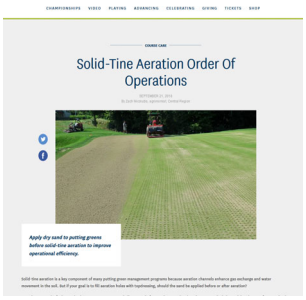
https://www.usga.org/content/usga/home-page/course-care/regional-updates/central-region/2018/solid-tine-aeration-order-of-operations.html



Solid-Tine Aeration Order Of Operations

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Aer-Aider.com

"By using Aer-Aider while you solid tine, you ensure maximum incorporation of sand, immediately filling holes and eliminating the bridging that occurs from traditional core aeration. Fill every hole, save hours of labor, and eliminate ruts left by dragging sand afterwards. Aeration is hard, we make it easy!"

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Topdressing

Old Tom Morris (1821–1908) is thought to have discovered the benefits of topdressing accidentally when he spilled a wheelbarrow of sand on a putting green and noted how the turf thrived shortly afterward (Hurdzan, 2004).

J.B. Beard is his classic textbook "Turfgrass Science & Culture, 1973 writes:
"The most important management practice for OM management is topdressing"

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How do you get rid of OM?

- Decomposition (microbial)
  - Increase surface area and aeration
  - Inoculation (inconsistent, not reliable)
  - Removal
  - Power raking, dethatching, core aerification
- Dilution
  - Topdressing

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"the solution to pollution is dilution"

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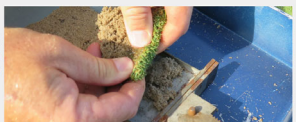
Light And Frequent Topdressing Programs

A combination of field observations and recent research shed new light on the type of sand and quantity of topdressing needed to manage thatch and organic matter accumulation in putting greens.



https://www.usga.org/content/usga/home-page/course-care/green-section-record/57/9/light-and-frequent-topdressing-programs.html

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Golf Course Industry Magazine · April 2018

True Grit

Features · Special Report

In the first of a two-part series, turf managers offer their views on their methodology for sanding greens and providing top-notch playing surfaces.

April 11, 2018

SUBSCRIBE

The unmistakable surface sheen is testament that the greens have been topdressed. An undeniably important agronomic process for golf course superintendents, it's also one not entirely appreciated by

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A Novel Method For Accurately Measuring Topdressing Rates

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How much sand to use for topdressing?

- Generic recommendation is 20-40 ft^3 per 1000 sq. feet/yr (about 0.5 inch/M/yr)
  - ***UNL worked showed 20-24 ft^3 for OM management***
- Varies by amount of:
  - Traffic
  - Grass species or cultivar
  - Nitrogen Applied
  - Water Applied
  - Microclimate/Location

Key is matching your growth rate to optimize topdressing + ……..

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"Growth Potential"

- Pace Turf
  - –https://www.paceturf.org/public/sand-and-growth-potential

72

#clipvol "*One bucket at a time*"

- Micah Woods, Asian Turfgrass Center
  - Asianturfgrass.com

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Greens Organic Matter Management Tool

A Location-Based Model of Organic Matter Fate within the Sand-Based Surface Layer of a Putting Green

Ed McCoy
Ohio State University

An empirical model to predict OM fate in putting green rootzones

https://buckeyeturf.osu.edu/organicmattertool

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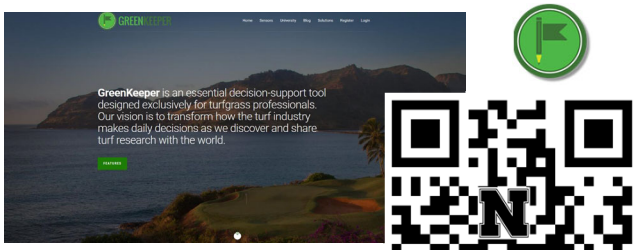

https://www.greenkeeperapp.com/marketing/

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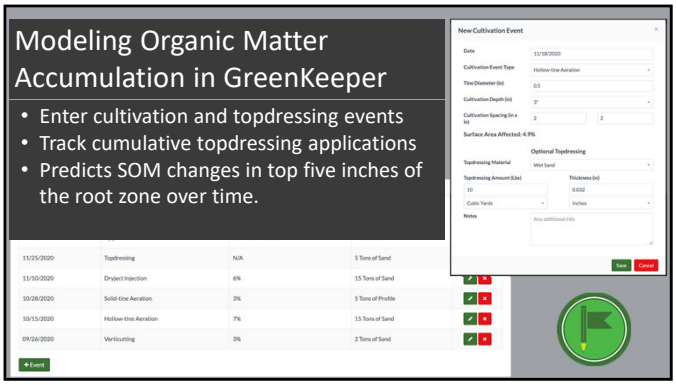
Modeling Organic Matter Accumulation in GreenKeeper

- Enter cultivation and topdressing events
- Track cumulative topdressing applications
- Predicts SOM changes in top five inches of the root zone over time.



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OM Testing

- **Know how your sample was taken and compare notes with others that use the same protocol**
- **Take annual tests to determine long-term trend**
  - **Same time of year**
  - **Same location and green *(or all greens!)***
  - ***Avoid a set sampling depth***
  - ***#OM246***
- **Correlate your test results with turf quality and performance during stressful environmental conditions to determine need for changes in management program**
- **Threshold/critical levels likely vary across the globe and from course to course**

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Clarification/over-simplification *regarding OM Management* on sand based rootzones

- One size does not fit all
- The universal optimal % OM has not been scientifically determined and may be mythical
- Methodology & sampling differences exist and must be considered
  - *Help is on the horizon (USGA OM Brain Trust)*
- Cultivation is critical to increase efficiency in sand incorporation
- Solid are not different than coring tines
- The benefits of topdressing continue to be identified.

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Chapter 12 ASA Monograph (3RD Edition)

Characterization, Development, and Management of Organic Matter in Turfgrass Systems

R.E. Gaussoin, Dep. of Agronomy and Horticulture, Univ. of Nebraska
W.L. Bernat, Dep. of Resort and Hospitality Management, Florida Gulf Coast University
C.A. Dockrell, Teagasc College of Amenity Horticulture Dublin, Ireland
R.A. Drijber, Dep. of Agronomy and Horticulture, Univ. of Nebraska

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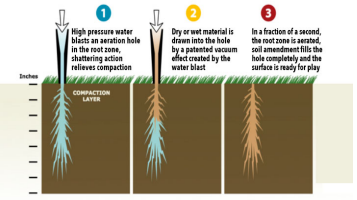
DryJect



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2021 DryJect Trial

- DryJect 3x3
- DryJect 2x3
- Needle 1/4"
- Hollow 1/2“ ID
- Solid 1/2“ OD
- Needle + Hollow
- Needle + Solid
- 3" target depth on all tines except Dryject = 5"

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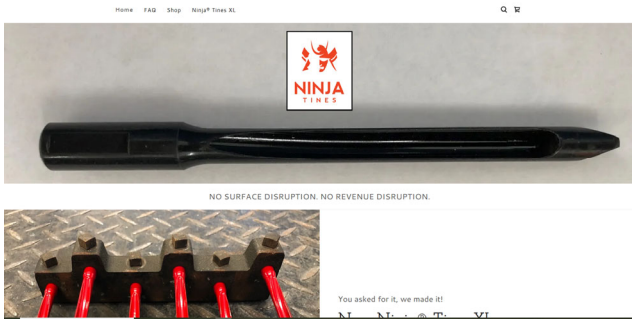

“YOU WON’T HAVE TO CLOSE THE COURSE WHEN YOU CORE AERIFY.”

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Acknowledgements

- USGA
- Environmental Institute for Golf
- Nebraska GCSA
- GCSA of South Dakota
- Peaks & Prairies GCSA
- Jacobsen, Toro, JRM & PlanetAir, DryJect

Nebraska Turfgrass Association

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