Understanding and Managing Organic Matter Accumulation in Putting Greens

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Practices to change thatch into mat include topdressing and …

~~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.

Physical And Chemical Characteristics Of Aging Golf Greens

Roch Gaussoin, PhD
Jason Lewis
Ty McClellan
Chas Schmid
Bob Shearman, PhD

THE USGA

Environmental Institute for Golf

Treatments

- rootzone Mix
  - 80:20 (sand/peat)
  - 80:15:5 (sand/peat/soil)
- Grow-In Procedure
  - Accelerated
  - Controlled

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 rootzone materials and grow-in procedures.

Project Schedule (Phase II)

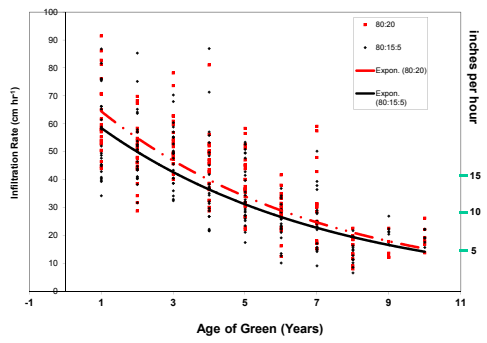
2002 | 2003 | 2004 | 2005

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

Materials and Methods

9 yr old green	10 yr old green	12 yr old green	13 yr old green

As of 2009



OM accumulates as sand greens age

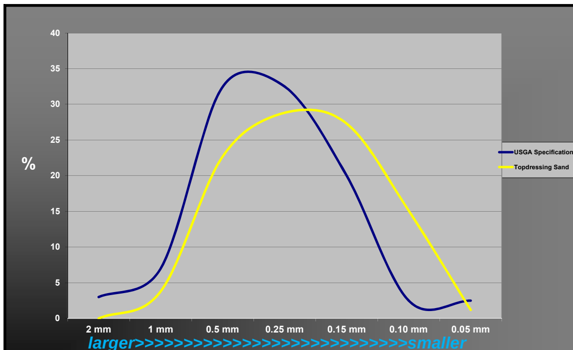
Formation of Mat

- Formation of mat layer increased approximately 0.3 inch 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 core aerification

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

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.**



Conclusions

- **The K_{SAT} decrease over time *may* be due to organic matter accumulation above and in the original rootzone and/or the increased fine sand content originating from topdressing sand**

Want to know more?

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

Organic Matter Management Study

Objectives

1. Determine if conventional hollow tine is more effective than solid tine aerification at managing organic matter accumulation

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2. Determine if venting methods are effective at managing OM accumulation

Treatments

Tine Treatment	Venting Treatment
None	None
2X Hollow tine	PlanetAir
2x Solid tine	Hydroject
	Bayonet tine
	Needle tine

Treatments

Tine Treatment	Venting Treatment
None	None
2X Hollow tine	PlanetAir
2x Solid tine	Hydroject
	Bayonet tine
	Needle tine

15 Trts per Rep
6 Reps per year
2 different years
= A whole lot of fun for one graduate student or 180 trts

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*

Materials and Methods

- Green Age:
  - 12 years
  - 9 years
- Data collected:
  - OM% (pre-cultivation/monthly)
  - Single wall infiltration (monthly)

OM Data Analysis Year 1

- No differences between green age except for higher % in older green

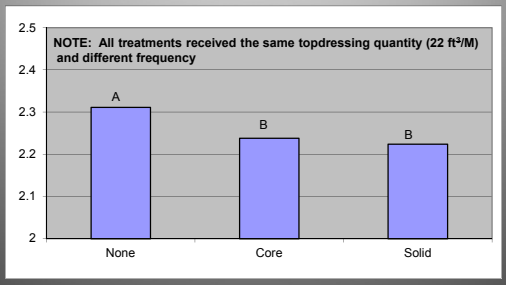
OM Data Analysis Year 1

- No differences between green age except for higher % in older green
- No differences among venting methods

OM Data Analysis Year 1

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

Effect of Tines on OM after 1 yr



OM Data Analysis Year 2

- No differences between green age except for higher % in older green

OM Data Analysis Year 2

- No differences between green age except for higher % in older green
- No differences among venting methods

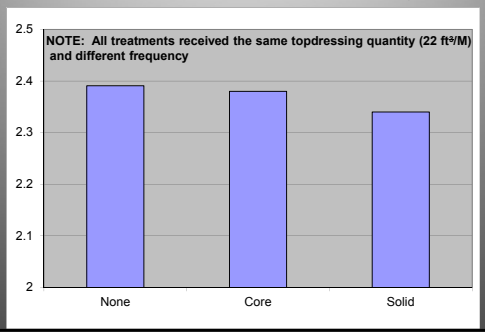
OM Data Analysis Year 2

- No differences between green age except for higher [illegible] older green
- No differences among venting methods
- No interactions with solid/hollow/none

OM Data Analysis Year 2

- No differences between green age except for higher [illegible] older green
- No differences among venting methods
- No interactions with solid/hollow/none
- No differences among solid/hollow/none

Effect of Tines on OM after 2 yrs



Let's take a quick look at that…

What these data do/don't suggest

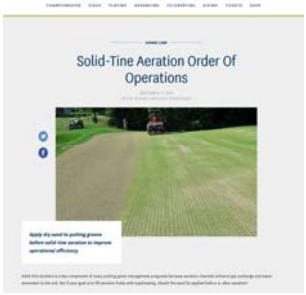
- Cultivation, when topdressing quantity was equal, was insignificant as a means to control OM
- However, a superintendent must use whatever tools they have at their disposal to ensure sand is making it into the profile and not the mower buckets

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

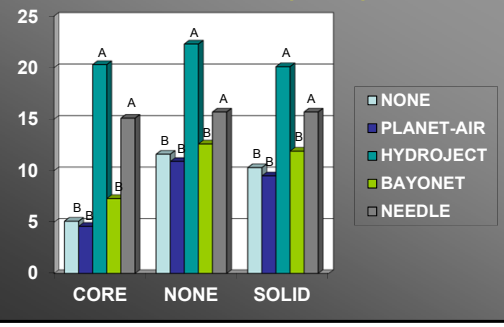
- **NONE/NONE**
  - 5-10 days
- **Solid & Hollow/NONE**
  - 7-14 days
- **Solid & Hollow/Venting**
  - 14-18 days

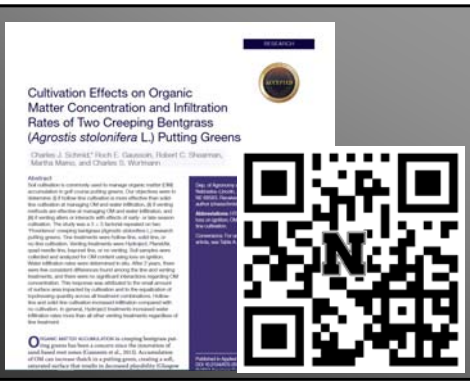
*Observed and calculated based on displacement and surface area opened

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



Infiltration (in/hr)

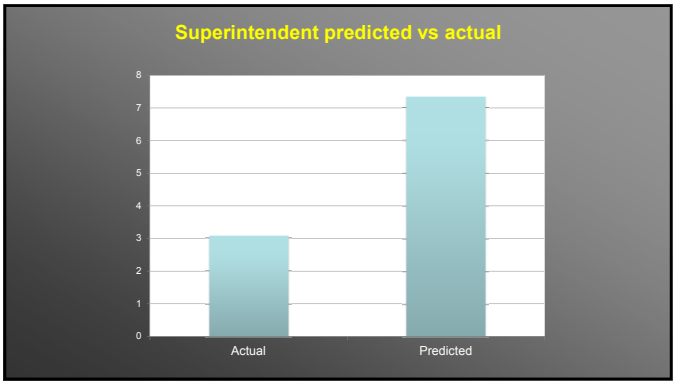


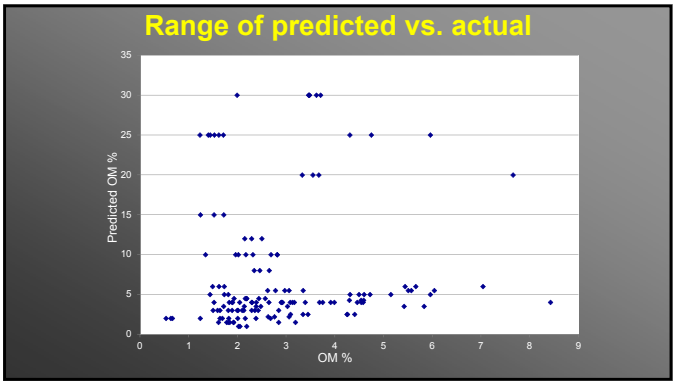


- **National Survey**
  - **Determine cause and effect relationship among managemnt practices and their interactions relative to surface OM accumulation**

Scope

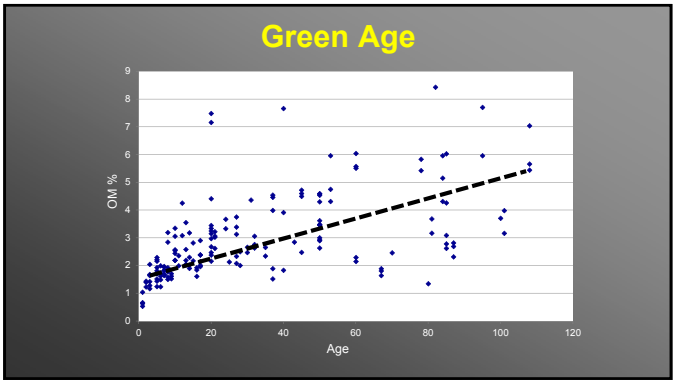
- **Sixteen states**
  - **Nebraska, South Dakota, Iowa, Wyoming, Colorado, Washington, Wisconsin, Illinois, New Jersey, Minnesota, New Mexico, Montana, Hawaii, California, Connecticut, Arkansas.**
- **117 golf courses sampled**
  - **More than 1600 samples**





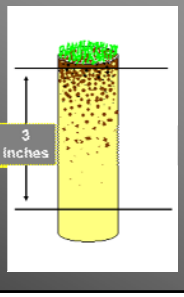
Why the disconnect?

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

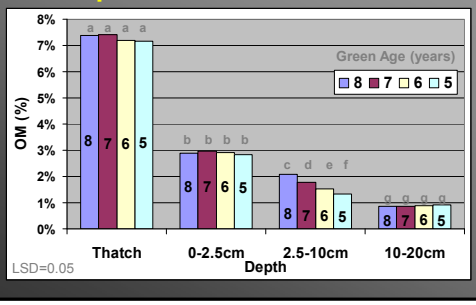


Is the age effect misleading?

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

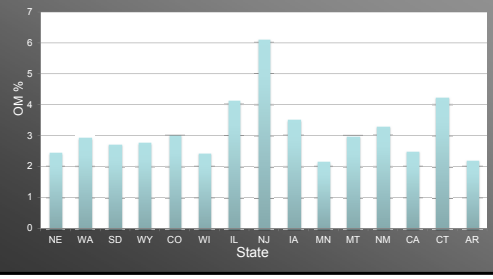


Organic Matter in USGA Specification Rootzones

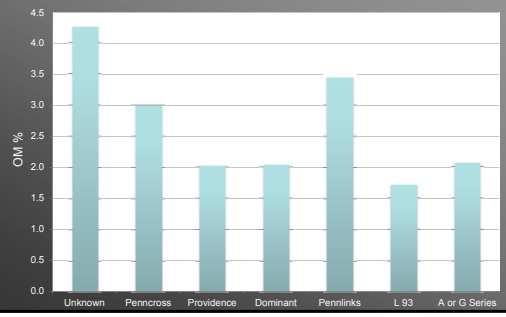


Mat Development with Age

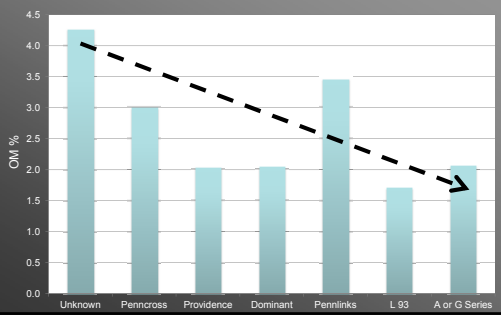
State Differences (highly correlated with age)



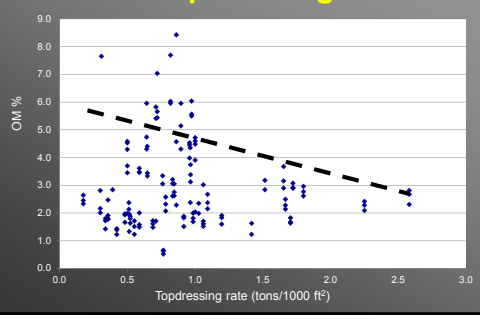
Cultivar



Cultivar



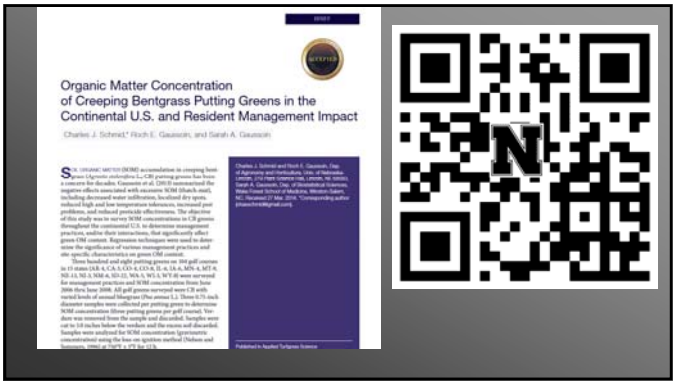
Topdressing



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*

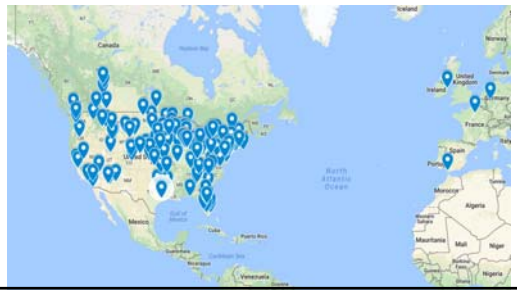


Topdressing

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"

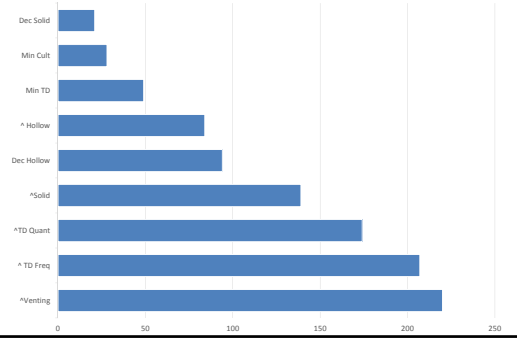
2016 Survey Respondents via Greenkeeper



Please mark all that apply. In the last 5-10 years, on our greens, our facility has:

- Increased topdressing quantity
- Increased topdressing frequency
- Increased hollow tine (equal or greater than 0.5") aeration
- Increased solid tine (equal or greater than 0.5") aeration
- Decreased hollow (equal or greater than 0.5") tine aeration
- Decreased solid tine (equal or greater than 0.5") aeration
- Made minimal changes in topdressing application quantity/frequency.
- Made minimal changes in cultivation practices.
- Increased "venting" practices.

303 Responses



PACE Turf
@paceturf

September 2020

For poa/bent greens. Which is your choice of fall aeration practice?

Core w or w/o sand	40%
Solid w or w/o sand	34%
No holes	4%
No vote just show results	22%

185 votes · Final results

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

"the solution to pollution is dilution"

GOLF COURSE INDUSTRY

THE VOICE FOR TODAY'S SUPERINTENDENT

True Grit

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RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

Topdressing Sand:
Sorting Out What Matters

Nebraska Turf Conference
Wednesday, January 9, 2019
9:00 – 9:45 a.m.

James A. Murphy, Ph.D.
Extension Specialist in Turfgrass Management

Sand Particle Size

Particle	Diameter (mm)	Sieve Mesh #
Fine Gravel	2 – 3.4	10 – 6
V. Coarse Sand	1 – 2	18
Coarse Sand	0.5 – 1	35
Medium Sand	0.25 – 0.5	60
Fine Sand	0.15 – 0.25	100
Very Fine Sand	0.05 – 0.15	270

Difficult to incorporate

Particle Size Distribution for Drainage

Particle Name	Diameter (mm)	Recommendation (by weight)
Fine Gravel	2 – 3.4	Not more than 10% total, maximum of 3% fine gravel
Very Coarse Sand	1 – 2	
Coarse Sand	0.5 – 1	Minimum of 60%
Medium Sand	0.25 – 0.5	
Fine Sand	0.15 – 0.25	Not more than 20%
Very Fine Sand	0.05 – 0.15	Not more than 5%
Silt	0.002 – 0.05	Not more than 5%
Clay	< 0.002	Not more than 3%
Total Fines	very fine sand + silt + clay	Less than or equal to 10%

Research Objectives:

1. Effects of topdressing with sand lacking coarse particles (0.5-mm sand)
2. Does core cultivation and backfilling holes with medium-coarse sand offset any negative effects of topdressing with sands lacking coarse particles?

RUTGERS

Sand Size	2-1 mm Very Coarse	1-0.5 mm Coarse	0.5-0.25 mm Medium	0.25-0.15 mm Fine	0.15-0.05 mm Very Fine
	% (by weight) retained				
Medium-coarse (1-mm)	0	30	60	10	< 1
Medium-fine (0.5-mm)	0	0	74	24	2
Fine-medium	0	4	27	48	21

RUTGERS

Treatment No.	Factors in the Experiment: Sand Size	Topdressing Rate during Growing Season	Cultivation (twice/year; May & Oct): Hollow Tine	Backfill / Topdress	Annual Quantity of Sand Applied
		lbs. / 1,000-sq.-ft.		lbs. / 1,000-sq.-ft.	lbs. / 1,000-sq.-ft.
1	Medium-coarse	50	None	400	1,300
2	Medium-coarse	50	Core + Backfill	600	1,700
3	Medium-coarse	100	None	400	1,800
4	Medium-coarse	100	Core + Backfill	600	2,200
5	Medium-fine	50	None	400	1,300
6	Medium-fine	50	Core + Backfill	600	1,700
7	Medium-fine	100	None	400	1,800
8	Medium-fine	100	Core + Backfill	600	2,200
9	Fine-medium	50	None	400	1,300
10	Fine-medium	50	Core + Backfill	600	1,700
11	Fine-medium	100	None	400	1,800
12	Fine-medium	100	Core + Backfill	600	2,200
13	None	0	None	0	0
14	None	0	Core + Backfill	600	1,200

RUTGERS

Research says, so far (3 years)…

1. Topdressing improved the surface:
   - reduced the OM concentration
   - produced a drier surface
2. Sand size impacts on mat layer physical properties:
   - medium-fine (>20% fine sand) increased the fineness of sand in mat layer but this did not influence infiltration or VWC
     - medium-coarse and medium-fine similar water infiltration and surface wetness
   - fine-medium sand slowed water infiltration and increased surface water retention
     - fine-medium sand substantially increased fine and very fine particles in mat layer

RUTGERS

Research says, so far (3 years)…

3. Core cultivation and backfilling with medium-coarse sand very effective at:
   - reduces surface wetness and OM concentration
   - reduces the amount of fine and very fine sand in the mat layer, thus offsetting the negative impact of those particles

RUTGERS

Managing for Drier Mat Layer

Topdressing
- Cost and interference with play and mowing are limiting factors
- Apply as much and as often as feasible (~48 tons / acre)
- Select as coarse a sand as feasible
  - medium-fine (0.5-mm) sand with less 30% fine sand

Core Cultivation
- Very effective at producing a drier surface
- Needed if reducing OM is important *(removal + allows for more sand incorporation)**
- Time for healing is greatest limitation *(less so for solid tines and venting)**

*Gaussoin adds

RUTGERS

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 + ……

"Growth Potential"

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

#clipvol "*One bucket at a time*"

- Micah Woods, Asian Turfgrass Center

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

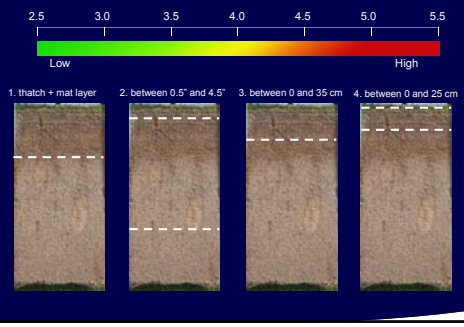
Introduction

Managing soil organic matter (SOM) in golf course putting greens is a major agronomic challenge facing golf course superintendents. If organic matter levels become excessive, the putting surface will be soft, bumpy and prone to disease and scalping. Yet measures to control organic matter accumulation such as topdressing and core aeration are commonly disruptive and result in player dissatisfaction and reduced course revenues. This article describes a location-based simulation model of organic matter accumulation, mineralization, dilution and removal to track the fate of SOM in the sand-based surface layer of

An empirical model to predict OM fate in putting green rootzones

buckeyeturf.osu.edu

Organic Matter Sampling Protocols



#OM246 Putting Green Organic Matter by Depth

- Micah Woods, Asian Turfgrass Center

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**

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.

Chapter 12 ASA Monograph (3RD Edition)

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

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- Nebraska Turfgrass Association