Topdressing 101: *Organic Matter Management for Cool Season Putting Greens*

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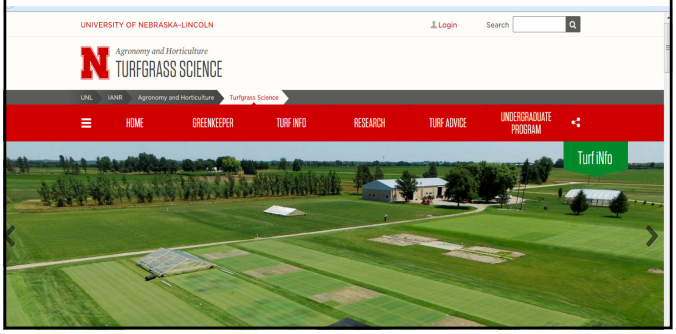
SAN DIEGO 2019 CONNECT. DISCOVER. ELEVATE. FEBRUARY 2-7 golf industry show

Turfgrass Science University of Nebraska

www.turf.unl.edu



ASA Monograph (3RD Edition)

Chapter 12
Characterization, Development, and Management of Organic Matter in Turfgrass Systems

R.E. Gaussoin, Dep. of Agronomy and Horticulture, Univ. of Nebraska
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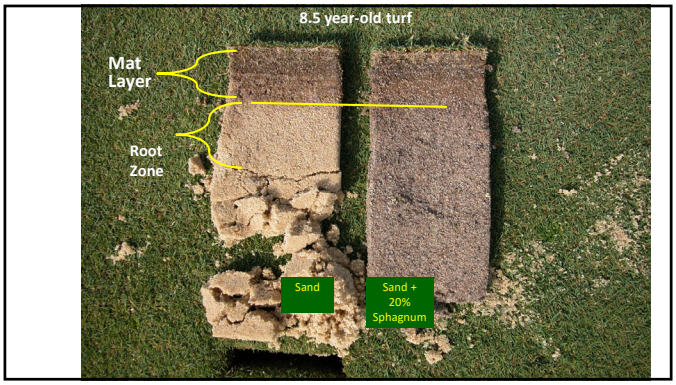


~~The~~ *My* organic matter journey……

- 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.

Physical And Chemical Characteristics Of Aging Golf Greens

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

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)

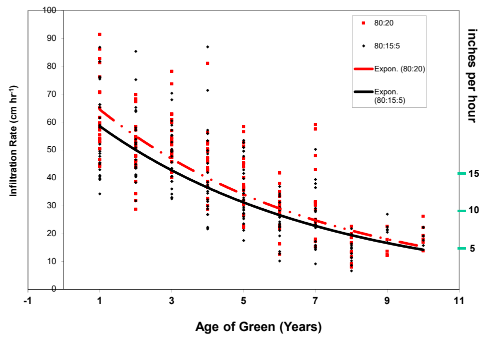
2002 | 2003 | 2004 | 2005

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

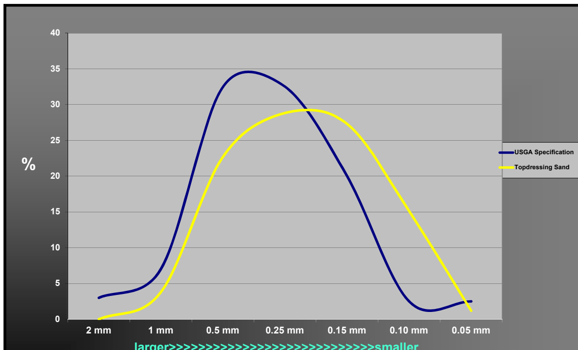
Formation of Mat

- Formation of mat layer increased approximately <u>0.3 inch annually</u> (following establishment year).
- No visible layering, only a <u>transition</u> is evident between mat and original rootzone.
- <u>Topdressing program</u>
  - 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

Published December 19, 2014

RESEARCH

ACCEPTED

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

Abstract

Organic Matter Management Study

Objectives

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

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

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**

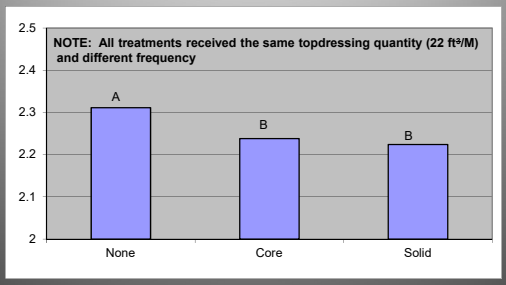
OM Data Analysis Year 1

- **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

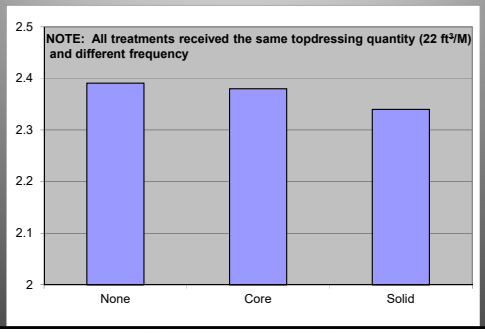
OM Data Analysis Year 2

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



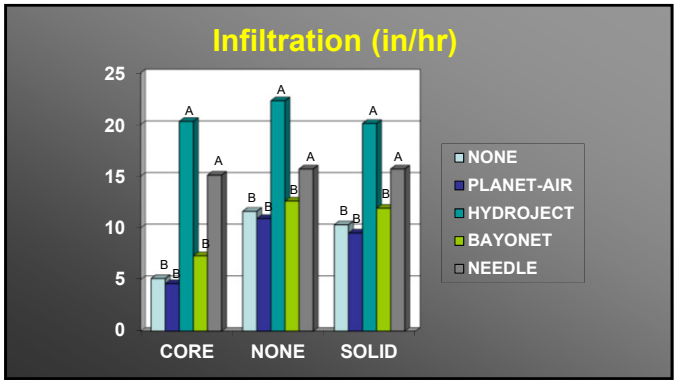
What these data do/don't suggest

- 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 insure 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



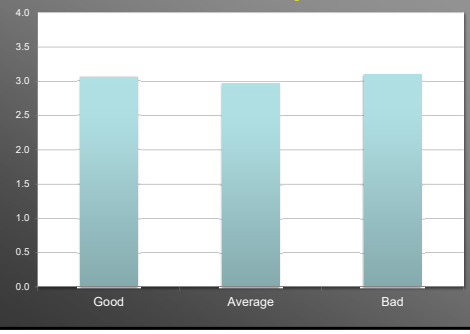
Project Objective

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

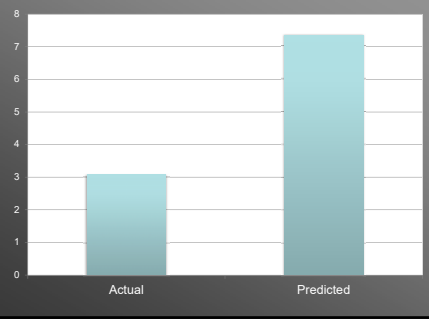
2006/07/08 Samples

- 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

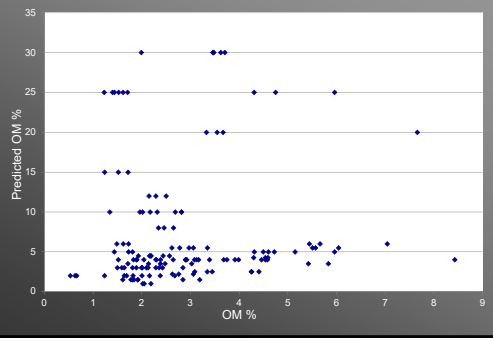
Problematic vs Non-problematic



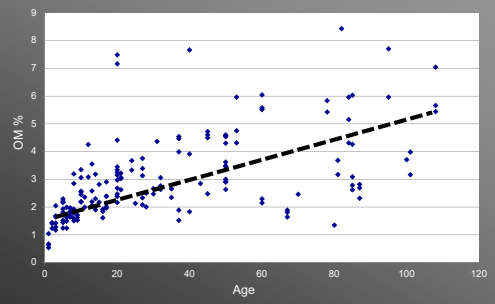
Superintendent predicted vs actual



Range of predicted vs. actual



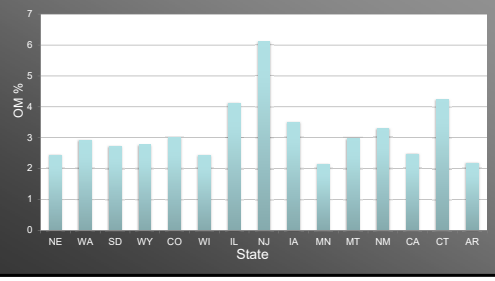
Green Age



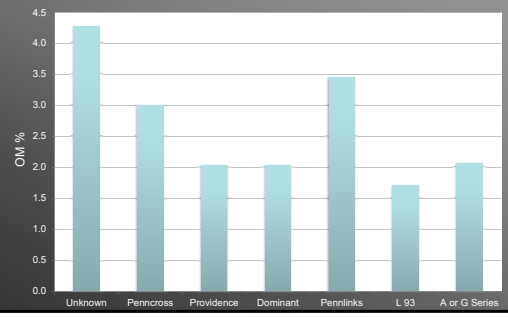
Is the age effect misleading?

- Sampling issues:
  - Mat depth increases as green ages resulting in more OM in the same volume soil.
  - Because deposition is relatively uniform, % per unit depth within the true mat layer is relatively uniform

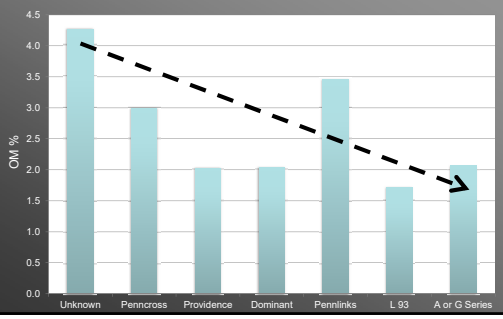
State Differences (highly correlated with age)



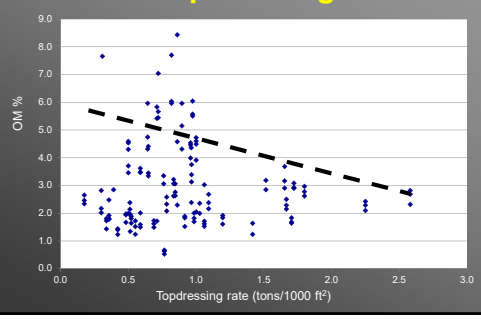
Cultivar



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

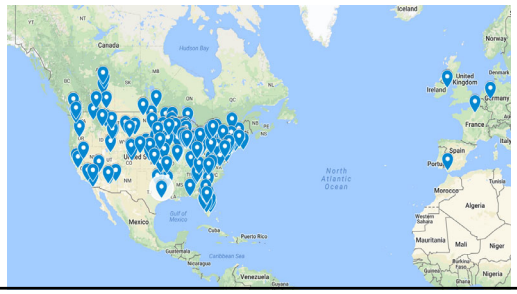
Old Tom Morris (1821–1908) is thought to have discovered the benefits of topdressing accidentally when he spilled a wheelbarrow of sand on a putting green and noted how the turf thrived shortly afterward (Hurdzan, 2004).

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

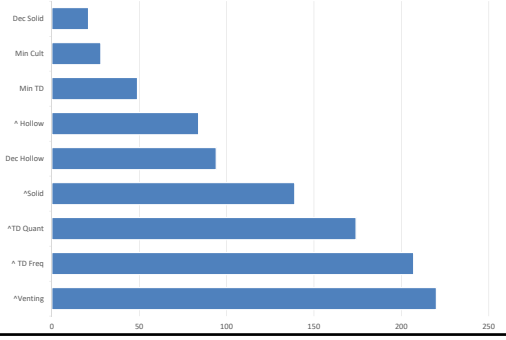
Please mark all that apply. In the last 5-10 years, on our greens, our facility has:

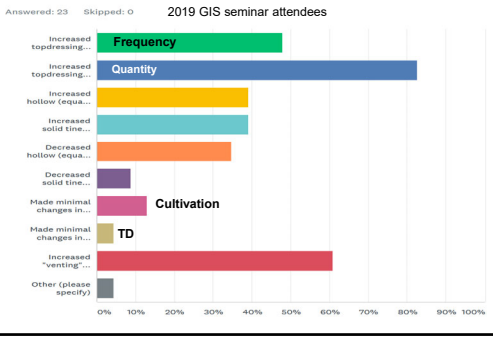
- Increased topdressing quantity
- Increased topdressing frequency
- Increased hollow tine (equal or greater than 0.5") aeration
- Increased solid tine (equal or greater than 0.5") aeration
- Decreased hollow (equal or greater than 0.5") tine aeration
- Decreased solid tine (equal or greater than 0.5")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

2016 Survey Respondents via Greenkeeper



303 Responses





How do you get rid of OM?

- Decomposition (microbial)
  - Increase surface area and aeration
  - Inoculation (???)
- Removal
  - Power raking, dethatching, core aerification
- Dilution
  - Topdressing

"the solution to pollution is dilution"

Next steps…….

GOLF COURSE INDUSTRY

THE VOICE FOR TODAY'S SUPERINTENDENT

sponsored by The Hayden Group Inc. PREMIER SAND

True Grit

https://www.golfcourseindustry.com/article/greens-golf-topdressing-agronomics/

Does your TD sand meet USGA specs?

90%

77%

72%

88%

When do you topdress?

	All Year	Warmer Months	Cooler Months
Northeast	57	29	14
Central	32	52	16
Southeast	55	43	2
West	45	54	1

Data presented as percentages

https://www.golfcourseindustry.com/article/greens-golf-topdressing-agronomics/

Preferred particle size (mm's):

	VC 1-2	C 0.5-1	M 0.25-0.5	F 0.15-0.5	VF 0.05-0.15	Silt/ Clay
Northeast	9	13	55	19	4	0
Central	2	11	51	35	1	0
Southeast	0	4	57	35	4	0
West	2	12	49	32	2	2

Data presented as percentages

https://www.golfcourseindustry.com/article/greens-golf-topdressing-agronomics/

Frequency of Heavy Topdressing (per/yr):

	1X	2X	3X	>3X	*+ Light TD?*
Northeast	17	45	25	11	85
Central	28	50	11	11	86
Southeast	18	41	21	20	86
West	19	61	12	7	86

Data presented as percentages

https://www.golfcourseindustry.com/article/greens-golf-topdressing-agronomics/

Frequency of Light Topdressing (days):

	7	14	21	28	>28	*Same amount?*
Northeast	10	43	15	14	18	Yes
Central	7	42	28	7	16	Yes
Southeast	32	56	6	4	2	No
West	8	41	24	13	14	Yes

Data presented as percentages

https://www.golfcourseindustry.com/article/greens-golf-topdressing-agronomics/

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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?

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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	Cultivation (twice/year; May & Oct): 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

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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

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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

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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 +

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

Growth Potential

- #clipvol
- Pace Turf
  - –https://www.paceturf.org/public/sand-and-growth-potential
- Micah Woods
- Jason Haines
- Bill Kreuser
- Others….

Next Level OM Management!

Wing Point GOLF & COUNTRY CLUB
Bainbridge Island, WA

Mike Goldsberry Golf Course Superintendent

- What is it that makes greens different? Essentially, two contributing factors.
  - Sunlight = growth
  - Soil medium = growth, infiltration rate, fertilizer leaching, wilting point, firmness, cold weather tolerance, air porosity
- How do we know if each greens soil medium is different without testing for % Organic Matter?
- Why are we aerating all the greens the same if they're all different?
- What are we really trying to accomplish when we aerate our greens twice a year? Many things we all know about, but mostly it's our chance to actually incorporate sand into the profile in order to mange the ongoing accumulation of OM. We're basically using these two opportunities to balance things out.
- What's the best method for making sure we have good incorporation of sand into the aeration holes?

2012 Numbers

Green	% OM Feb, 2012
1	3.02
2	3.5
3	3.05
4	2.91
5	3.37
6	3.87
7	3.28
8	3.89
9	3.89
10	3.09
11	3.31
12	3.96
13	3.3
14	3.27
15	2.89
16	2.94
17	4.28
18	4.3
Putter	3.57
Chipper	4.53

2014 Numbers

Green	% OM Feb, 2014
1	3.31
2	3.4
3	3.89
4	3.08
5	3.52
6	3.12
7	2.66
8	3.3
9	3.35
10	3.16
11	3.31
12	3.06
13	3.41
14	3.19
15	2.74
16	3.14
17	3.96
18	3.48
Putter	3.03
Chipper	3.09

Increased sand and only solid tine implemented in 2013/14

1.) Low %OM greens received a top dressing in 3rd gear and aerated 1 time

2.) Desired %OM greens received a top dressing in 2nd gear and aerated 2 times

3.) High %OM greens received a top dressing in 1st gear and aerated 3 times

- 1st gear low was 2.5 mph
  - 38% more sand than 2nd gear
- 2nd gear low was 4 mph
  - This has been our standard gear for aeration
- 3rd gear low was 7 mph
  - 43% less sand than 2nd gear

Pro Core 648
3/8" solid tines

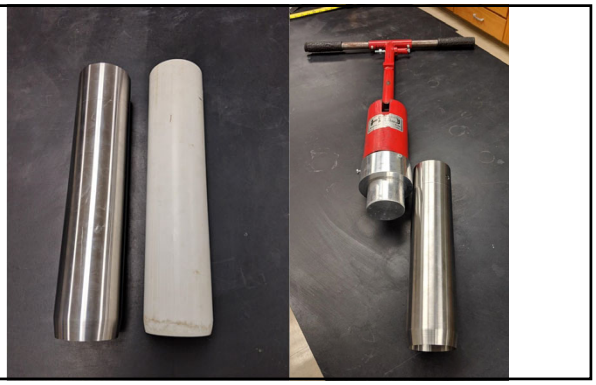
Green	% OM Feb, 2012	%OM Feb, 2016
1	3.02	2.65
2	3.5	2.34
3	3.05	2.49
4	2.91	2.66
5	3.37	2.62
6	3.87	2.9
7	3.28	2.45
8	3.89	2.52
9	3.89	3.03
10	3.09	2.9
11	3.31	2.65
12	3.96	2.58
13	3.3	2.96
14	3.27	2.53
15	2.89	2.58
16	2.94	2.51
17	4.28	3.04
18	4.3	2.64
Putter	3.57	2.73
Chipper	4.53	2.56

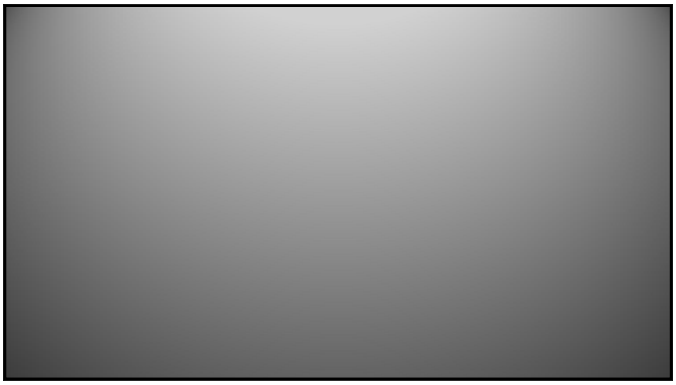
Conclusions

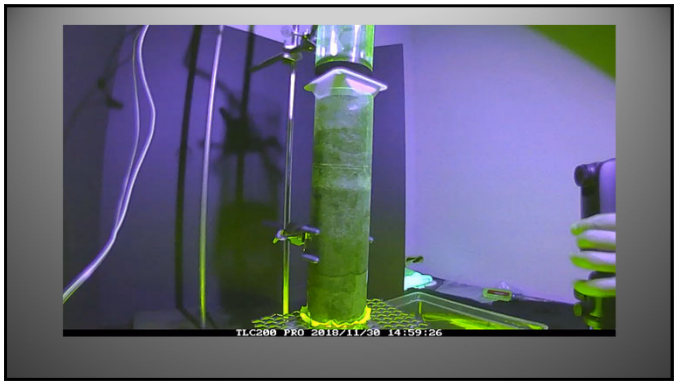
- Growing medium significantly altered in 4 years.
- Infiltration rate increased.
- Lower and/or more consistent %OM throughout your greens gives you more control.
- Wilt point much higher.
- Playability is extremely consistent with golf shots being received the same throughout the course.
- We will continue to sample the greens for %OM each February and August to make informed decisions on what to do next.
- Our aeration process is simple and fast. The staff and membership are equally pleased with process and results.
- This program has become the backbone of what we do. The unit of %OM is the most important tool in our box and has allowed us to produce consistent greens that perform far better than before this program was implimented.
- Regardless of whether you pull a core or solid tine, testing each green and then knowing how much sand to use, is essential to producing consistent greens.

Organic Matter Next Steps at UNL…

- *"the solution to pollution is dilution"*
- Next Steps
  - Topdressing impacts on structure and fluid dynamics







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!)***
  - ***Sample mat layer vs set depth (maybe??)***
- **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
- 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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- USGA
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- Nebraska Turfgrass Association