If organic is so good, why am I tearing up my greens to get rid of it?

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Because of inherent ambiguity in terminology and sampling techniques, the term “thatch-mat” has appeared frequently since the late 2000’s (McCarty et al., 2007; Barton et al., 2009; Fu et al., 2009).

and yet one more definition.............

SOM- Soil Organic Matter

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)

<table>
<thead>
<tr>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
</tr>
<tr>
<td>1997</td>
</tr>
<tr>
<td>1998</td>
</tr>
<tr>
<td>1999</td>
</tr>
<tr>
<td>2000</td>
</tr>
</tbody>
</table>

- Greens construction (one set per year)
- Seeding

Project Schedule (Phase II)

<table>
<thead>
<tr>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2003</td>
</tr>
<tr>
<td>2004</td>
</tr>
<tr>
<td>2005</td>
</tr>
</tbody>
</table>

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

Materials and Methods

<table>
<thead>
<tr>
<th>Age of Green</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 yr old green</td>
</tr>
<tr>
<td>12 yr old green</td>
</tr>
<tr>
<td>13 yr old green</td>
</tr>
<tr>
<td>14 yr old green</td>
</tr>
</tbody>
</table>

As of 2011

Data points and exponential regression lines of infiltration rate decline on USGA specification putting greens at Mead, NE.
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

Mat development (cm)

- 2.8
- 2.5
- 2.2
- 2.0

Green age (years)

- 8
- 7
- 6
- 5

• 2004 USGA research committee site visit
• original rootzone
• mat development
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).

• Other analysis also completed

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 $K_{\text{SAT}}$ 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

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.
Importance of OM in the rhizosphere

- deposition of particulate OM
- microbial niches
- nutrient uptake
- pathogen competition

Why is high OM considered to be “bad”? 

- Loss of infiltration
- Decreased aeration
- Traps “toxic” gases
- Are these concerns real or imagined?
- Why the confusion?

Analysis Methods

- Many exist, but the most relevant is “combustion” or “loss on ignition”

- The sample represents both dead and living organic matter

- Food for thought……

Sampling of Recommendations

- Private Lab A: < 3% - unrealistic
- Private Lab A: 1.5 – 2.5% at a 0.25 to 1-in depth
- Hartwiger & O'Brien: < 3.5 – 4.5%
- Low: < 3%
- High: < 5%
- J. W. Murphy: < 4.5%
- Carrow: < 3%
- McCoy: < 3.5%
- N.Z. Turf In.: < 8%
- Realistic & achievable

Seasonal Root Depth

- Spring
- Summer
- Fall
- Winter

root decline

Organic Matter Sampling Protocols

- 1. thatch + mat layer
- 2. between 0.5” and 4.5”
- 3. between 0 and 35 cm
- 4. between 0 and 25 cm

Low
High
There is no “magic” number

“the squeeze test”
(courtesy of Dave Oatis - USGA Director NE)

How do you get rid of OM?
• Decomposition (microbial)
  – Increase surface area and aeration
  – Inoculation (???)
• Removal
  – Power raking, dethatching, core aerification
• Dilution
  – Topdressing

How effective is removal?
• Surface disruptive, short and long term
• Core aeration is the most widespread practice recommended for OM management
<table>
<thead>
<tr>
<th>Tine Size (in.)</th>
<th>Spacing (in.)</th>
<th>Holes/ft²</th>
<th>Surface Area of One Tine</th>
<th>Percent Surface Area Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>1.25²</td>
<td>100</td>
<td>0.049</td>
<td>3.4%</td>
</tr>
<tr>
<td>1/4</td>
<td>2.5²</td>
<td>25</td>
<td>0.049</td>
<td>0.9%</td>
</tr>
<tr>
<td>1/2</td>
<td>1.25²</td>
<td>100</td>
<td>0.196</td>
<td>13.6%</td>
</tr>
<tr>
<td>1/2</td>
<td>2.5²</td>
<td>25</td>
<td>0.196</td>
<td>3.4%</td>
</tr>
<tr>
<td>5/8</td>
<td>2.5²</td>
<td>25</td>
<td>3.07</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

**Influence of Rootzone Organic Matter on Putting Green Quality and Performance**

- Funded by:
  - USGA (2006)
  - Nebraska Golf Course Superintendents Assoc. (2007-2009)
  - Golf Course Superintendents Assoc. of South Dakota (2006-2009)
  - Peaks & Prairies GCSA (2007-2009)

**Project Objective**

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

**Test Procedures**

**Years 1, 2, & 3**
- At least 3 different greens per golf course sampled
- Soil samples taken from 3 different area per green
- Samples were evaluated for OM levels using LOI
- Management survey
- GPS location
- NOA climate data
**Sampling Locations**

- **Sixteen states**
- **117 golf courses sampled**
  - More than 1600 samples
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)

<table>
<thead>
<tr>
<th>State</th>
<th>OM %</th>
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<tbody>
<tr>
<td>NE</td>
<td>0</td>
</tr>
<tr>
<td>WA</td>
<td>1.0</td>
</tr>
<tr>
<td>SD</td>
<td>2</td>
</tr>
<tr>
<td>WY</td>
<td>3</td>
</tr>
<tr>
<td>CO</td>
<td>4</td>
</tr>
<tr>
<td>WI</td>
<td>5</td>
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<td>IL</td>
<td>6</td>
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</tr>
<tr>
<td>CT</td>
<td></td>
</tr>
<tr>
<td>HI</td>
<td></td>
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</table>

Cultivar

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>OM %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td>0.0</td>
</tr>
<tr>
<td>Penncross</td>
<td>0.5</td>
</tr>
<tr>
<td>Providence</td>
<td>1.0</td>
</tr>
<tr>
<td>Dominant</td>
<td>1.5</td>
</tr>
<tr>
<td>Pennlinks</td>
<td>2.0</td>
</tr>
<tr>
<td>L 93</td>
<td>2.5</td>
</tr>
<tr>
<td>A or G Series</td>
<td>3.0</td>
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</table>

Cultivation Frequency (& type)

<table>
<thead>
<tr>
<th>Frequency &amp; Type</th>
<th>OM %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly</td>
<td>0.0</td>
</tr>
<tr>
<td>3-4 per year</td>
<td>0.5</td>
</tr>
<tr>
<td>Spring and fall</td>
<td>1.0</td>
</tr>
<tr>
<td>Spring only</td>
<td>1.5</td>
</tr>
<tr>
<td>Fall only</td>
<td>2.0</td>
</tr>
<tr>
<td>Every other year</td>
<td>2.5</td>
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</table>
Survey Summary

- None of the variables collected, by themselves, or in combination with others, predicted OM.
- Courses using >20 cubic ft/M of topdressing with or without “venting” had lower OM.

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

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 less invasive cultivation (LIC) methods are effective at managing OM accumulation.
### Materials and Methods

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

### Infiltration Effects

Comparison of preconstruction $K_{sat}$ values to $K_{sat}$ values taken 10/04.

### Relationship between OM and Infiltration

*Significant at $\alpha = 0.01$
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

NOTE: All treatments received the same topdressing quantity (22 ft³/M) and different frequency

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

Effect of Tines on OM after 2 yrs

<table>
<thead>
<tr>
<th>Treatment</th>
<th>O.M. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>2.4</td>
</tr>
<tr>
<td>Core</td>
<td>2.3</td>
</tr>
<tr>
<td>Solid</td>
<td>2.2</td>
</tr>
</tbody>
</table>

NOTE: All treatments received the same topdressing quantity (22 ft³/M) and different frequency

Acknowledgements

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

What these data do/don’t suggest

- Topdressing is the most consistent and repeatable factor in OM management
- Cultivation 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/LIC combinations (22 cu ft/M)*

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

*Observed and calculated based on displacement and surface area opened
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 in his classic textbook "Turfgrass Science & Culture, 1973 writes: "The most important management practice for OM management is topdressing"

Layering

- Water retention is non-uniform
- Thatch/mat layers can store twice as much water than the root zone

NOT a function of drainage

Rather it is the difference in pore size distribution among layers

Layering

- Aeration alone not that effective
- Must topdress to dilute OM (change its pore size distribution) and use deficit irrigation
Compacted

Pores must be continuous (connected)!

ASA Monograph (3rd Edition)

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

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