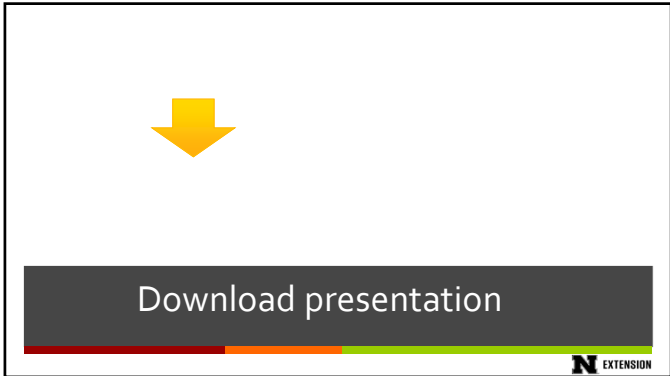
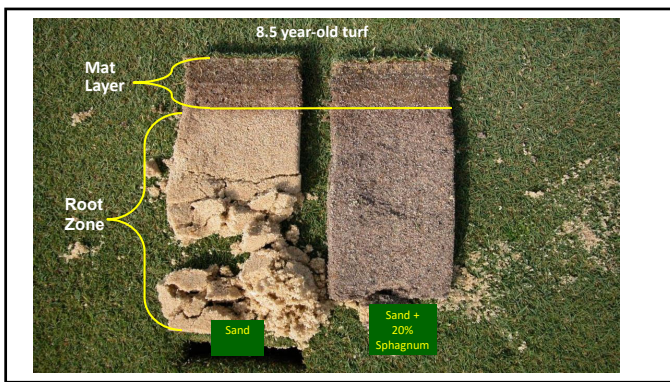




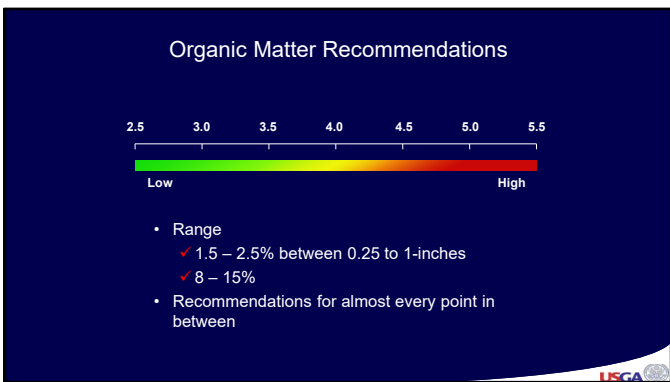
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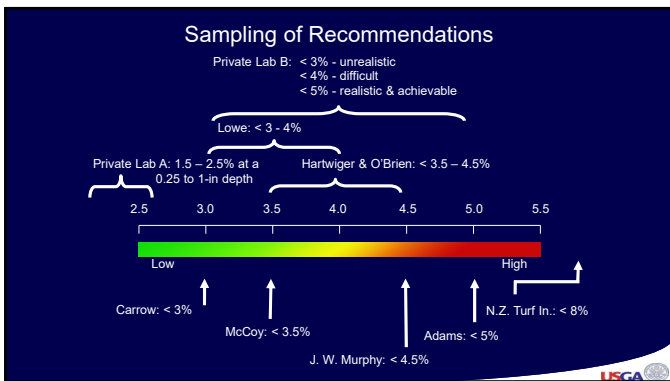
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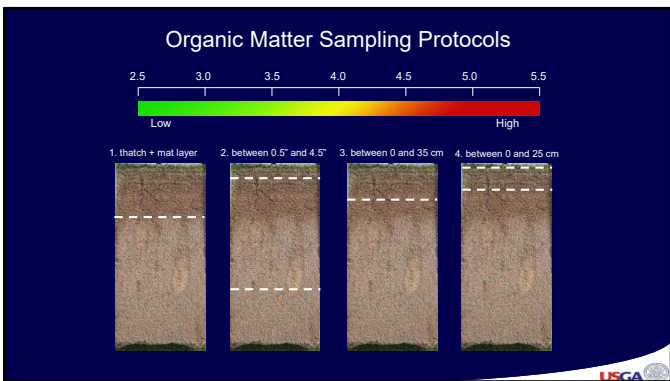
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6

### Historic Sampling Depth (as approved by the SSSA)

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

Top growth (verdure) Removed  
Depth set to 3 or 6 inches  
3 inches

**N** EXTENSION

7



8

### Accuracy and Precision

Need to have a root zone specific **sampling** and analysis protocol for OM in sand based rootzones

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### Developing a Standard for Measuring Organic Matter in Putting Green Soils

▪ Collaborators:  
 Roch Gaussoin / Professor / Agronomy & Horticulture/University of Nebraska-Lincoln  
 ▪ Doug Linde / Professor / Plant Science / Delaware Valley University  
 ▪ James Murphy / Professor / Plant Biology / Rutgers University  
 ▪ Doug Soldat / Professor / Soil Science / University of Wisconsin-Madison  
 ▪ Travis J. Miller / Graduate Student / University of Wisconsin-Madison

Funded by  
**USGA** Mike Davis Program for Advancing Golf Course Management

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### What is the most common analytic test?

Loss on Ignition (LOI)

- 100-1200°C (370-420 °C norm)
- Sample is weighed, placed in oven, then weighed again
- OM% determined % by weight (or mg/g)
- Ovens are \$1200-\$2500

**N** EXTENSION

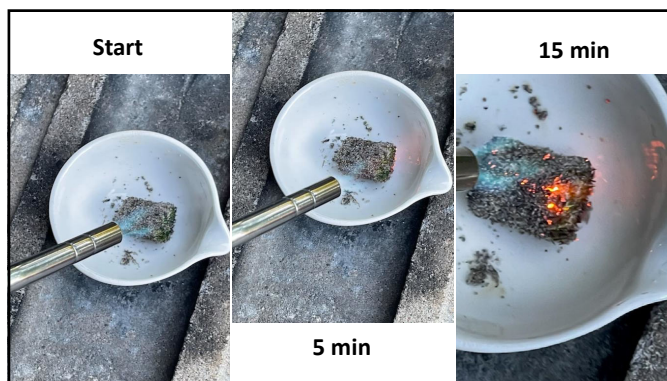
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**Developing a simple, practical method for organic matter content determination by superintendents**

Leifeld and Kogel-Knabner (2001)

Funded by **USGA** Mike Davis Program for Advancing Golf Course Management

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**Don't try this at home.....**

- Methods using hydrogen peroxide adapted from Leifeld and Kogel-Knabner (2001) were time-consuming and step intensive for practical use.
- Attempts to find a correction factor were also not discovered.
- Regression models based on data of the best attempt showed a high level of variation measuring OM percentages of pre-determined lab mixed samples.
- A rapid, practical, inexpensive, and reliable method to test OM content on golf using equipment available on a typical golf course is not feasible.
- Like the torch fiasco, you still need an analytic balance and other lab equipment

**N** EXTENSION

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**Taking a representative sample**

- Sample depth(s)
- Number of samples
- Sample location
- Sample size
- Time of year
- Verdure on or off?


**N** EXTENSION

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### Develop an accurate and efficient method for characterizing OM in sand root zones

Questions that need to be answered:


1. How does sample preparation affect mean SOM?
2. How does core diameter affect mean SOM?
3. How many samples are required to adequately characterize the mean SOM on a single putting green?
4. How far apart should samples be taken?



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### How does sample preparation affect mean SOM?

- Some researchers leave verdure on, some remove, how does this impact mean SOM?
- Most labs grind and sieve samples, how does this impact the mean SOM when verdure is left on?
- Does increased core diameter size affect the mean SOM?



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### Site Characteristics

Samples were taken at the OJ Noer Turf Research Facility and University Ridge Golf Course in Verona, WI


50 samples were taken from five different root zones on a 10'X10' grid  
 3 from research plots  
 2 from putting greens

	Mean OM %
Putting Green 1	5.82
Putting Green 2	5.39
Research Green 2	5.23
Research Green 3	5.07
Research Green 1	4.74

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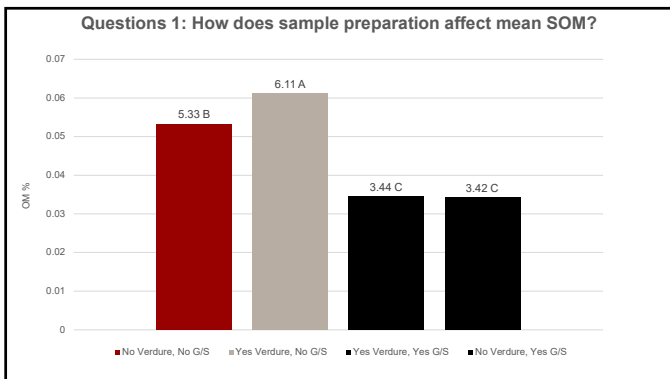
### Sample Preparation

- Core diameter evaluation
  - 0.75 inch or 1.5 inch
- Verdure evaluation
  - removed above the thatch layer to remove all green material
  - left on
- Grinding/sieving evaluation
  - analyzed intact
  - ground with mortar and pestle and sieved with no. 10 sieve
- All samples were dried for 24 hr. at 105 C before weighing and burned and 360 C for 2 hours



Diameter (cm)	Verdure	Sieve
3.8	Yes	No
1.9	Yes	No
1.9	Yes	Yes
1.9	No	Yes
1.9	No	No

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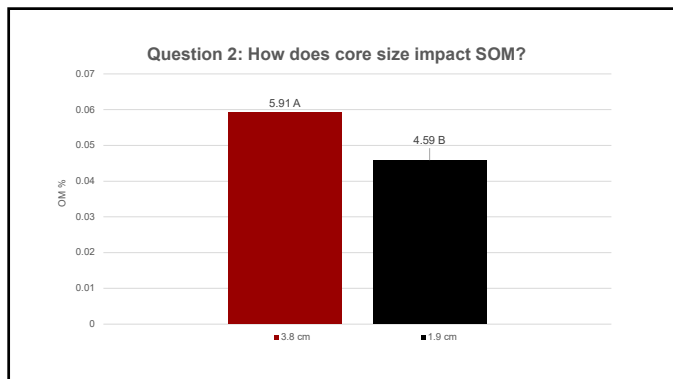


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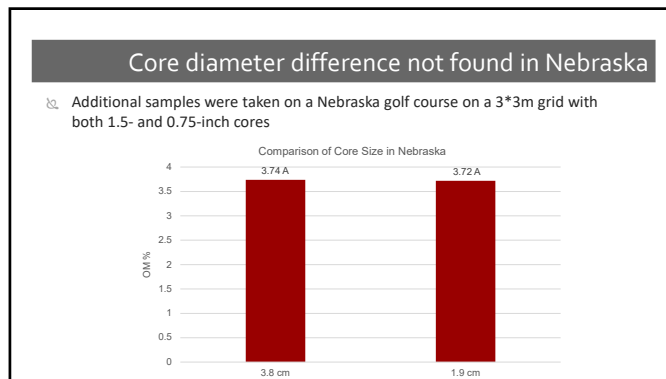
### Sample size



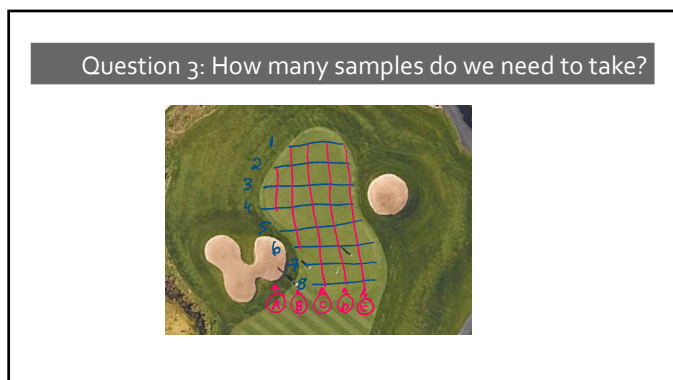
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### # of samples and location

- 3 golf courses at different geographic locations
- 5 holes at each course
- Samples from N to and E to W on 10 ft centers

**N** EXTENSION

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Loc	N	E
1	1	B
2	1	C
3	1	D
4	1	E
5	2	A
6	2	B
7	2	C

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### With standard 0.75 inch probes most greens need only 5 samples to characterize the mean OM

Wisconsin			Pennsylvania			Nebraska		
Green	# Samples	Average OM	Green	# Samples	Average OM	Green	# Samples	Average OM
Chip	5	4.59	6	7	17.14	9	5	4.01
	12	7.21	2	5	10.83	8	5	4.09
	8	7.23	3	8	15.66	7	5	3.95
	4	7.06	4	5	11.72	6	5	3.60
	1	6.69	7	5	13.2	5	5	3.09

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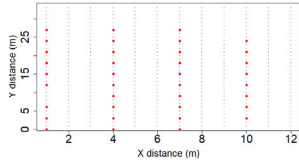
With the 1.5 inch probe need between 4-5 samples to achieve the same precision

Nebraska Standard			Nebraska Large		
Green	# Samples	Average OM	Green	# Samples	Average OM
9	5	4.01	9	4	3.96
8	5	4.09	8	5	4.09
7	5	3.95	7	5	3.90
6	5	3.60	6	4	3.62
5	5	3.09	5	4	3.20

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Question 4: How far apart should samples be taken?


- What we did
  - Same sampling technique, 3\*3m grids, 0.75 inch probe on 5 greens at 3 courses
  - Analyzed the data using spatial variograms to determine sampling distance



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Initial findings for how to take samples


- Choose 5-10 random locations 25 -30 ft apart
- Use 0.75-inch diameter probe to a depth of 1 inch (larger cores acceptable but not necessary)
- Leave verdure on without grinding and sieving




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What are you most interested in?



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OM Testing


- Take annual tests to determine long-term trend
  - Same time of year
  - Same location and green
- 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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**Chapter 12** ASA Monograph (3RD Edition)  
**Characterization, Development, and Management  
of Organic Matter in Turfgrass Systems**

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Golf Course Management



Nebraska Turfgrass Association

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