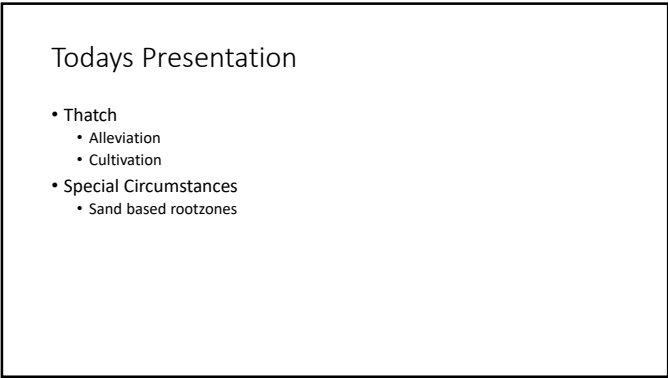
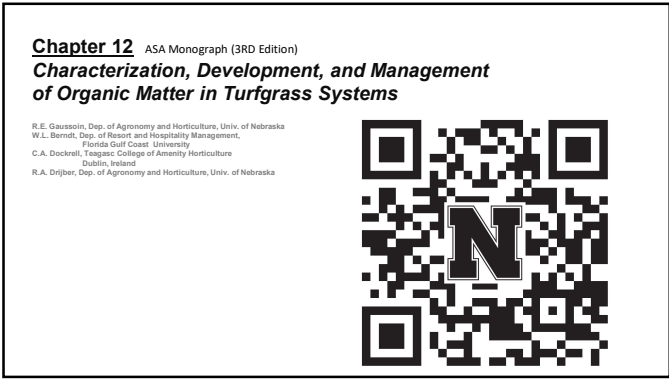




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2



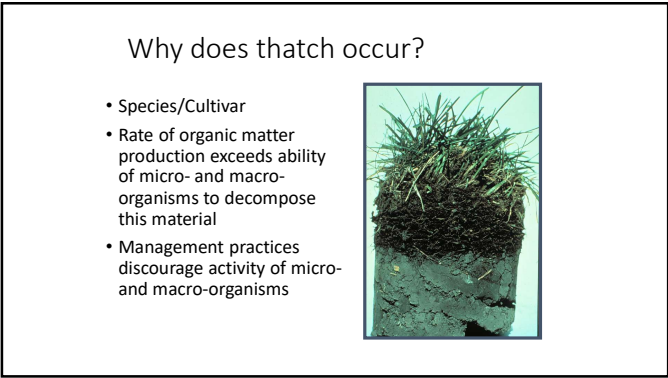
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Thatch: The Negative

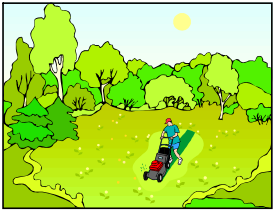


- Can become hydrophobic (water repellent)
- Porous; water retention issues
- Difficult to rewet
- Poor N and K retention
- Increased weed, disease, and insect problems
- Decreased pesticide effectiveness (insecticides)

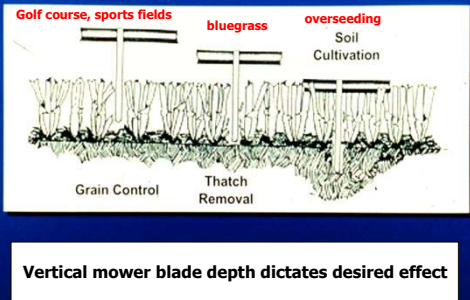
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Turfgrass Thatch/Compaction Remedies

- Cultivation techniques
  - Core cultivation
  - Vertical mowing



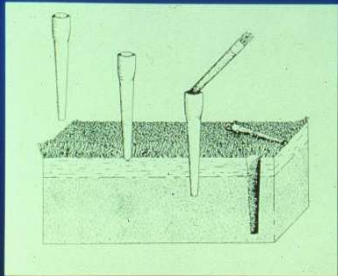
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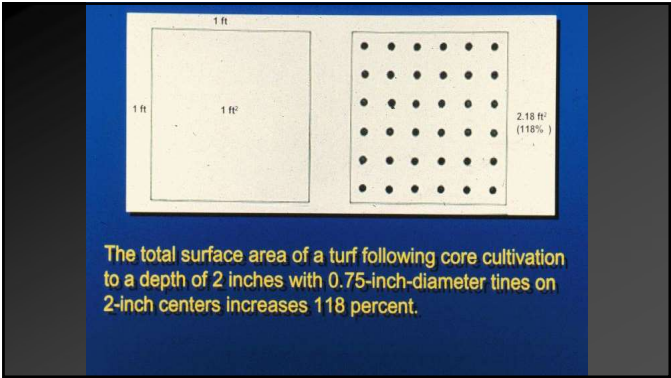
Core Cultivation

11



12





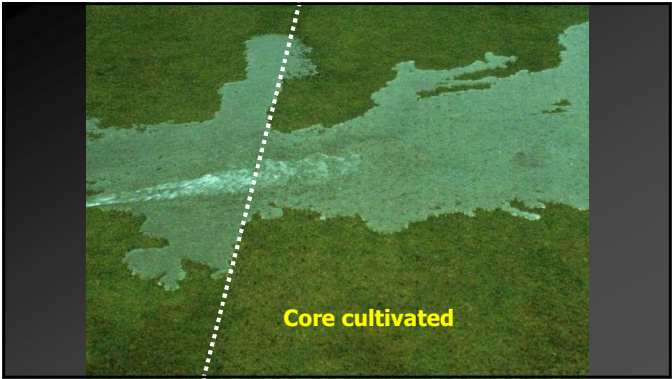
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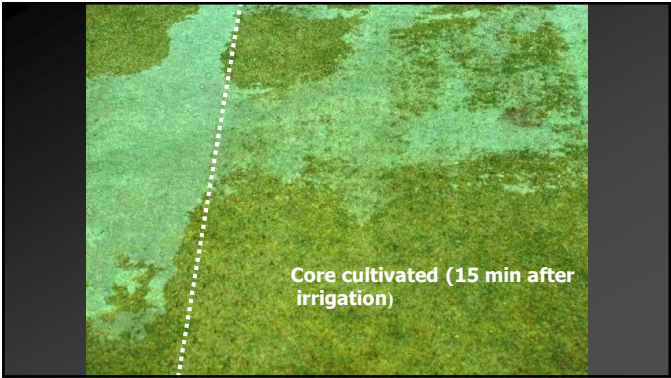
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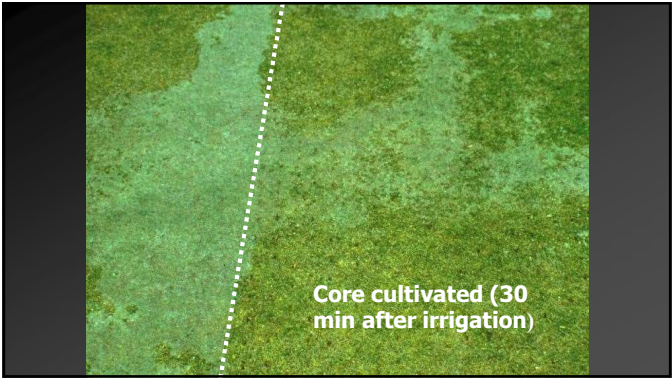
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17



18

Mat

Thatch that has been intermixed with mineral (soil) matter. Biologically Active & critical for healthy turfgrass

19



20

Soil Moisture Content Prior to Aeration

moist

dryer

hollow tine, very compacted

solid tine, slicing, spiking

use soil moisture content to optimize desired effect

21

Sand-based rootzones

22

Outline

- Historical perspective
  - Greens Construction
  - New Management Paradigm
    - Firm and Fast
    - Organic Matter Accumulation
- Fine tuning
  - Topdressing
  - Cultivation
  - Tines and sand

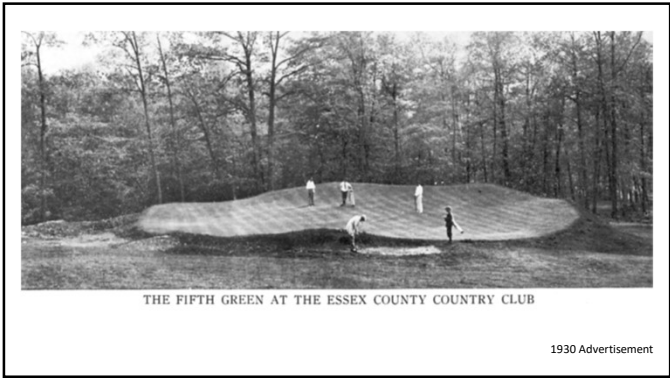
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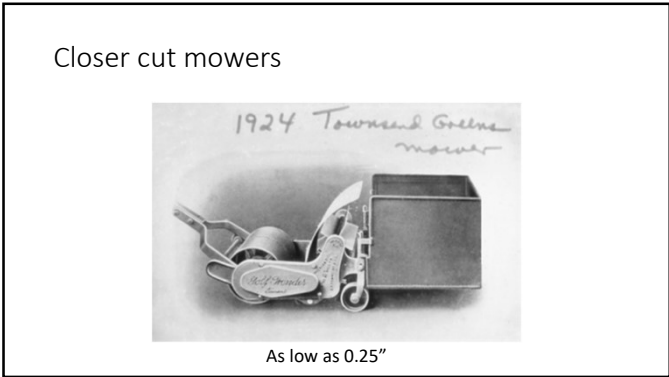
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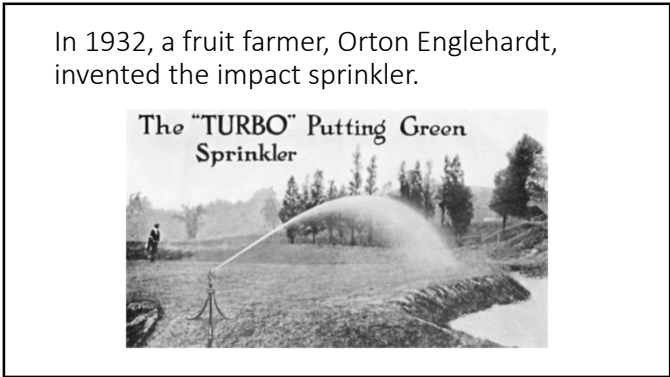
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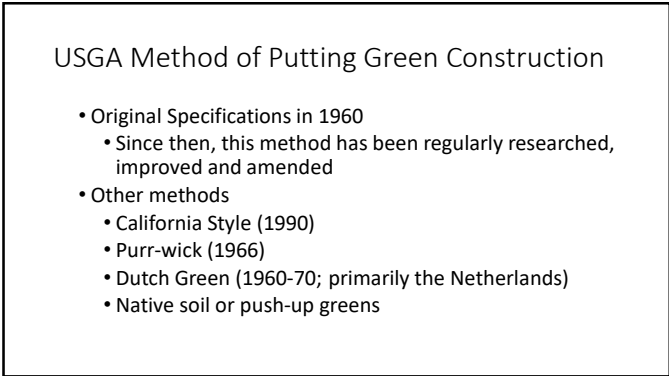
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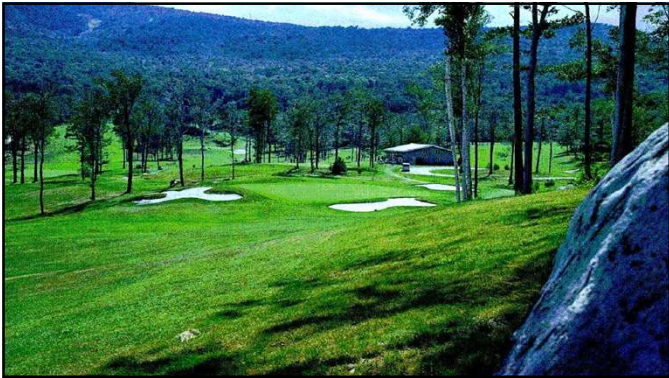


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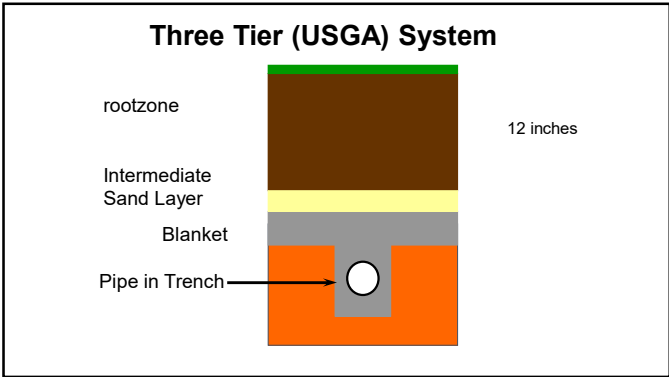




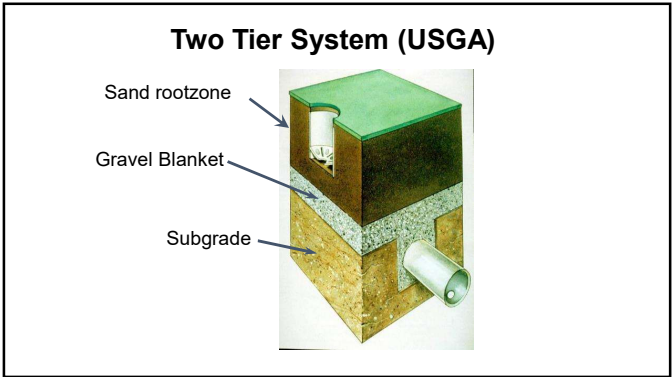
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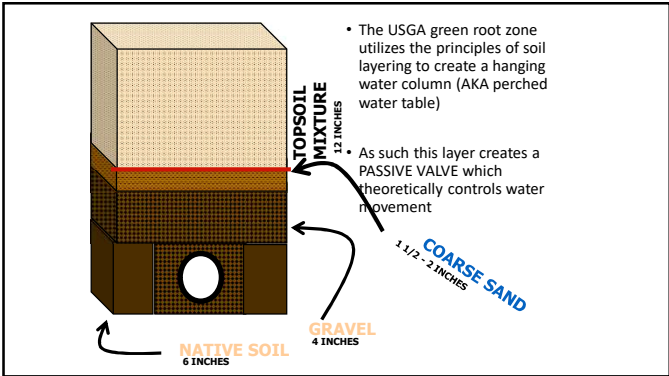
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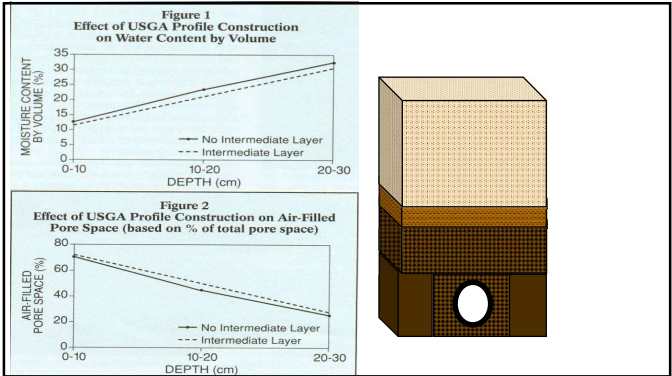
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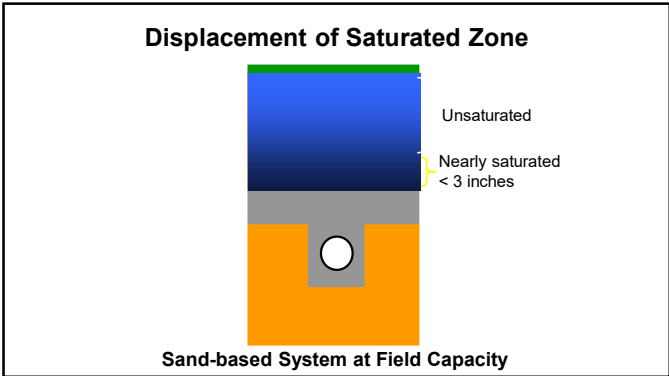
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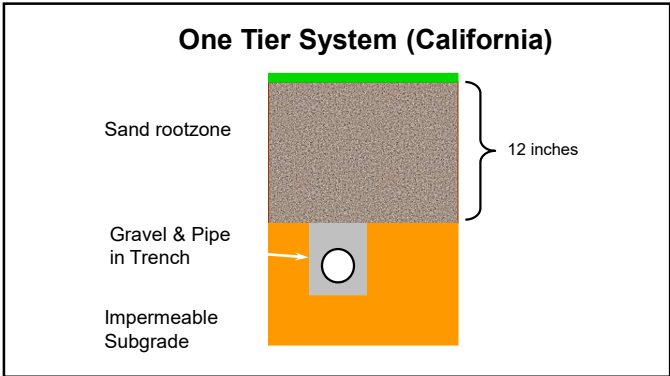
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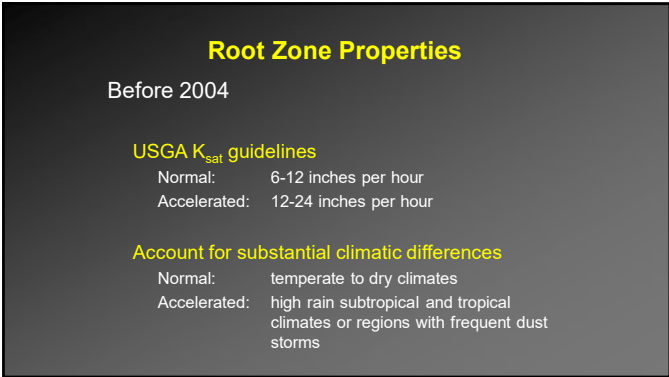
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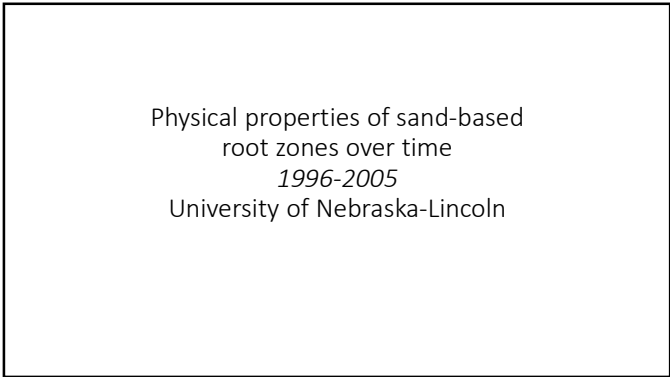
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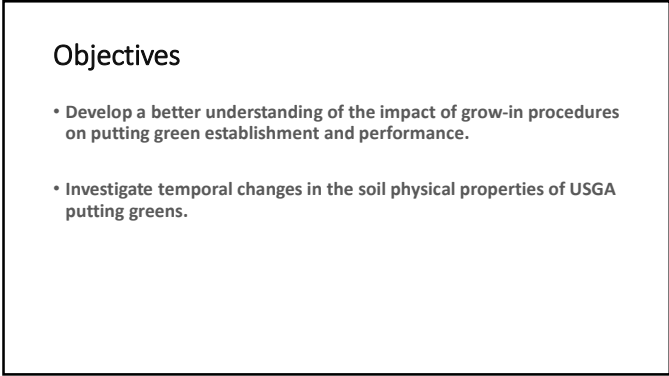
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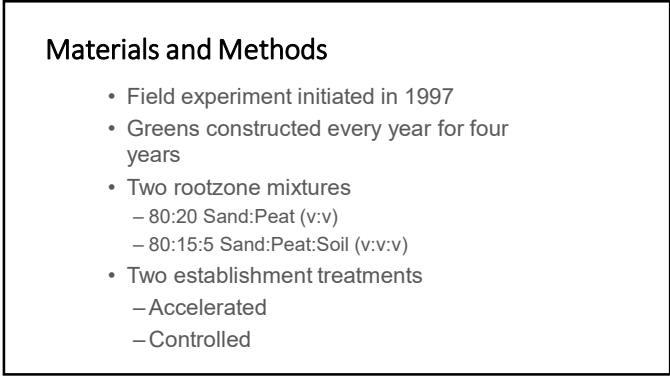
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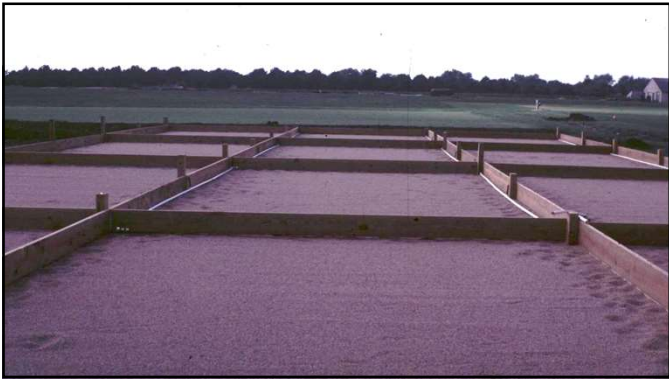
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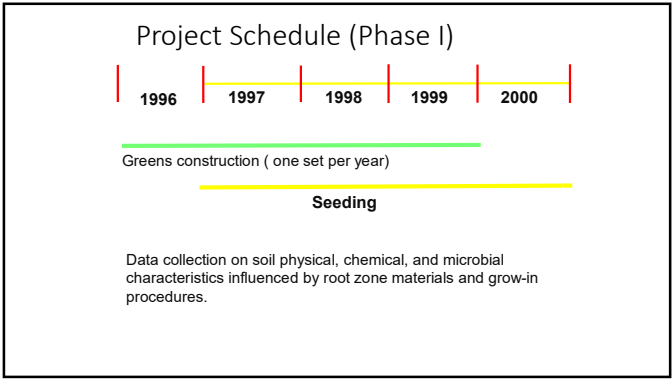
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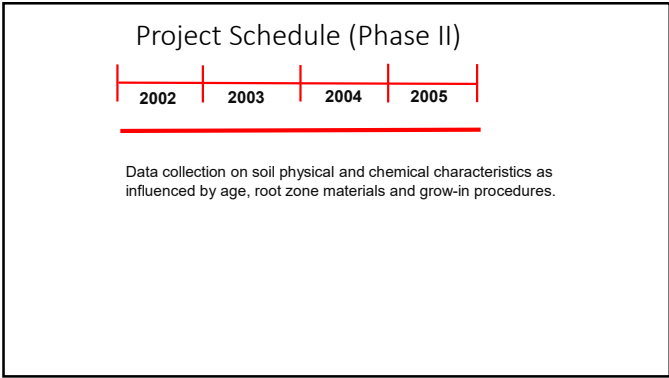
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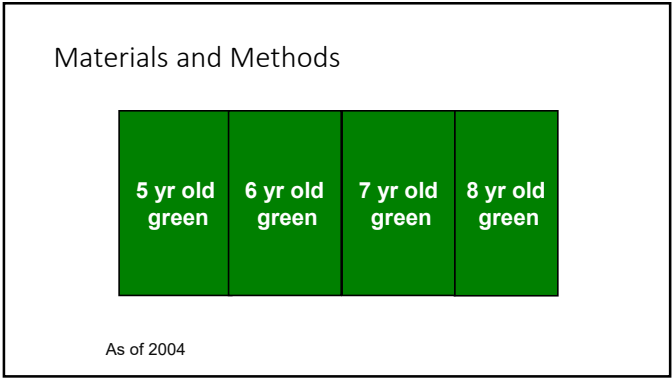
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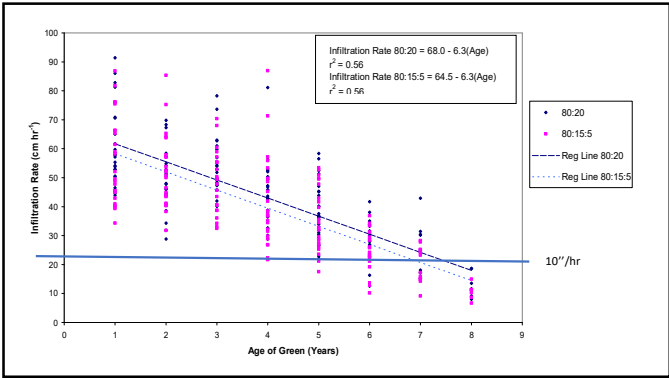


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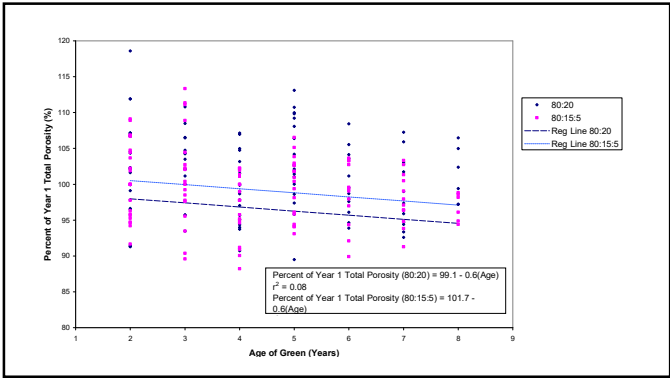


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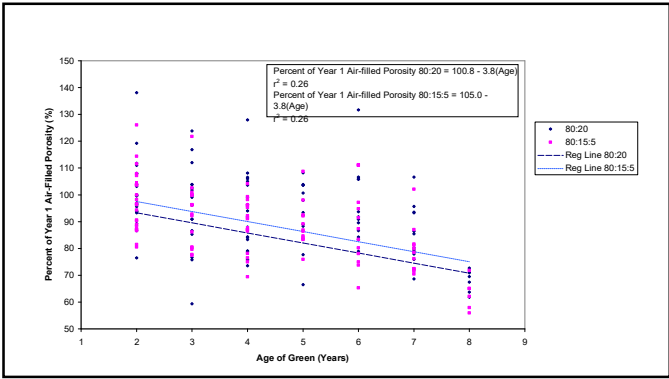




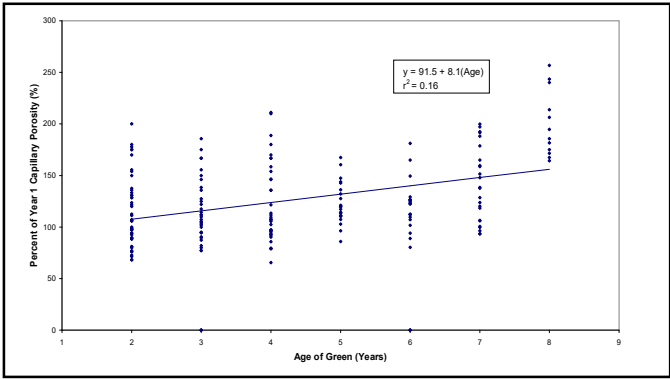
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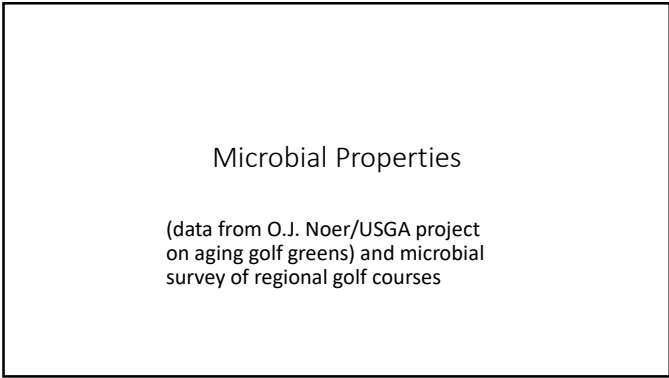
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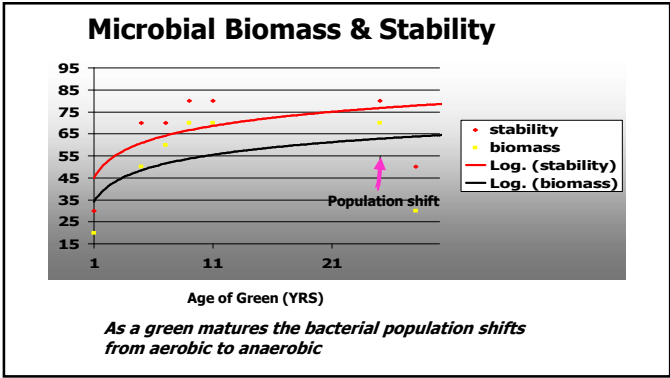
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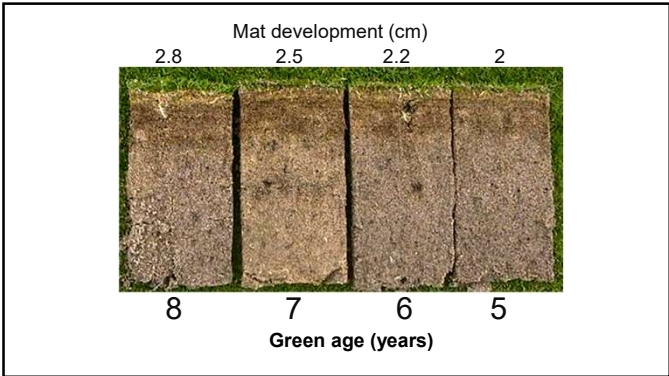
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55

Formation of Mat

- Formation of mat layer increased approximately 0.25" (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 core aerification

56

Annual organic matter accumulation in a sand/peat green

Year	0	1	2
0.65%	3.0%	6.0%	

USGA spec. green constructed with 20% (by volume) organic matter

57

Mat


Original Rootzone

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

58

Conclusions

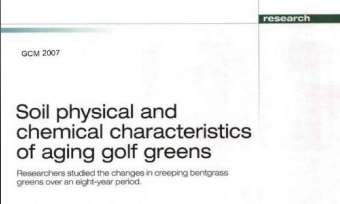
- Based on *in situ* green testing  $K_{SAT}$  decreased, and surface moisture increased, over time due to organic matter accumulation above the original rootzone and increased fine sand content originating from topdressing sand
- Organic matter did result in positive agronomic change: pH, CEC, nutrient holding capacity, microbial stability and amount



59

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.



60

Research Need (2004)

- Comprehensive evaluation of sand quantity, particle size, sampling protocol and cultivation methods

61

OM accumulates as sand greens age

62

8.5 year-old turf

63

Practices to change thatch into mat include topdressing and ...

64

... cultivation.

65

Organic Matter Management Study

Objectives

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

66



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

67

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

68

All treatments received the same topdressing quantity (22 ft<sup>3</sup>/M\*) but different frequency

Equilibrated to identify differences of the practices in question

\*1 ft<sup>3</sup> = 100 lbs of dry sand; yd<sup>3</sup> = 2700 lbs

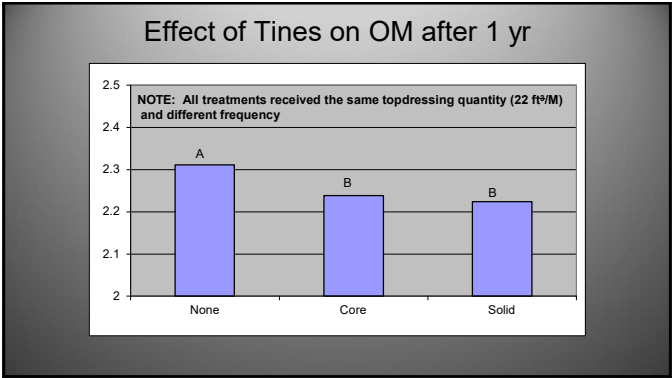
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- Materials and Methods
- Green Age:
    - 12 years
    - 9 years
  - Data collected:
    - OM% (pre-cultivation/monthly)
    - Single wall infiltration (monthly)

70

- 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

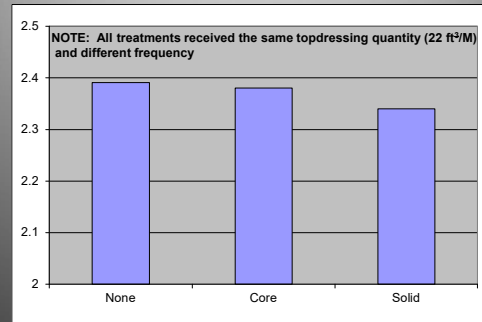
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72

- 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 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

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

Charles J. Schmid,\* Roch E. Gaussoin, Rob  
Martha Mamo, and Charles S. Wortmann

[illegible]

**O**RGANIC MATTER ACCUMULATION in creeping bentgrass putting greens has been a concern since the innovation of sand-based root zones (Gausman et al., 2011). Accumulation of OM can increase thatch in a putting green, creating a saturated surface that results in decreased playability (Gla-



Dep. of Agronomy and Horticulture, Univ. of Nebraska-Lincoln, 209 Plant Science Hall, Lincoln, NE 68505. Received 27 May 2014. \*Corresponding author (jshewchuk@gmail.com).

**Abbreviations:** HFC, hollow-line cultivation; LCI, less no-tillage; OM, organic matter; STC, solid-line cultivation.

**Conversions:** For unit conversions relevant to this article, see Table A.

Published in *Applied Ergonomics*  
DOI 10.1016/j.apergo.2014.03.002

78

Project Objective

➤ National Survey

➤ Determine cause and effect relationship among maintenance practices and their interactions relative to surface OM accumulation

79

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

80

81

Topdressing

82

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

83

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

Charles J. Schmidt\*, Heidi E. Gausman, and Sarah A. Gausman

**S**oil organic matter (SOM) accumulation in creeping bentgrass (*Elymus canadensis* L.) golf putting greens has been a concern for decades. Gausman et al. (2011) demonstrated that negative effects associated with excessive SOM (black soil), including decreased water infiltration, increased 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 CG 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 eighty putting greens on 101 golf courses in 15 states (AR, CA, CO, IA, IL, IN, MI, MN, MT, NE, NJ, NM, NY, SD, VA, WI, WY) were surveyed for management practices and SOM concentration from June 2006 to June 2008. All golf courses returned seven CR methods (annual level of annual bentgrass (lb/acre), 1.3, 2.0, 2.7, 3.4, 4.1, 4.8, 5.5) and 10 soil samples (0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, 9-10 inches) from each green. The 0-1 inch sample was analyzed for SOM concentration (g organic C/g dry weight) and the 0-10 inch sample was analyzed for SOM concentration (g organic C/g dry weight). Samples were analyzed using the loss on ignition method (Nelson and Sommers, 1996) at 750°C ± 5°C for 12 h.

Charles J. Schmidt received a B.S. degree in Agriculture and Horticulture, Univ. of Nebraska-Lincoln, 1991; M.S. degree in Agronomy, Univ. of Nebraska-Lincoln, 1993; and a Ph.D. degree in Agronomy, Univ. of Nebraska-Lincoln, 1996. He is currently an Associate Professor of Agronomy at the University of Nebraska-Lincoln. He is also a member of the American Society of Agronomy, the American Society of Crop Science, and the American Society of Horticultural Science.

Heidi E. Gausman received a B.S. degree in Agriculture and Horticulture, Univ. of Nebraska-Lincoln, 1991; M.S. degree in Agronomy, Univ. of Nebraska-Lincoln, 1993; and a Ph.D. degree in Agronomy, Univ. of Nebraska-Lincoln, 1996. She is currently an Associate Professor of Agronomy at the University of Nebraska-Lincoln. She is also a member of the American Society of Agronomy, the American Society of Crop Science, and the American Society of Horticultural Science.

Sarah A. Gausman received a B.S. degree in Agriculture and Horticulture, Univ. of Nebraska-Lincoln, 1991; M.S. degree in Agronomy, Univ. of Nebraska-Lincoln, 1993; and a Ph.D. degree in Agronomy, Univ. of Nebraska-Lincoln, 1996. She is currently an Associate Professor of Agronomy at the University of Nebraska-Lincoln. She is also a member of the American Society of Agronomy, the American Society of Crop Science, and the American Society of Horticultural Science.


84



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"**



85

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



86

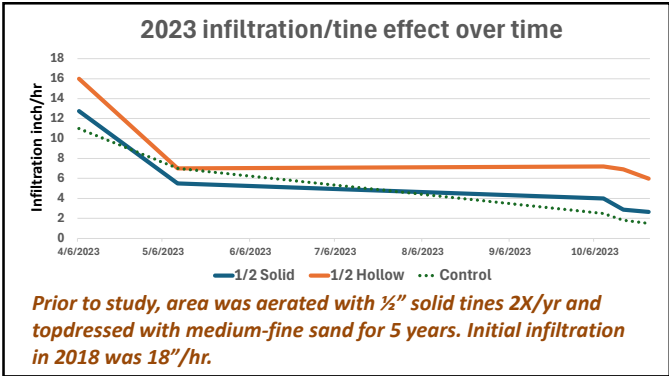
***"Advocates of solid-tine aeration report that they get the same benefits of thatch and organic matter reduction with less labor for the collection and removal of aeration cores. Whether you pull a core or use solid tines, it's all about sand volume and the ability to dilute organic matter in the rootzone. Regardless of the method, the most important factor is filling the hole with sand. It's all about dilution, and if you can do that with less of a mess and less labor, then solid-tine aeration is a viable alternative."***

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

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88



89

Layering

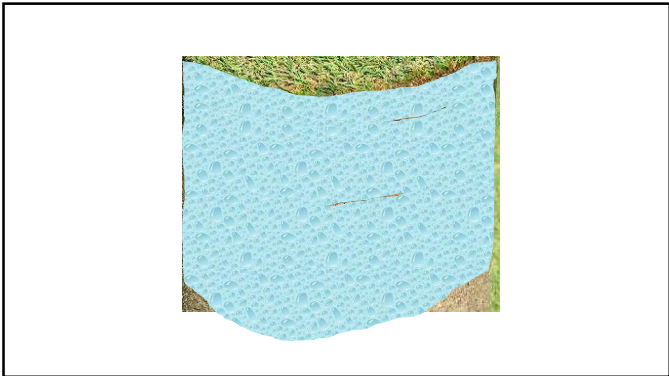
- Water retention is non-uniform
- Thatch/mat layers can store twice as much water than the root zone



NOT a function of drainage

Rather it is the difference in pore size distribution among layers

90



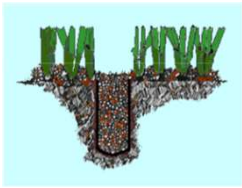

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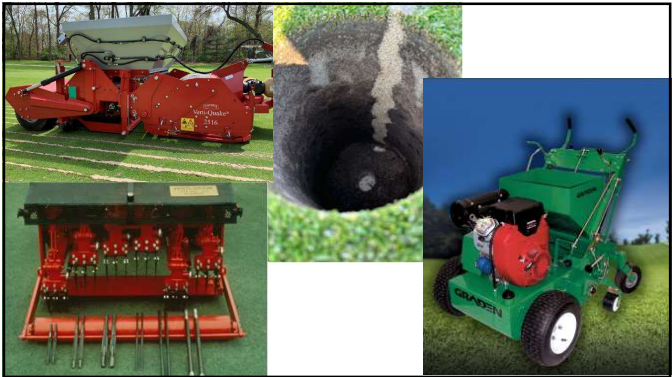
92

### Layering

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



93




94



95

eric bachels  
@thegreengrass

I pride myself in having a nice selection of aerifying tines depending on how I'm feeling



Roch Gaussoin  
rgaussoin1@unl.edu

96