Organic Matter Management

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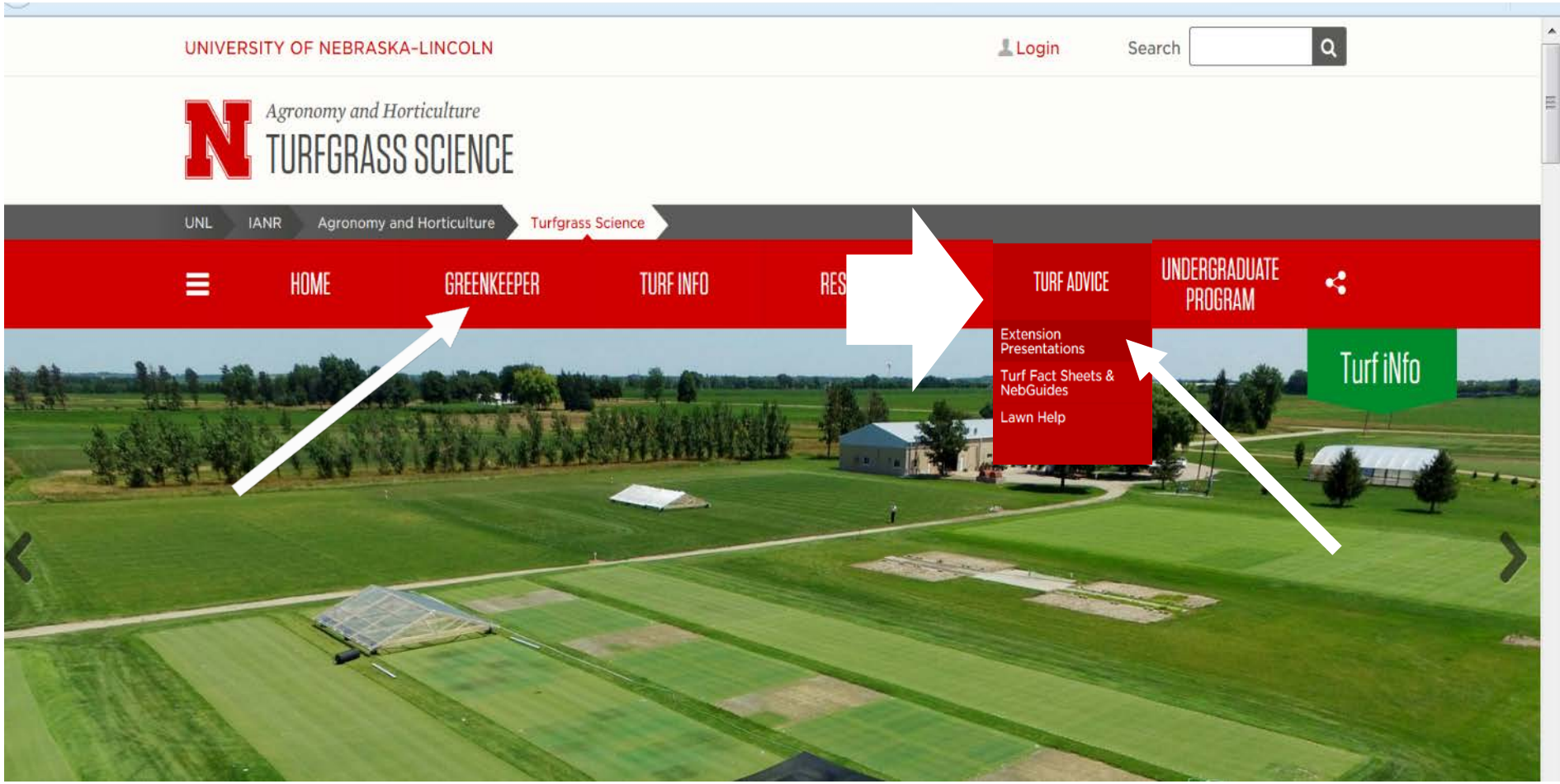
Alberta Golf Course Superintendents Association
2016 Property Manager's Conference
Canmore, Alberta

AGSA



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ASA Monograph (3RD Edition)

Chapter 12

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

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RESEARCH

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

Published December 19, 2014

BRIEF

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

Soldat's Hierarchy of Golf Course Soil Problems

- **Compaction**
- Excessive organic matter and thatch accumulation
- Layering


GRASS
THATCH
SOIL
METRIC 1
2
3
4
5


GRASS
THATCH
MAT
SOIL

Because of inherent ambiguity in terminology and sampling techniques, the term <u>"thatch-mat"</u> 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

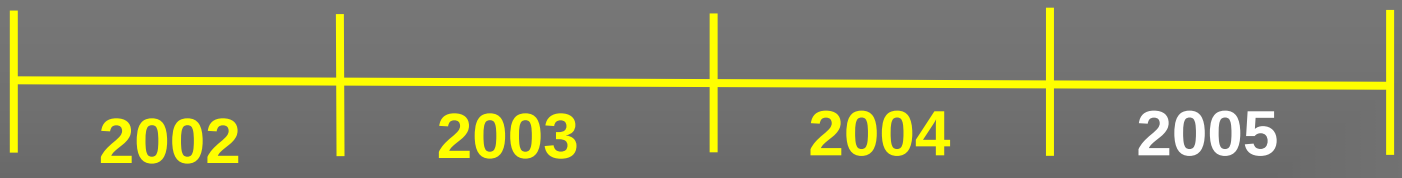
Project Schedule (Phase I)

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)

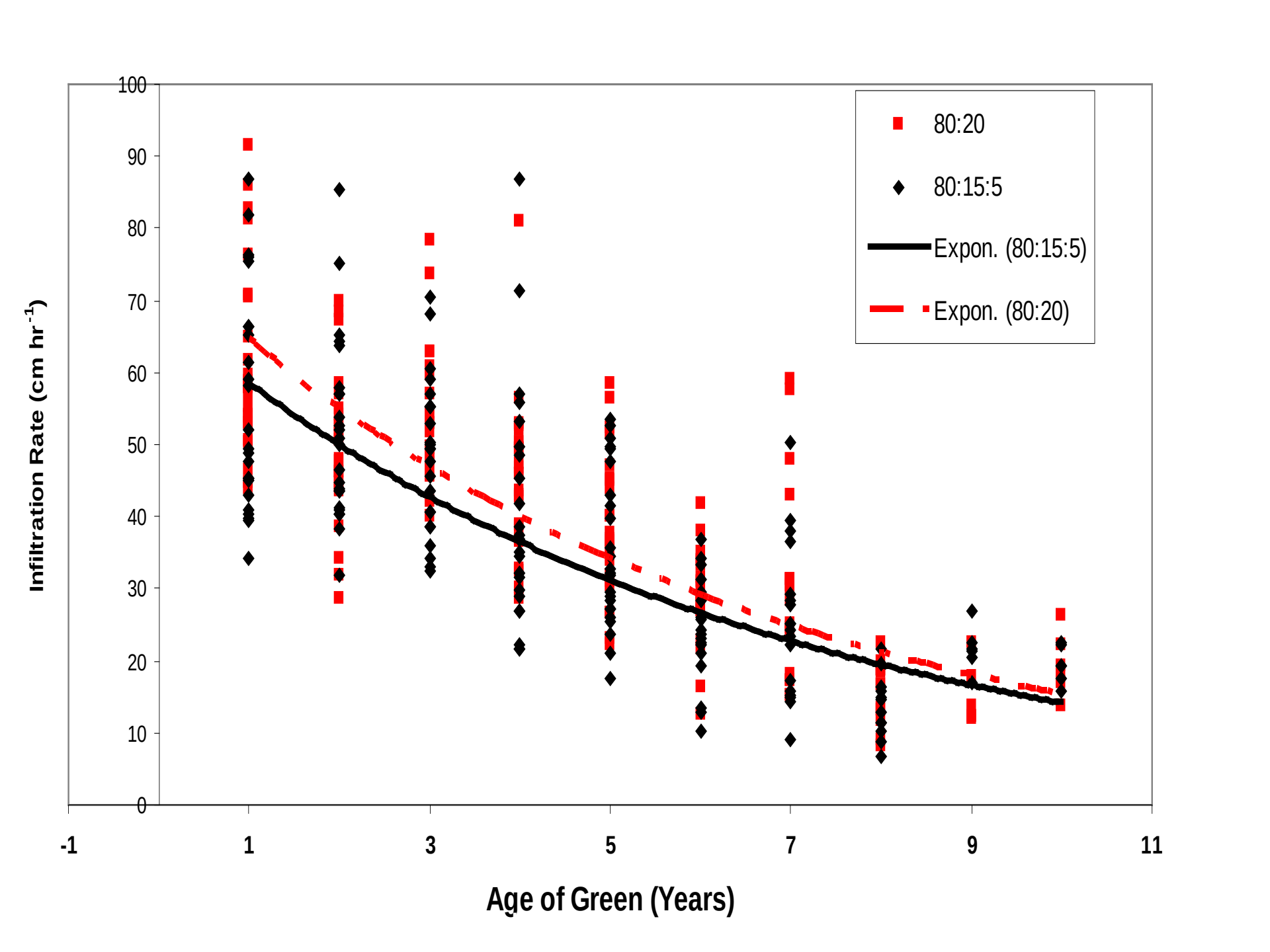


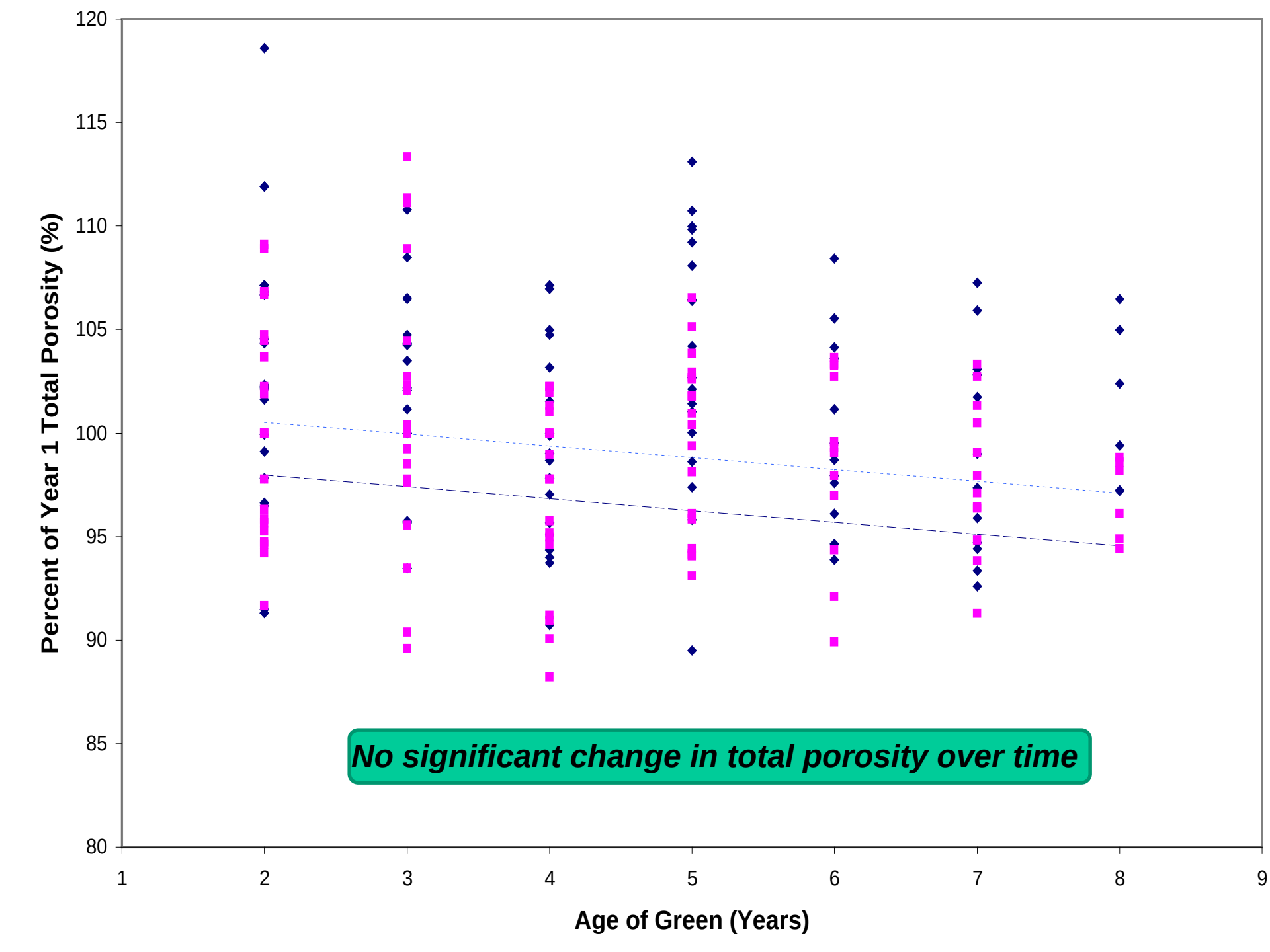
Data collection on soil physical and chemical characteristics as influenced by age, rootzone materials and grow-in procedures.

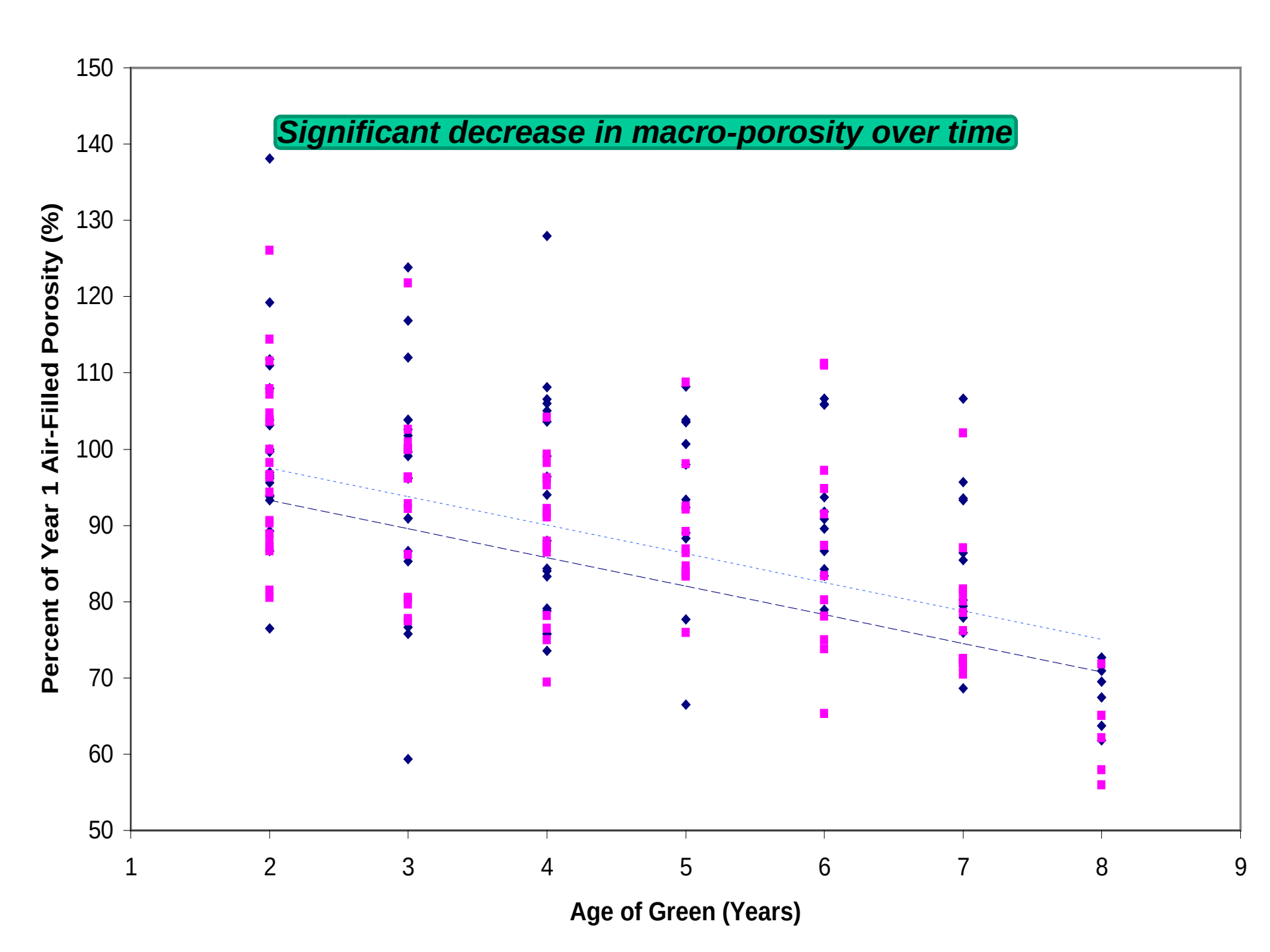
Materials and Methods

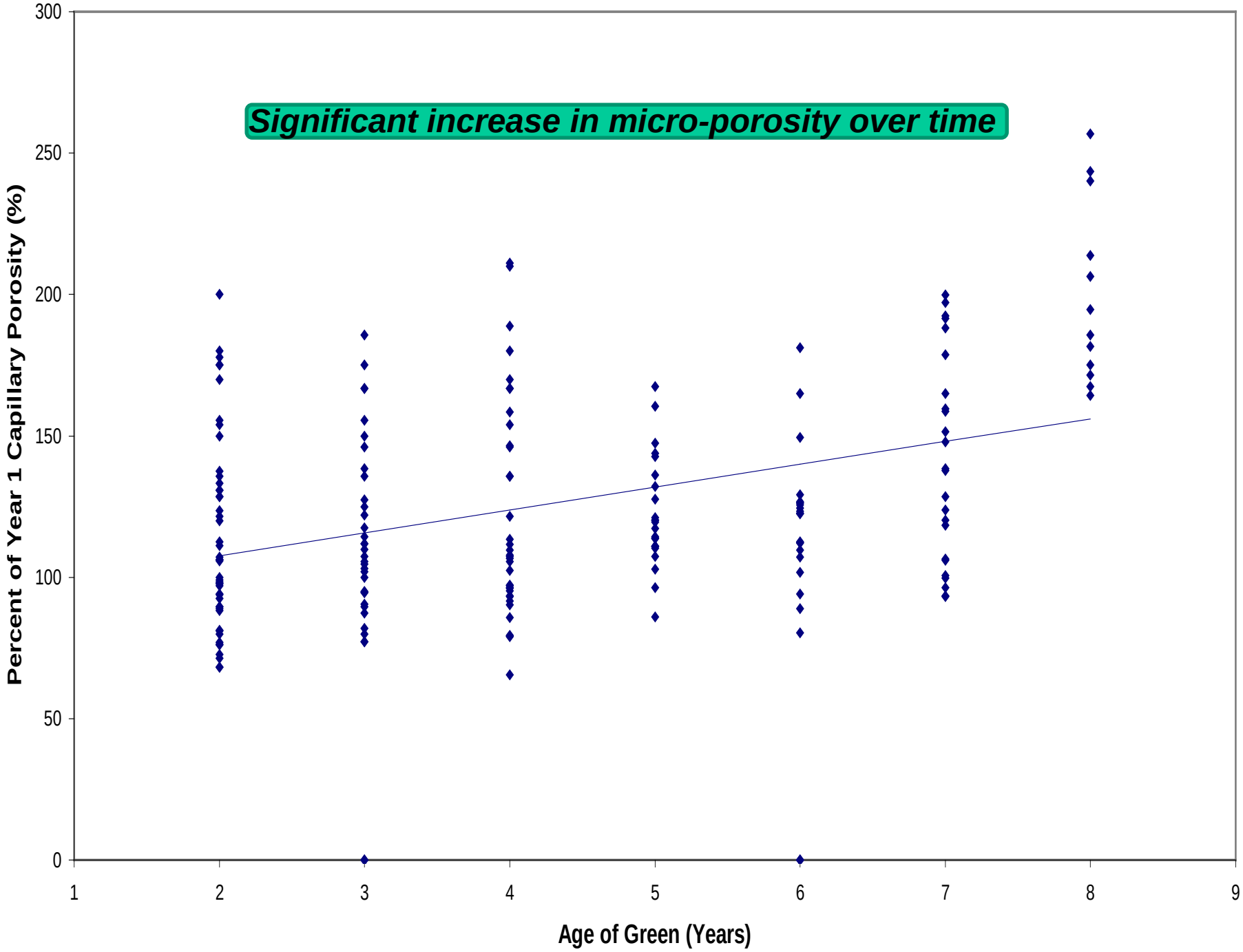
9 yr old green	10 yr old green	12 yr old green	13 yr old green

As of 2009


Infiltration Rate (cm hr-1)
100
90
80
70
60
50
40
30
20
10
0
-1
1
3
5
7
9
11
Age of Green (Years)
80:20
80:15:5
Expon. (80:15:5)
Expon. (80:20)


Percent of Year 1 Total Porosity (%)
120
115
110
105
100
95
90
85
80
1
2
3
4
5
6
7
8
9
Age of Green (Years)
No significant change in total porosity over time

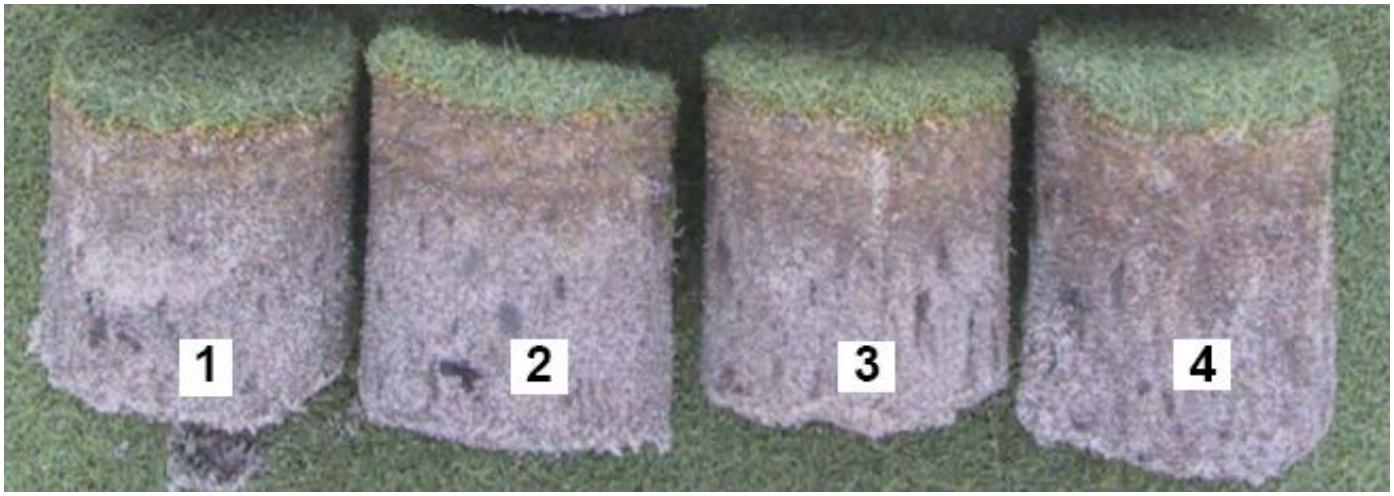

Significant decrease in macro-porosity over time
Percent of Year 1 Air-Filled Porosity (%)
150
140
130
120
110
100
90
80
70
60
50
1
2
3
4
5
6
7
8
9
Age of Green (Years)


Significant increase in micro-porosity over time
Percent of Year 1 Capillary Porosity (%)
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
Age of Green (Years)

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

OM accumulates as sand greens age



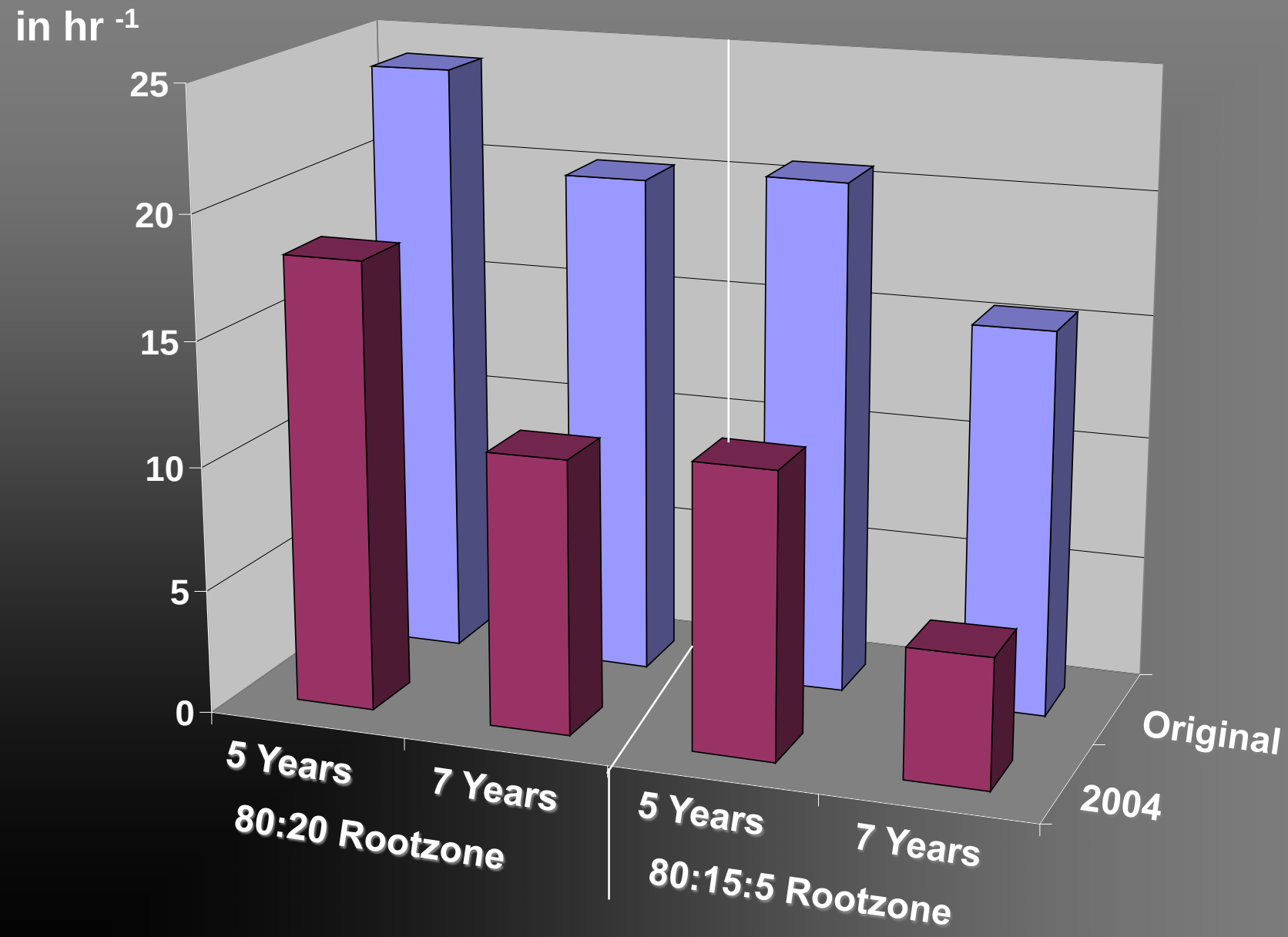
Source: Gaussoin and Shearman, 2003; Gaussoin et al., 2006

- 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).

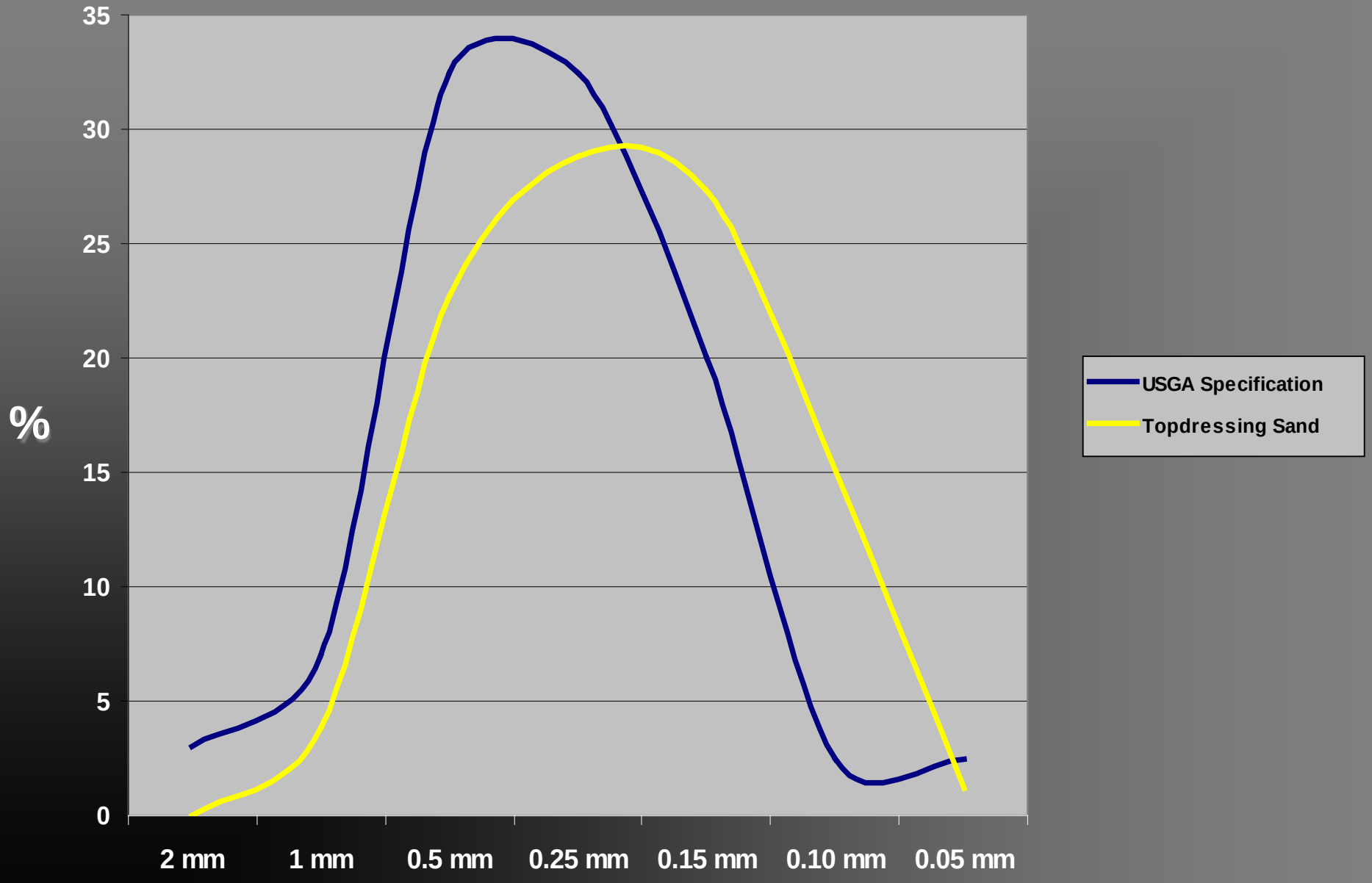
- Other analysis also completed



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

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.



USGA sand specifications compared to sand used in topdressing program for USGA plots at Mead, NE.

Conclusions

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

- **Mat accumulation modifies pH positively if sands are calcareous and increases nutrient retention**

Want to know more?

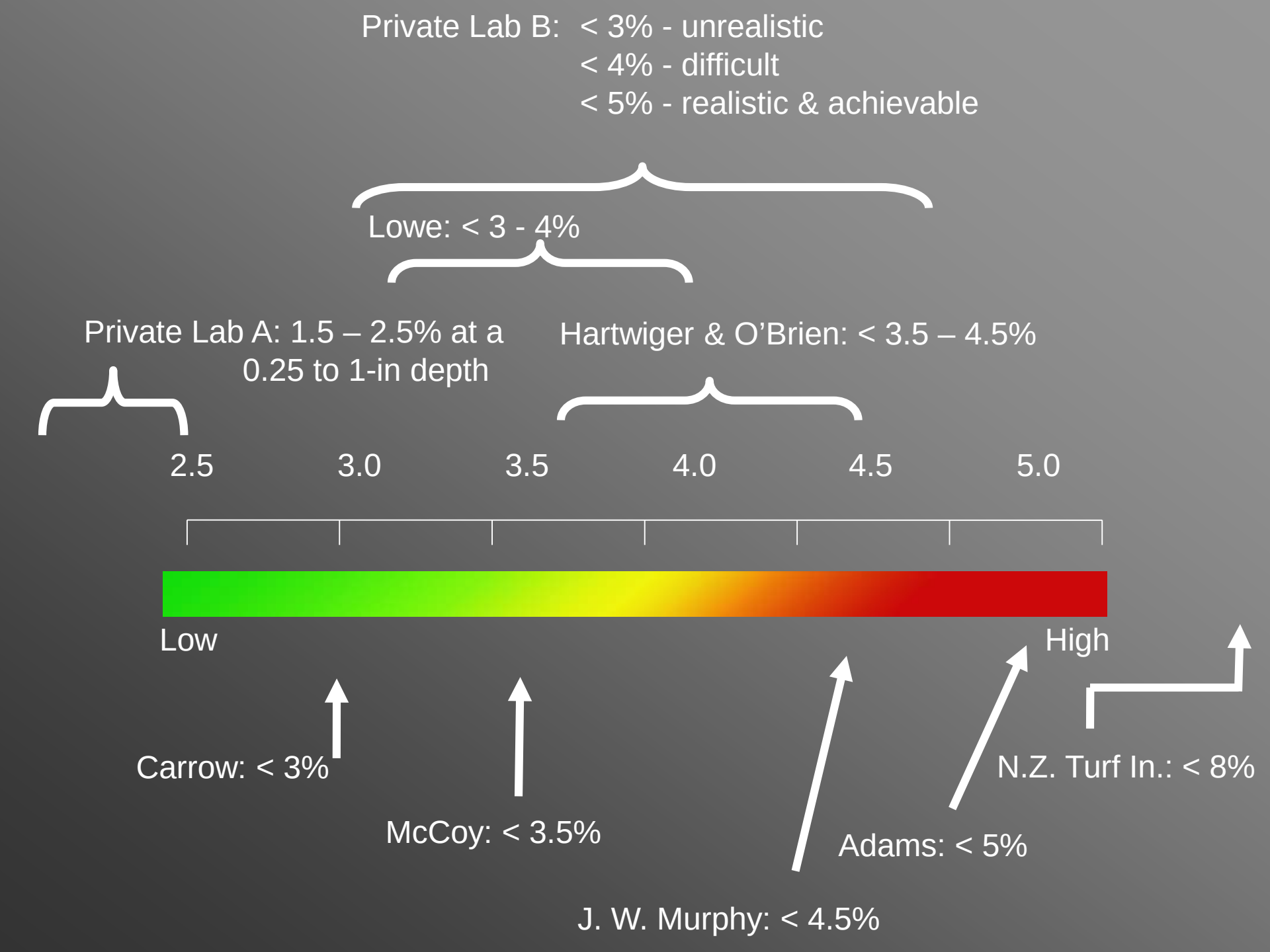
- **Gaussoin, R., R. Shearman, L. Wit, T. McClellan, and J. Lewis. 2007. Soil physical and chemical characteristics of aging golf greens.** *Golf Course Manage.* **75(1):p. 161-165.**

- **Gaussoin, R., R. Shearman, L. Wit, T. McClellan, and J. Lewis. 2006. Soil physical and chemical characteristics of aging golf greens. [Online]***USGA Turfgrass Environ. Res. Online.* **5(14):p. [1-11].**

- **Gaussoin, R., and R. Shearman. 2003. Soil microbial characteristics of aging golf greens. [Online]***USGA Turfgrass Environ. Res. Online.* **2(3):p. [1-8].**

Why is high SOM considered to be “bad”?

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


Private Lab B: < 3% - unrealistic
< 4% - difficult
< 5% - realistic & achievable
Lowe: < 3 - 4%
Private Lab A: 1.5 – 2.5% at a 0.25 to 1-in depth
Hartwiger & O'Brien: < 3.5 – 4.5%
2.5
3.0
3.5
4.0
4.5
5.0
Low
High
Carrow: < 3%
McCoy: < 3.5%
J. W. Murphy: < 4.5%
Adams: < 5%
N.Z. Turf In.: < 8%

Organic Matter Sampling depends on…….

1. thatch + mat layer

2. between 0.5” and 4.5”

3. between 0 and 35 cm

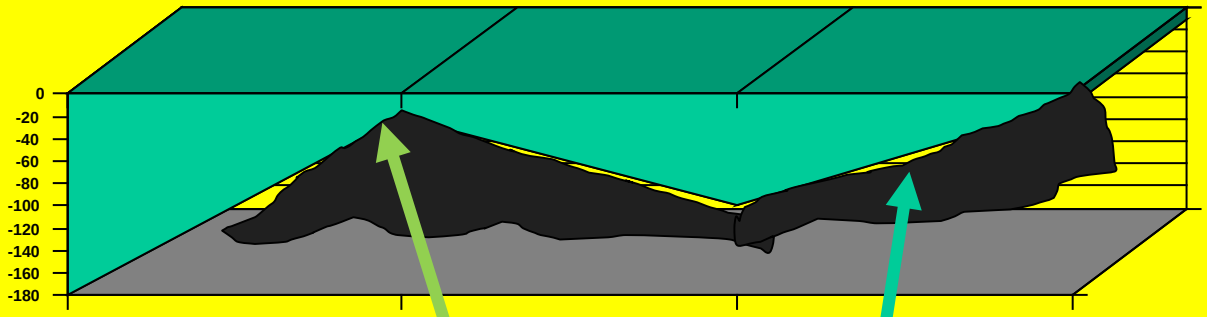
4. between 0 and 25 cm

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……**

Seasonal Root Depth



rootgrowth

spring

fall

root decline

There is no “magic” number

- **Be consistent in sampling**
  - **Time of year**
  - **Technique**
  - **Lab doing analysis**


“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

Organic Matter Degradation Study

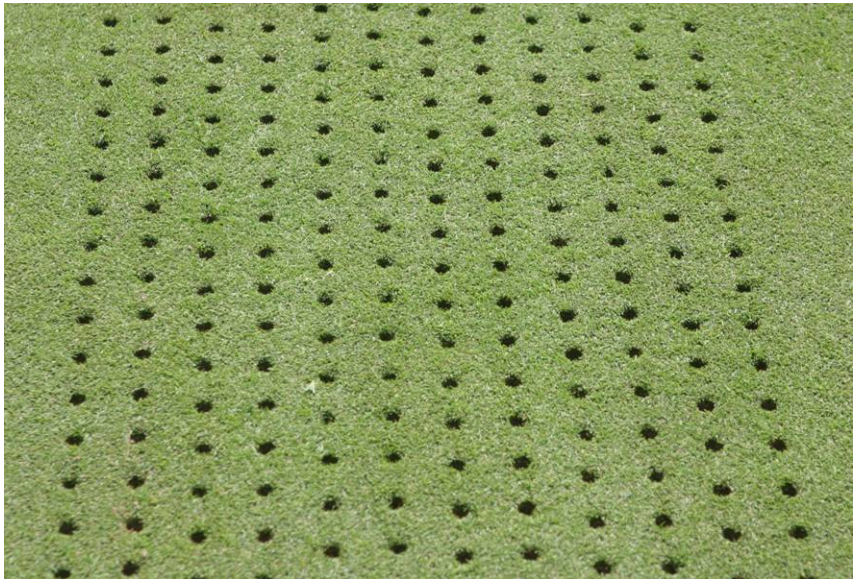
Treatments

- **Aerator (Granular)**
- **Aerator (Liquid)**
- **EXP072**
- **EXP074**
- **EXP076**
- **Carbo-Plex**
- **Bio-Blend**
- ***Carbo-Plex + Bio-Blend***
- **Bio-Groundskeeper (Granular)**
- ***Bio-Groundskeeper (Liquid)***
- ***Thatch X***
- **EXPO70M**
- **EcoChem Lawn Thatch Reducer**
- **Untreated Control**

Locations

- **KY Bluegrass Tee Box**
  - **Native Soil**
- **Bentgrass Green**
  - **California Green**
- **KY Bluegrass Sports Turf**
  - **Sand based**
  - **2.5” Mowing**

Each Plot (including untreated) Core Aerified before Application of products



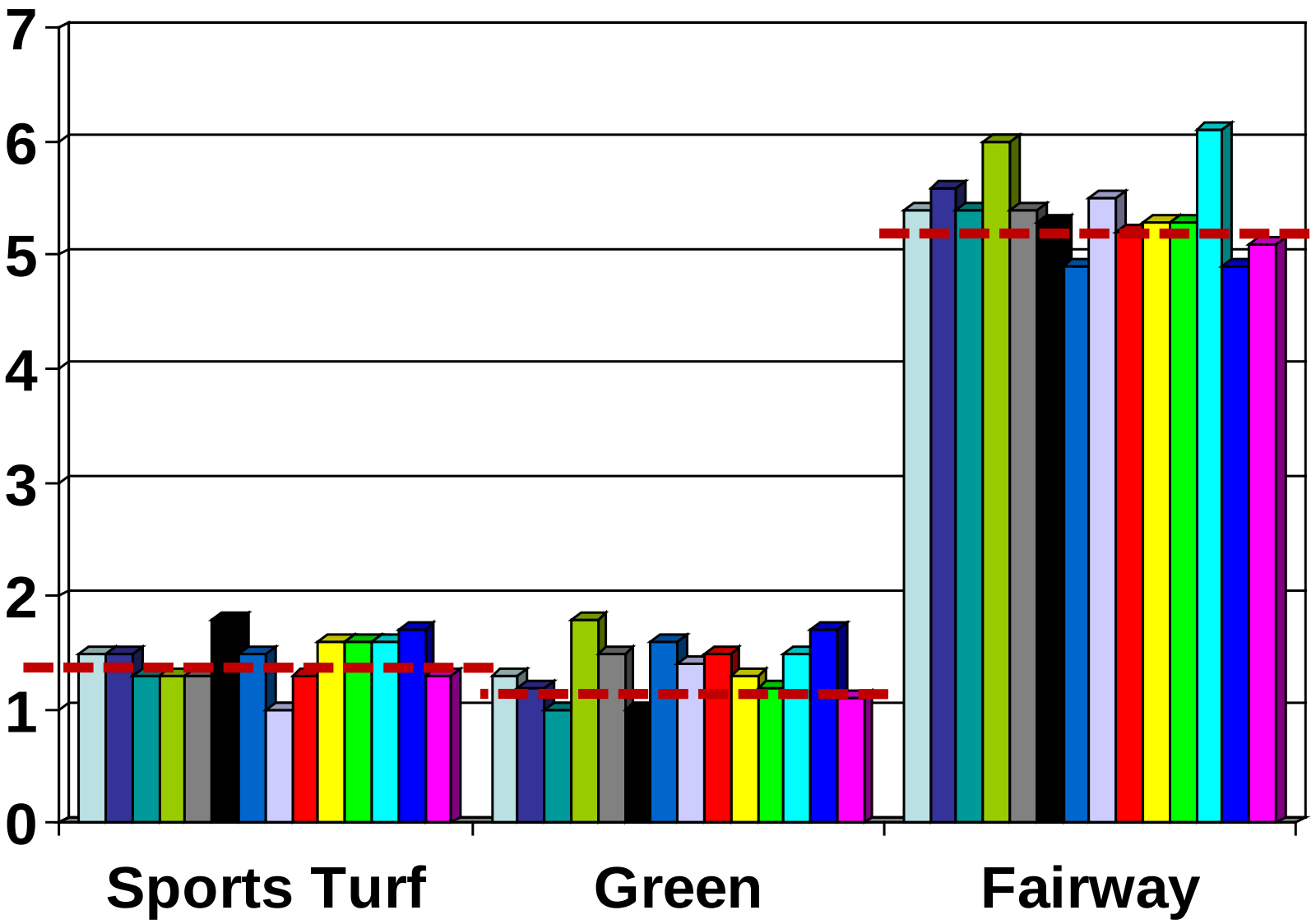
Data Collection

- **Infiltration**
- **Penotrometer**
- **Thatch**
- **Organic Matter**
  - **Thatch, 0-3”, 3-6”**

Analysis Summary

Source	Thatch (mm)	Clegg (g)	Infiltrat (in/hr)	Thatch (OM %)	0-3” (OM %)	3-6” (OM %)
Site	**	*	**	**	**	**
Trtmnt	NS	NS	NS	NS	NS	NS

0-3” OM %

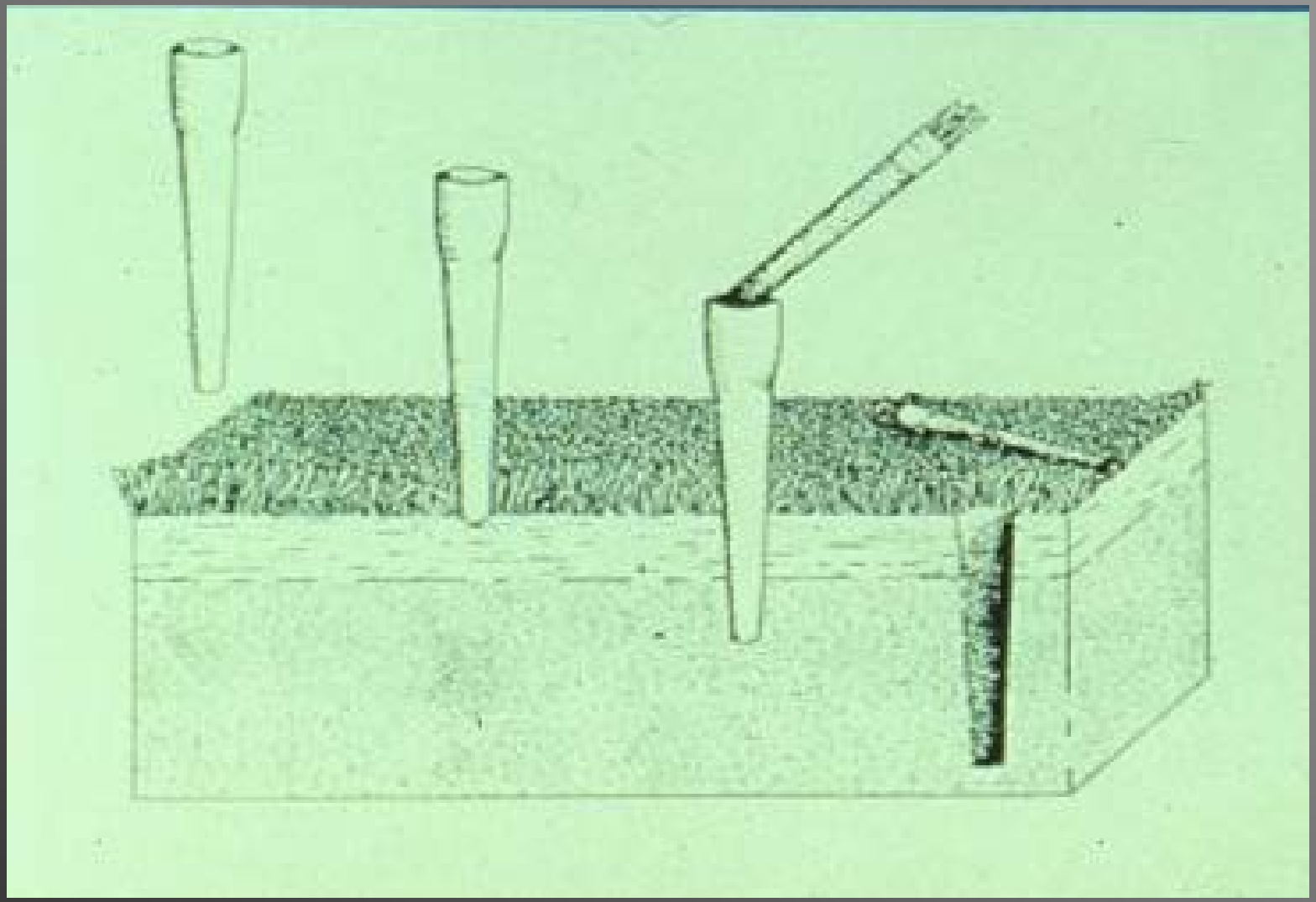


Summary

- No product increased degradation of OM

How effective is removal?

- Surface disruptive, short and long term
- Core aeration is the most widespread practice recommended for OM management



Tine Size and Surface Area Chart

Tine Size (in.)	Spacing (in.)	Holes/ft^2	Surface Area of One Tine	Percent Surface Area Affected
1/4	1.25^2	100	0.049	3.4%
1/4	2.5^2	25	0.049	0.9%
1/2	1.25^2	100	0.196	13.6%
1/2	2.5^2	25	0.196	3.4%
5/8	2.5^2	25	3.07	5.3%

Regardless of what spacing or tine diameter, core aerification, as well as many cultivation techniques, promotes root growth and ultimately organic matter deposition.

Influence of Rootzone Organic Matter on Putting Green Quality and Performance

- **Two studies**
  - National survey
  - Field study
- **Funded by:**
  - USGA -1 year
  - Nebraska Golf Course Superintendents Assoc. – 2 years
  - Golf Course Superintendents Assoc. of South Dakota – 2 years
  - Peaks & Prairies GCSA - 3 years

National Survey

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

Sampling Procedures

Years 1, 2, & 3

- **At least 3 different greens per golf course sampled**
- **Soil samples taken from 3 different area per green**
- **Samples are evaluated for OM levels using LOI**
- ***Management survey***
- **GPS location**

Sampling Methods

- Samples from at least 3 greens per course
  - (1) Problematic, (1) Non-problematic plus rebuilt or varied age/management
- 3 samples from each green
- Samples taken with

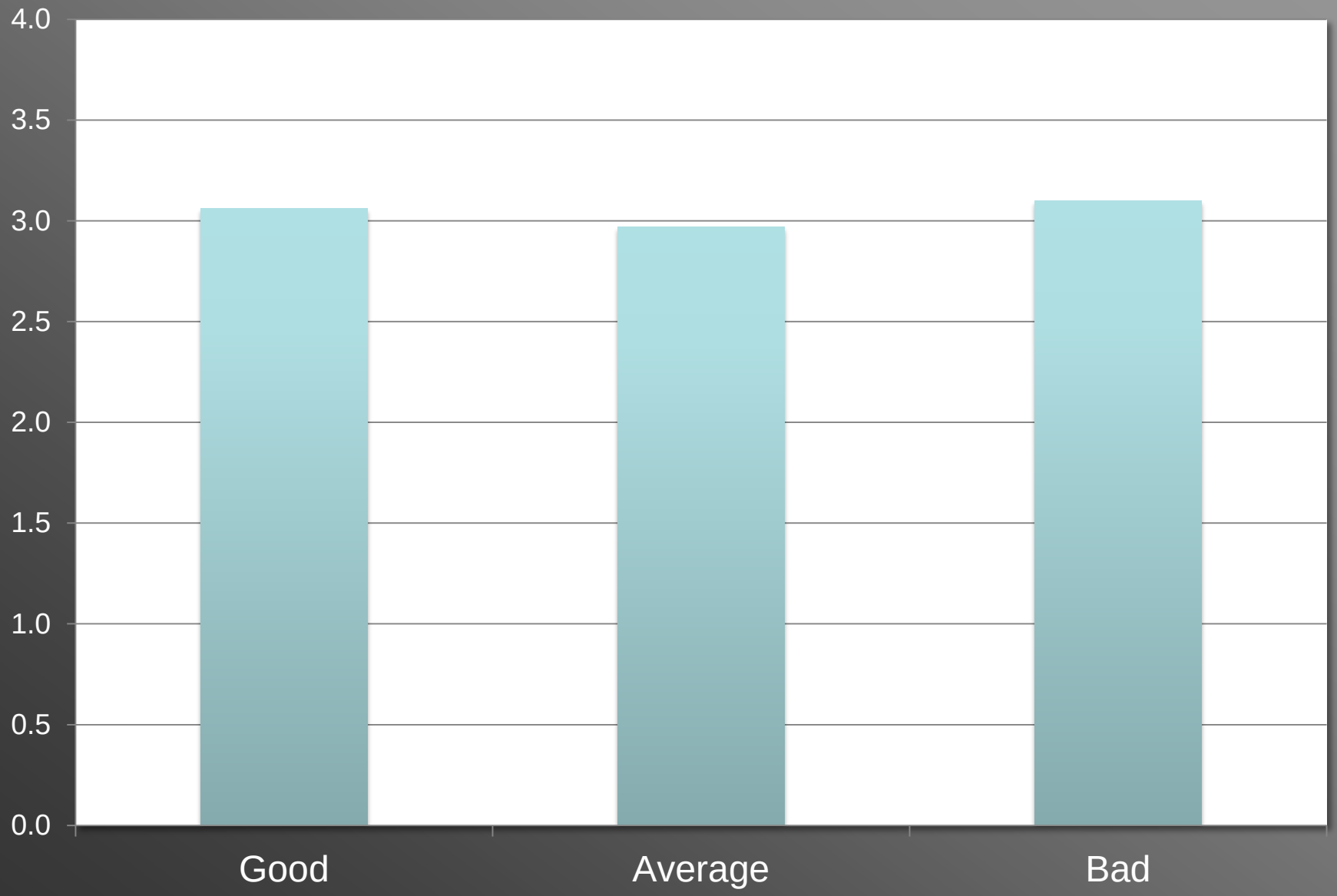
  ¾ inch soil probe

2006/07/08 Samples

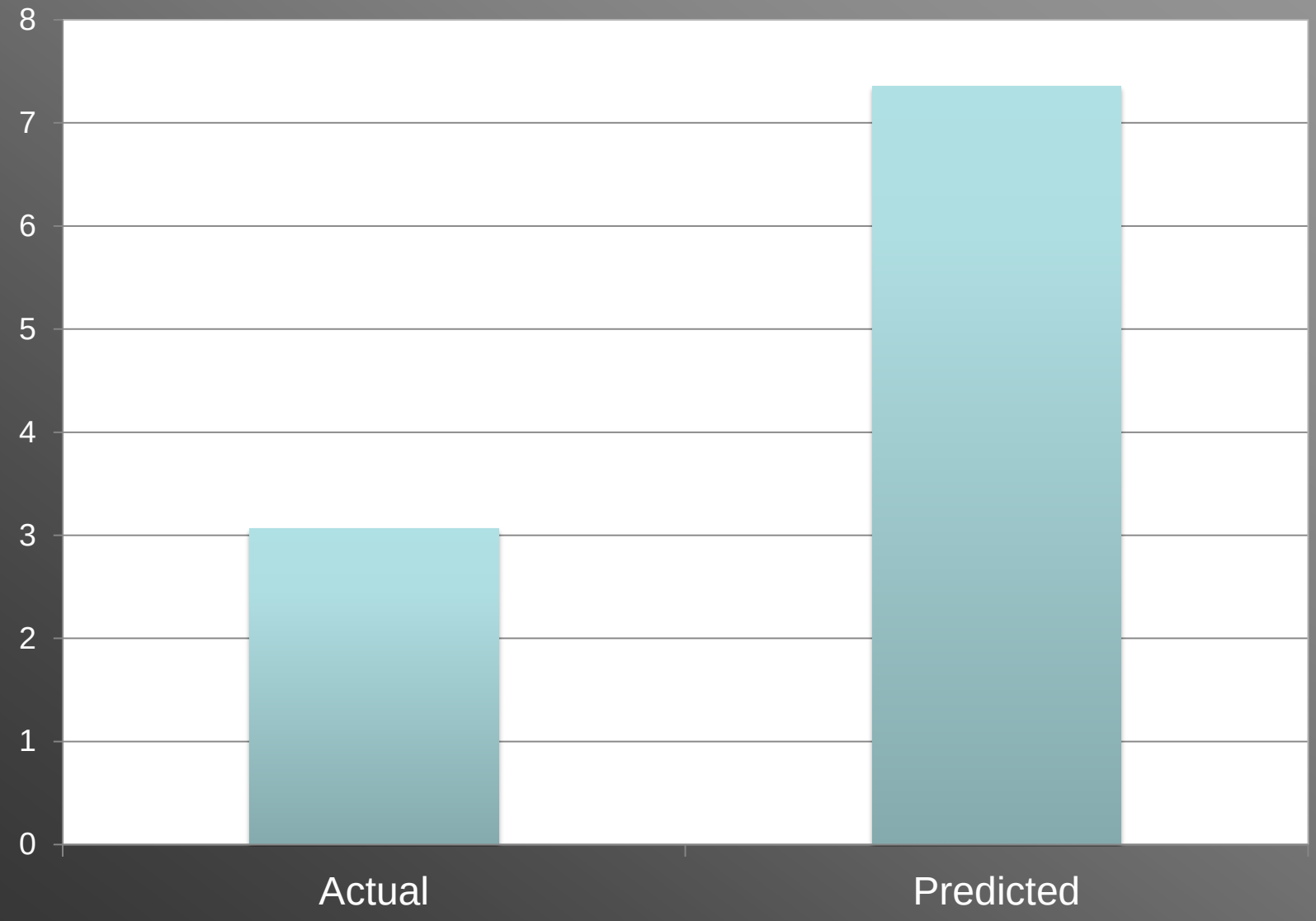
- **Sixteen states**
  - **Nebraska, South Dakota, Iowa, Wyoming, Colorado, Washington, Wisconsin, Illinois, New Jersey, Minnesota, New Mexico, Montana, Hawaii, California, Connecticut, Arkansas.**
- **117 golf courses sampled**
  - **More than 1600 samples**


WA
ID
MT
WI
SD
MN
NY, CT
WY
NJ
CA
NE
IA
IL
CO
NM
AR
HI

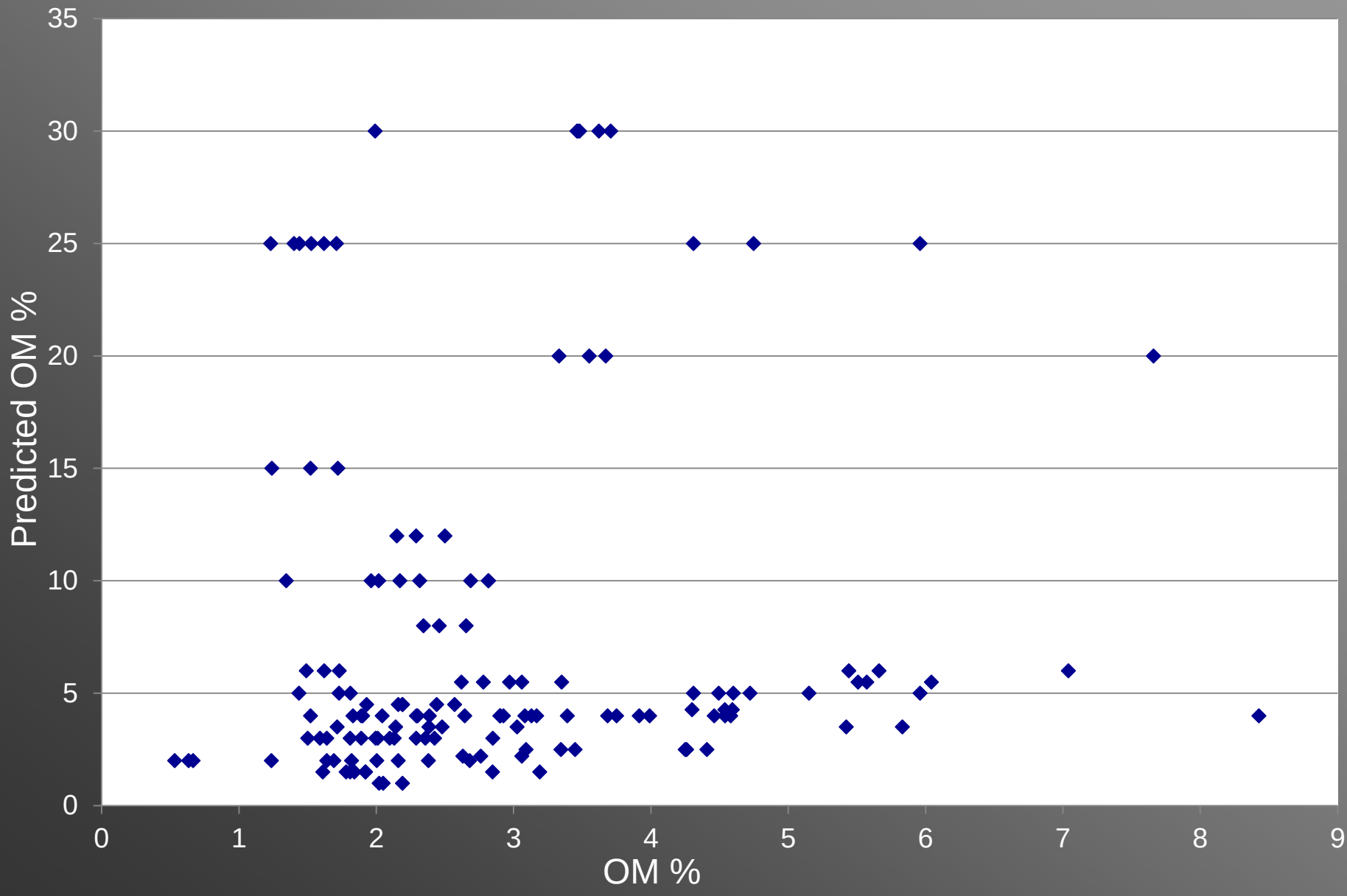
Problematic vs Non-problematic



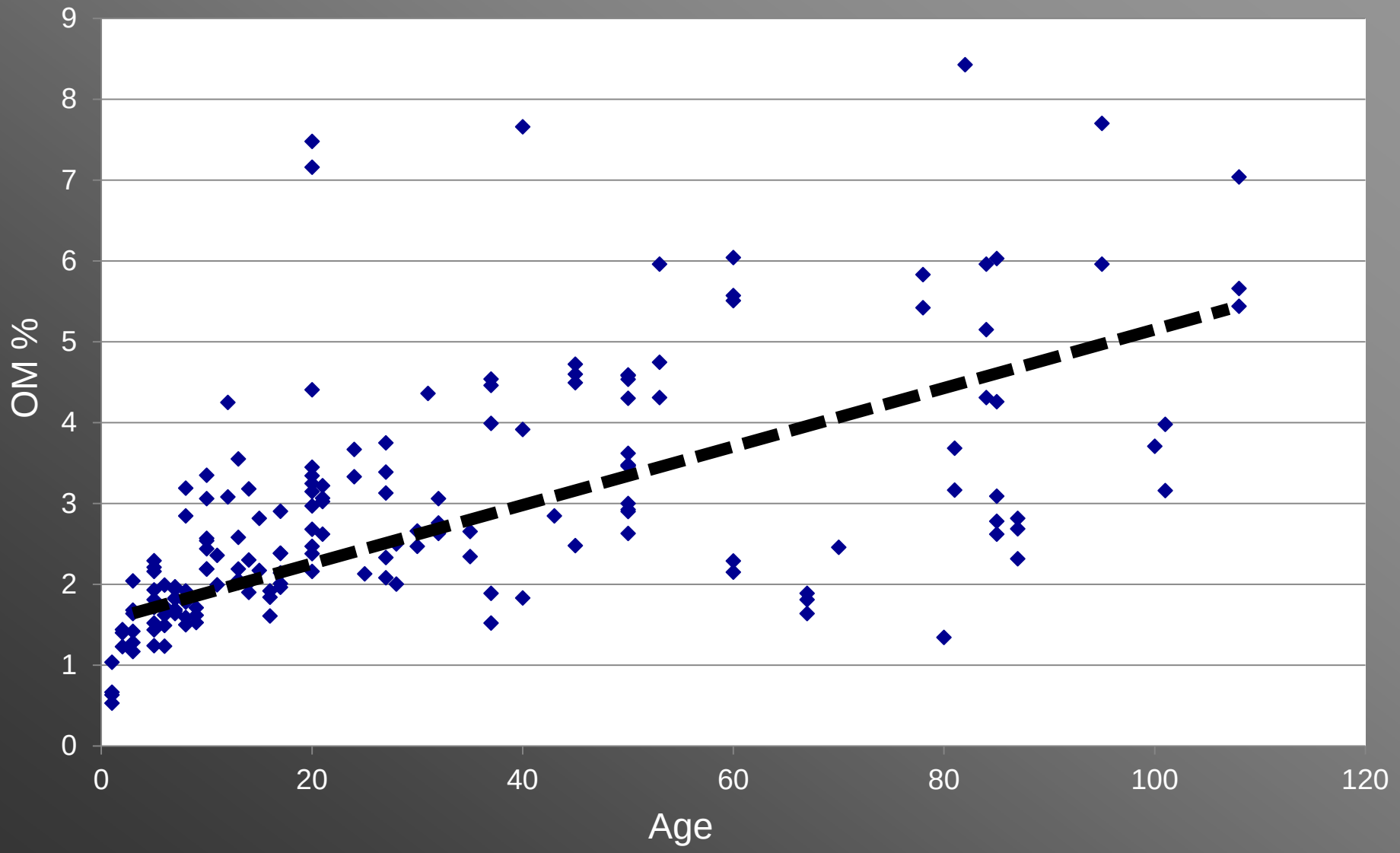
Superintendent predicted vs actual



Range of predicted vs. actual



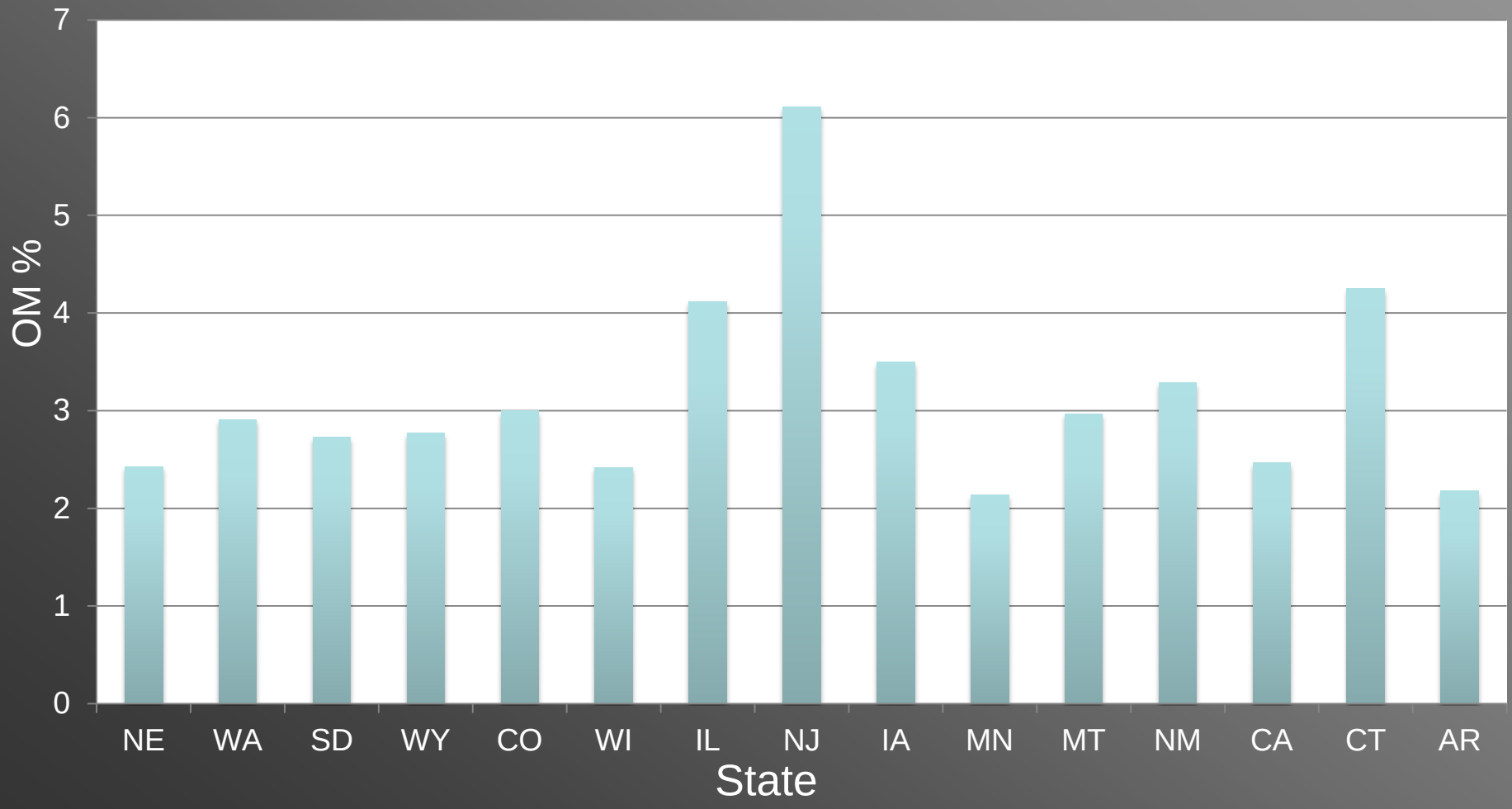
Green Age



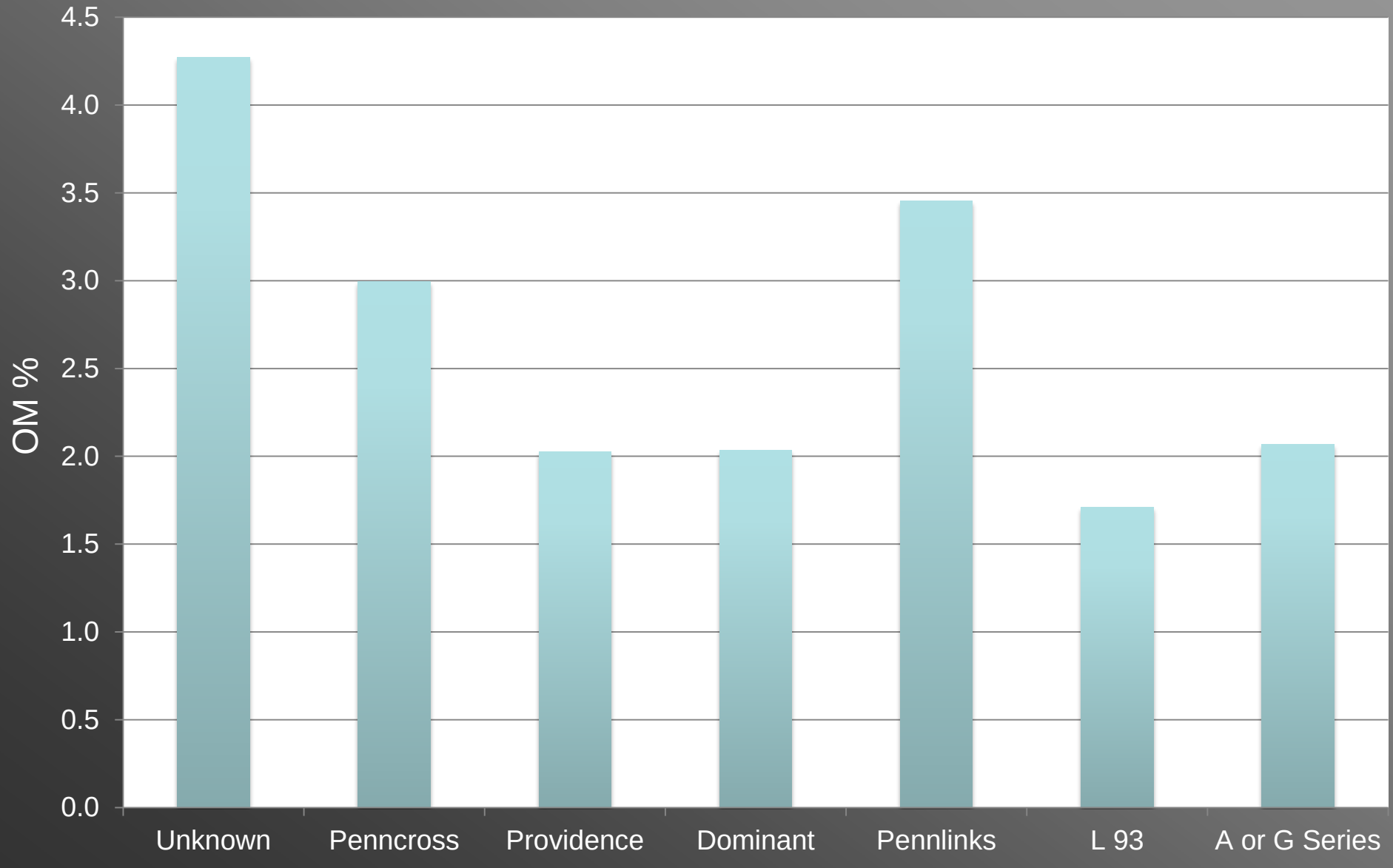
Is the age effect misleading?

- **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**

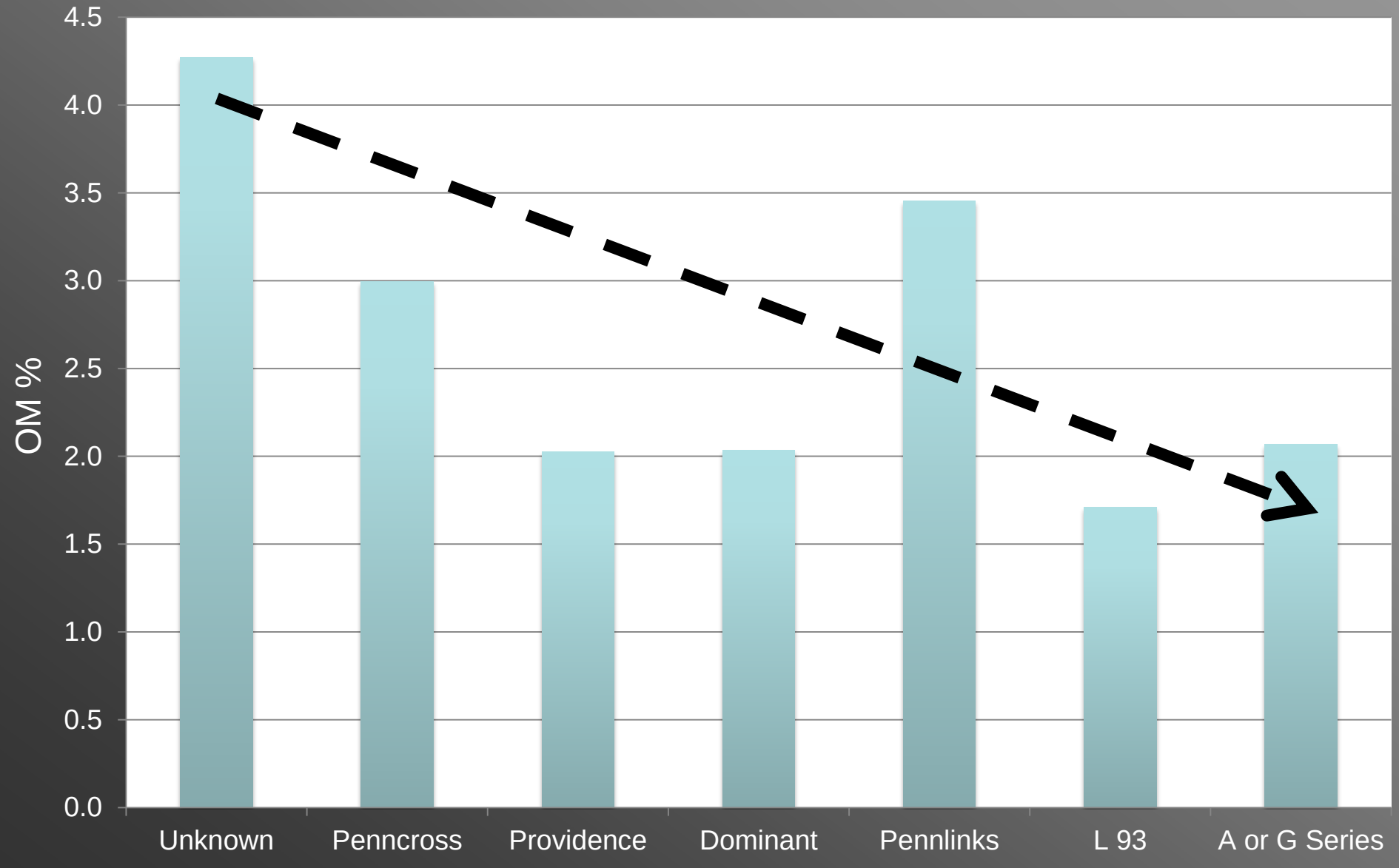
State Differences
(highly correlated with age)



Cultivar

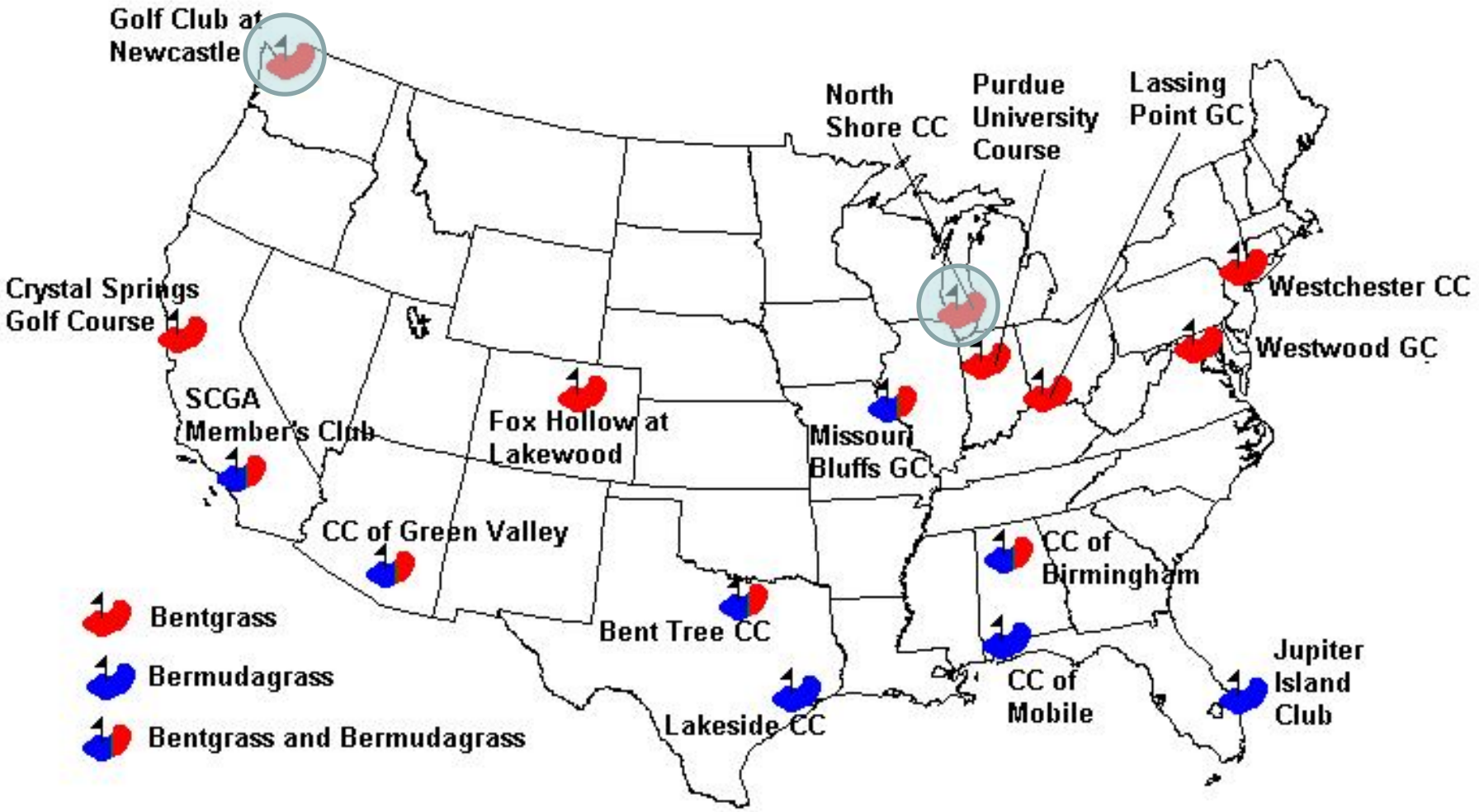

OM %
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Unknown
Penncross
Providence
Dominant
Pennlinks
L 93
A or G Series

Cultivar

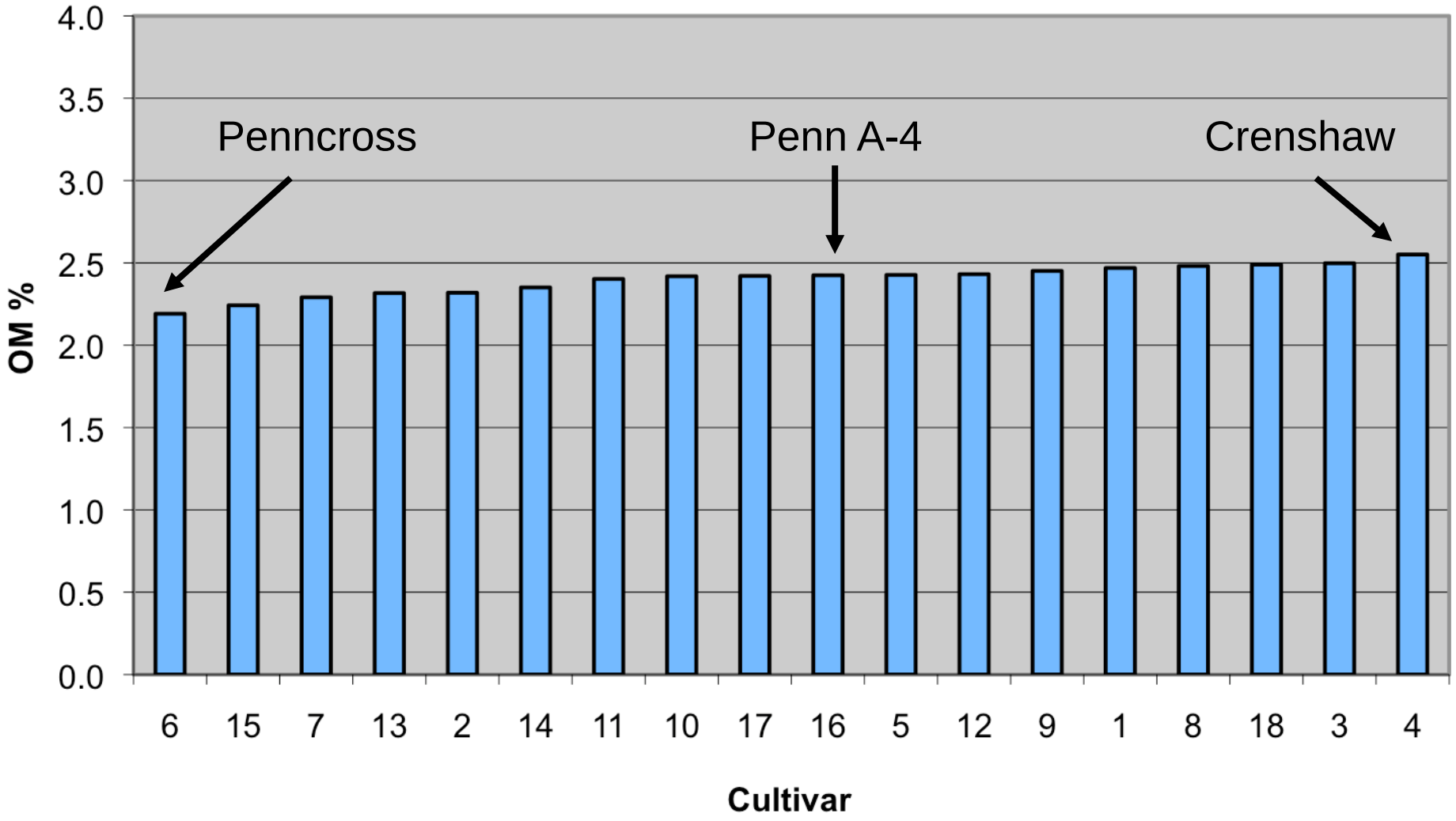

4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
OM %
Unknown
Penncross
Providence
Dominant
Pennlinks
L 93
A or G Series

Onsite NTEP Cultivar Evaluation

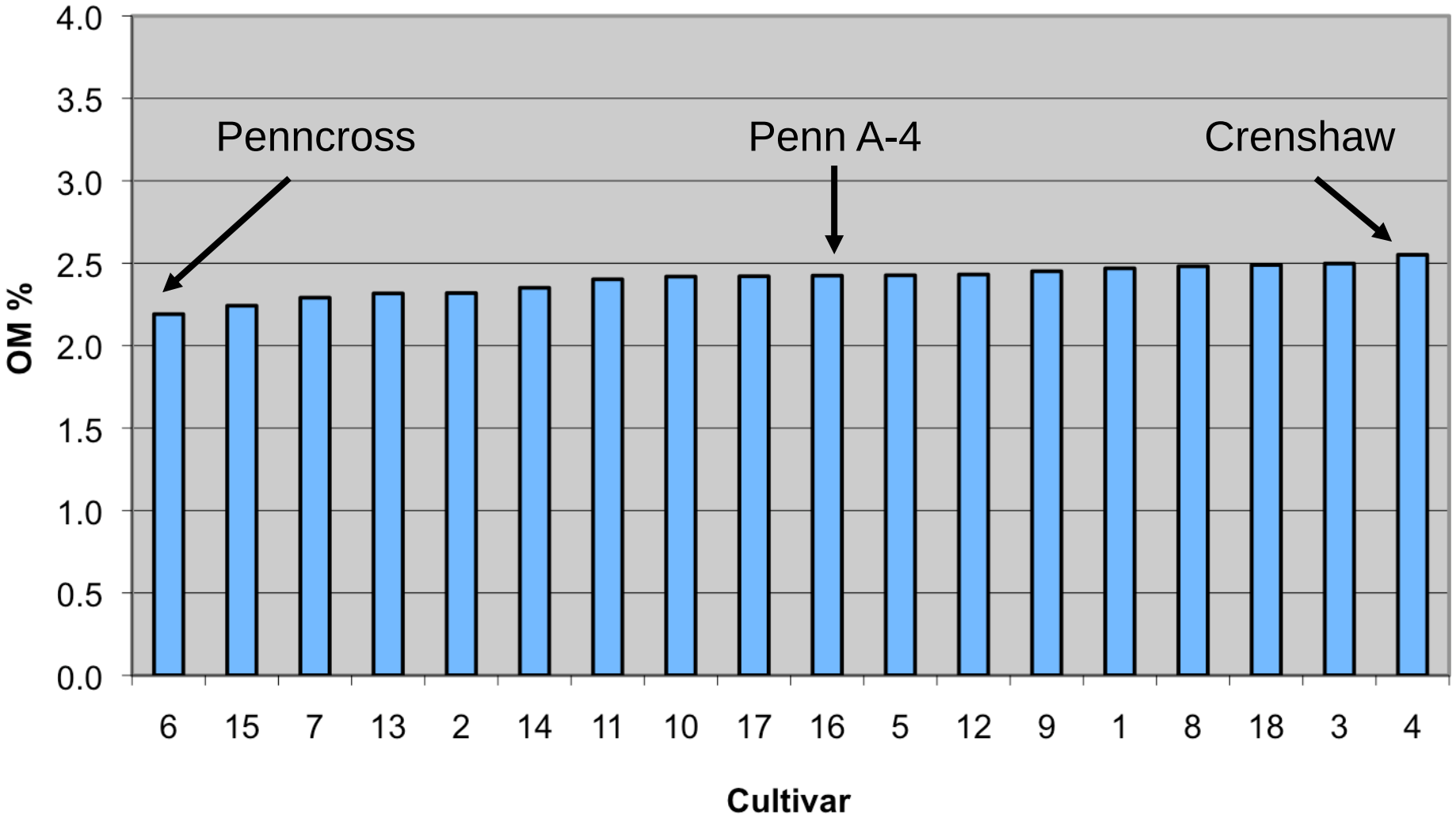
1 L-93
2 Putter
3 Cato
4 Crenshaw
5 LCB-103
6 Penncross
7 Backspin
8 Trueline
9 Providence
10 SR 1020
11 SR 1119
12 Viper
13 Century
14 Imperial
15 Penn A-1
16 Penn A-4
17 Penn G-6
18 Penn G-1


Golf Club at Newcastle
North Shore CC
Purdue University Course
Lassing Point GC
Crystal Springs Golf Course
Westchester CC
Westwood GC
SCGA Member's Club
Fox Hollow at Lakewood
Missouri Bluffs GC
CC of Green Valley
CC of Birmingham
Bent Tree CC
Jupiter Island Club
CC of Mobile
Lakeside CC
Bentgrass
Bermudagrass
Bentgrass and Bermudagrass

Onsite NTEP Bentgrass Evaluation

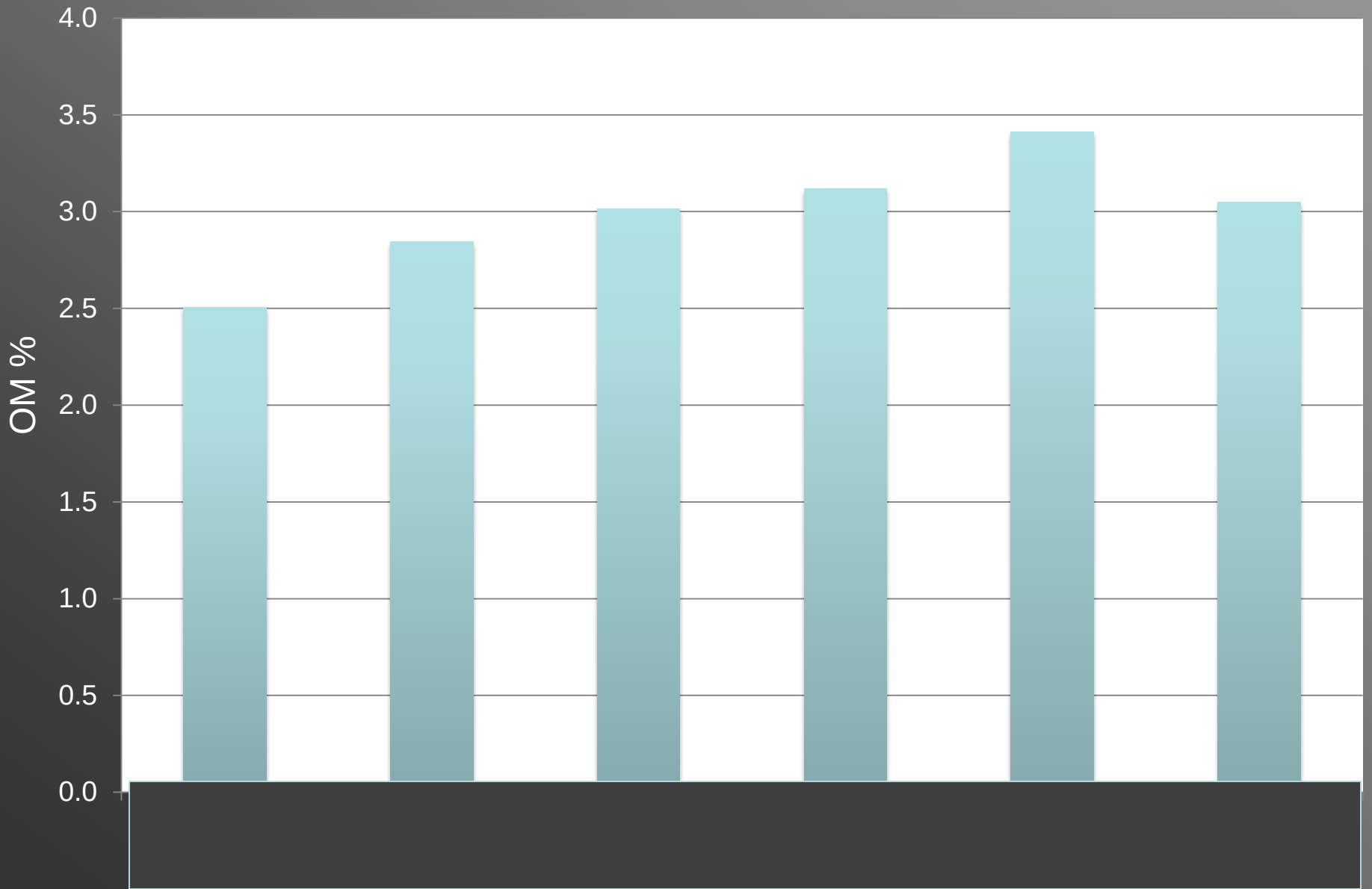


Onsite NTEP Bentgrass Evaluation

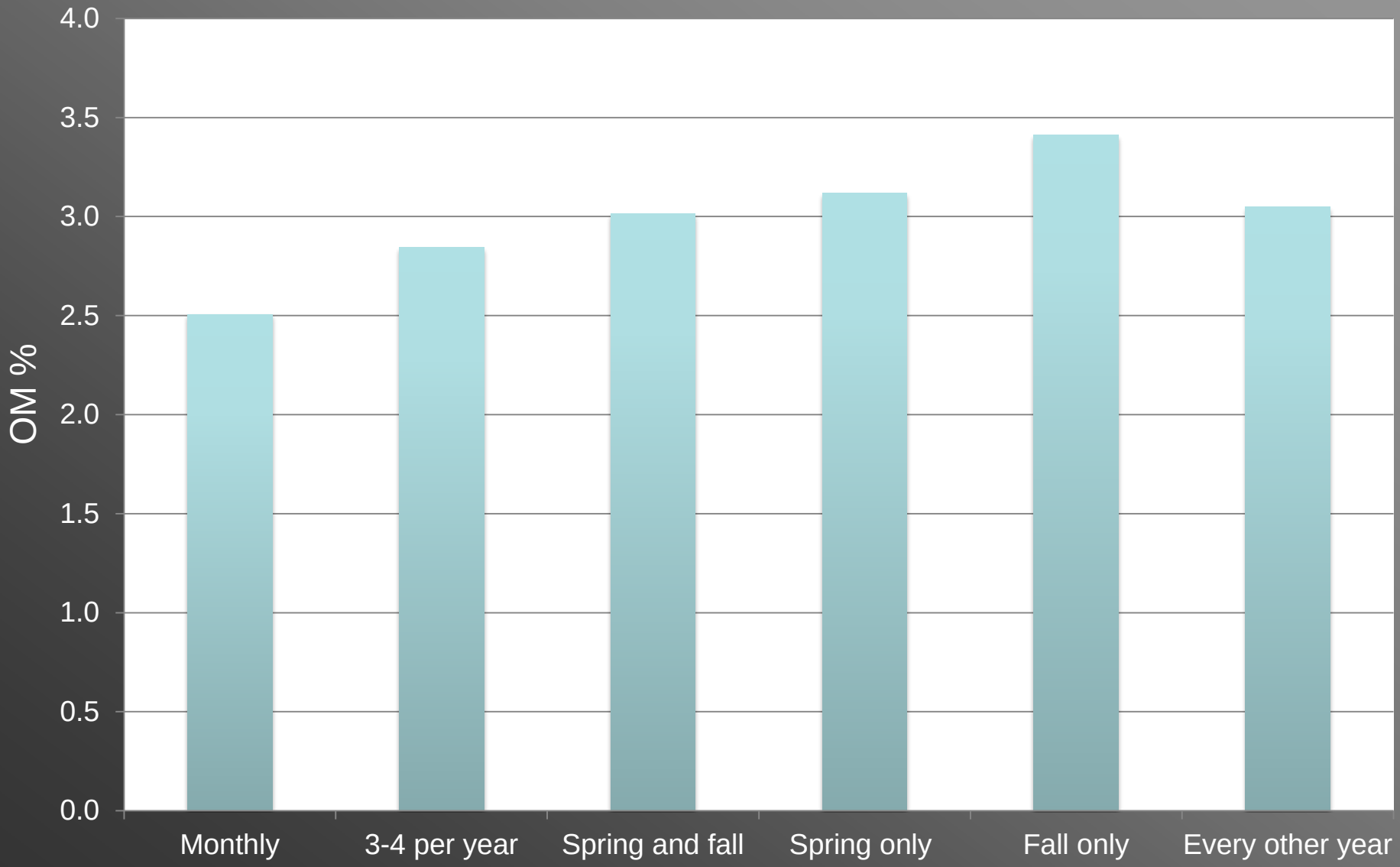


No differences in "total" SOM but might be density differences

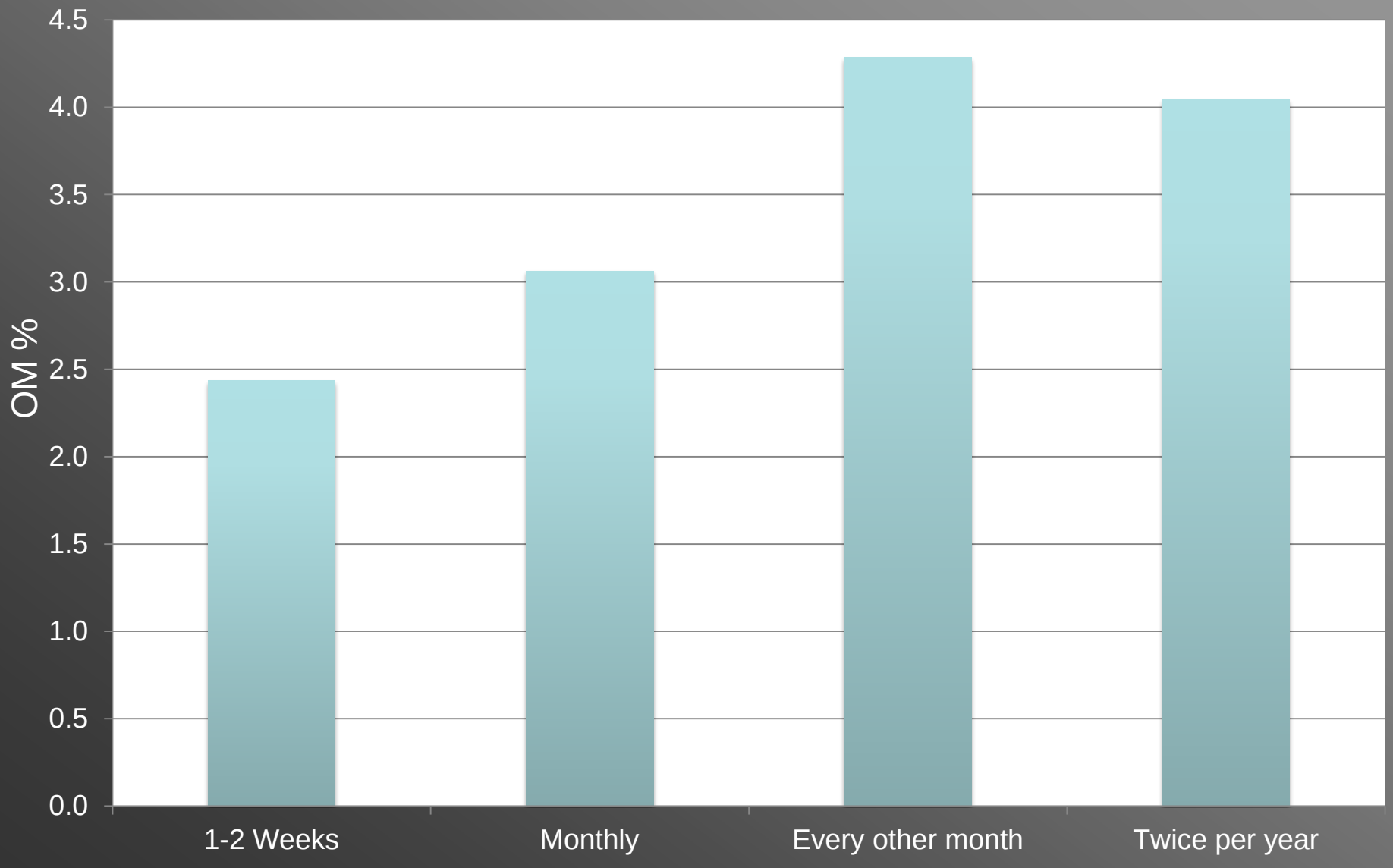
Cultivation Frequency *(& type)*



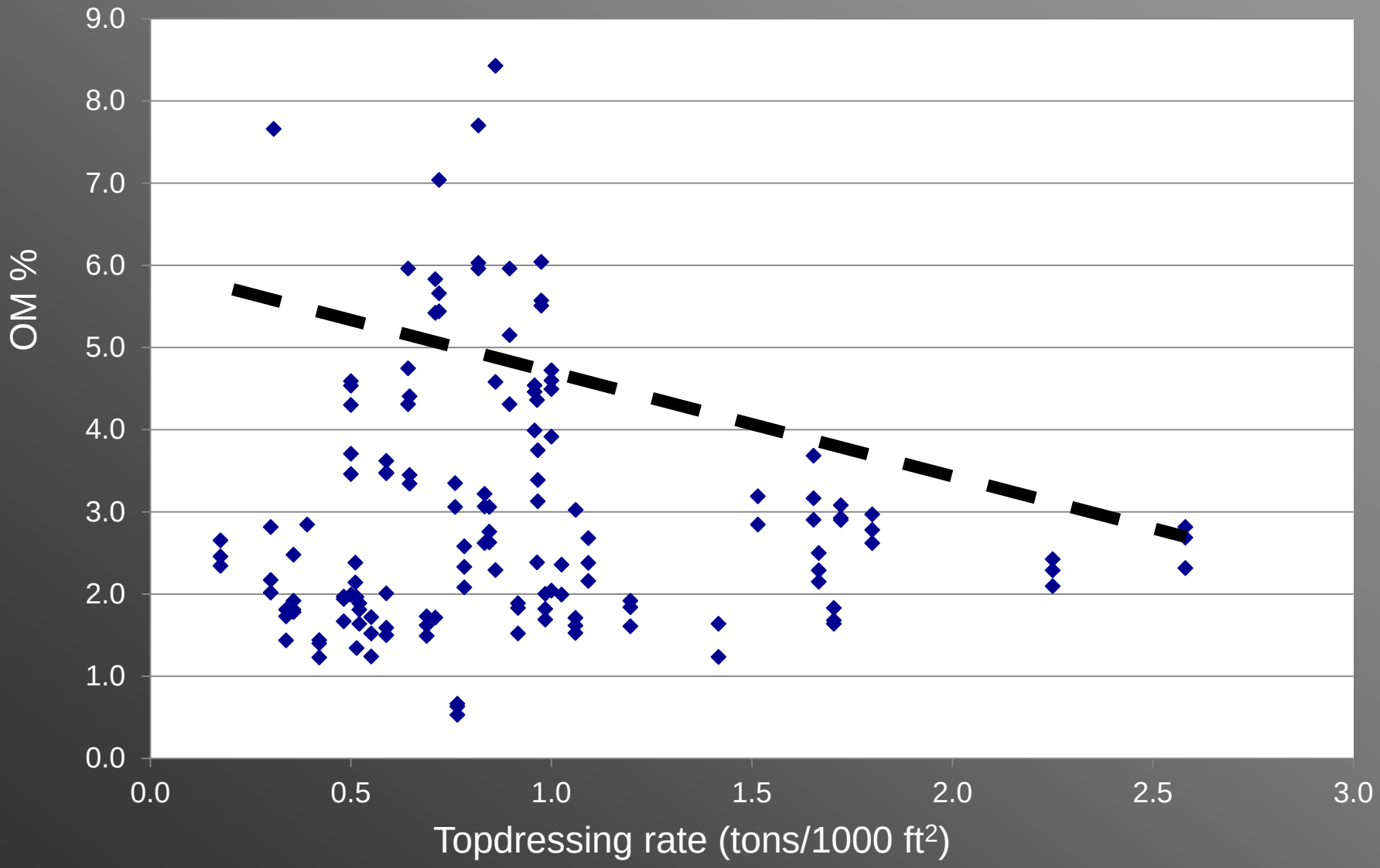
Cultivation Frequency *(& type)*



Topdressing Frequency



Topdressing



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
- Of the ***known*** cultivars, no differences in OM were evident

1 ft^3 = 100 lbs of dry sand; yd^3 = 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 in his classic textbook "Turfgrass Science & Culture, 1973 writes:

"The most important management practice for OM management is topdressing"

“the solution to pollution is dilution”

How do you get rid of OM?

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

Acknowledgements

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