



The Metropolitan

*Water Reclamation District*

of Greater Chicago



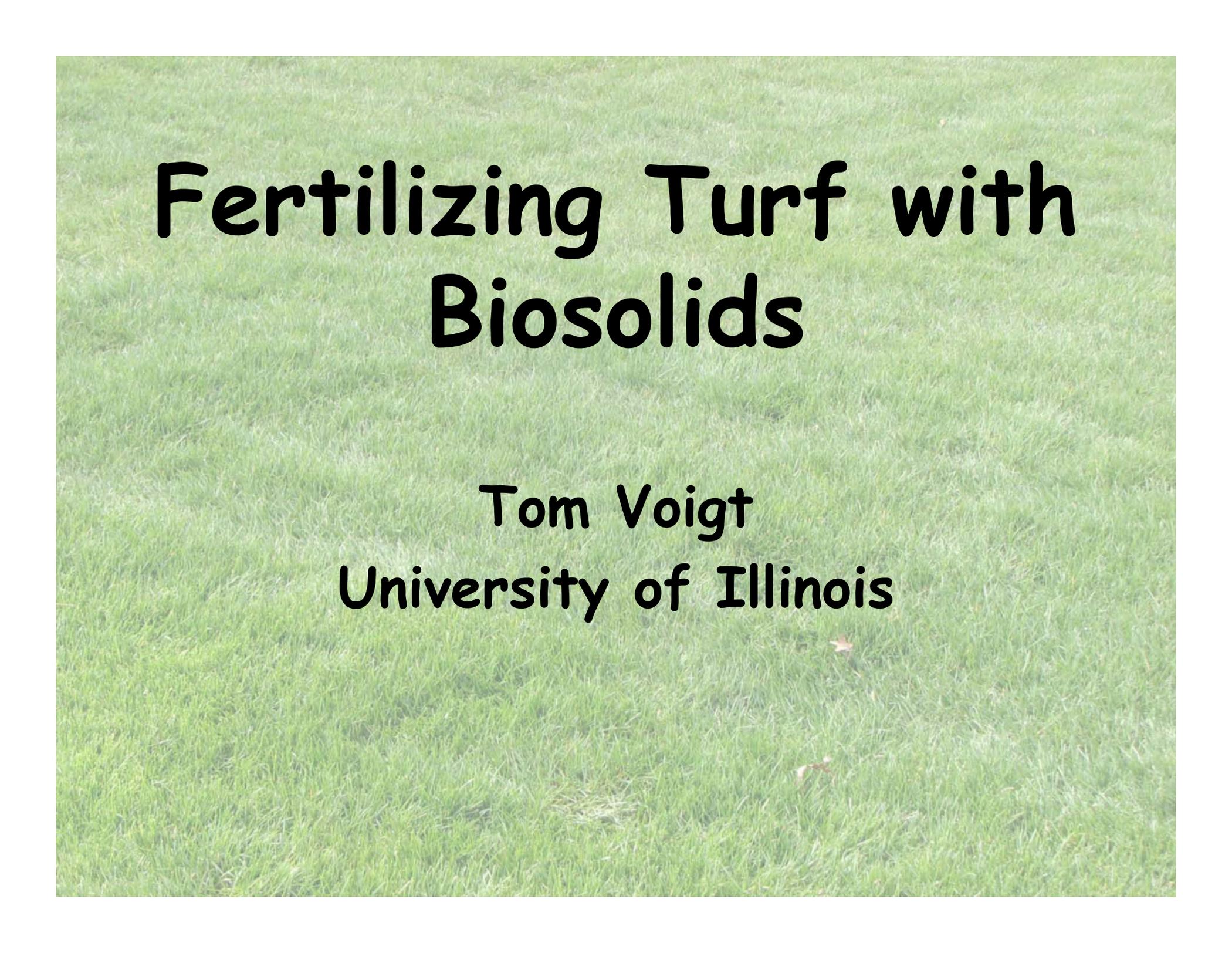
**WELCOME  
TO THE AUGUST EDITION  
OF THE 2009  
M&R SEMINAR SERIES**

# BEFORE WE BEGIN

- SILENCE CELL PHONES & PAGERS
- QUESTION AND ANSWER SESSION WILL FOLLOW PRESENTATION
- SEMINAR SLIDES WILL BE POSTED ON MWRD WEBSITE AT ([www. MWRD.org](http://www.MWRD.org))
- Home Page → (Public Interest) → more public interest → M&R Seminar Series → 2009 Seminar Series

# Dr. Tom Voigt

- Ph.D. Horticulture                      University of Illinois - Urbana/Champaign
- M.S. Horticulture                      University of Illinois - Urbana/Champaign
- B.S. Horticulture                      University of Illinois - Urbana/Champaign
- University of Illinois (22 yrs. )
  - Associate Professor and Extension Specialist- Turfgrass
  - Grass/forb evaluation for landscaping
  - Evaluation of turfgrass cultivars
  - Development of low maintenance turfgrass
  - Development of management programs for golf course turf
  - Development of sustainable and optimized culture practices for alternative and native species as biomass feedstock for ethanol production
- Joliet Junior College
  - Taught horticulture and turf management
- Logan Correctional Center, Lincoln IL
  - Taught vocational horticulture

A photograph of a lush green lawn with the title text overlaid.

# **Fertilizing Turf with Biosolids**

**Tom Voigt  
University of Illinois**

# Outline

- **Turf fertilization**
- **Introduction to study**
- **Materials and methods**
- **Results**
- **Conclusions**

# Turfgrass Fertilization

Following mowing, fertilization is often the most common and costly turf management practice.

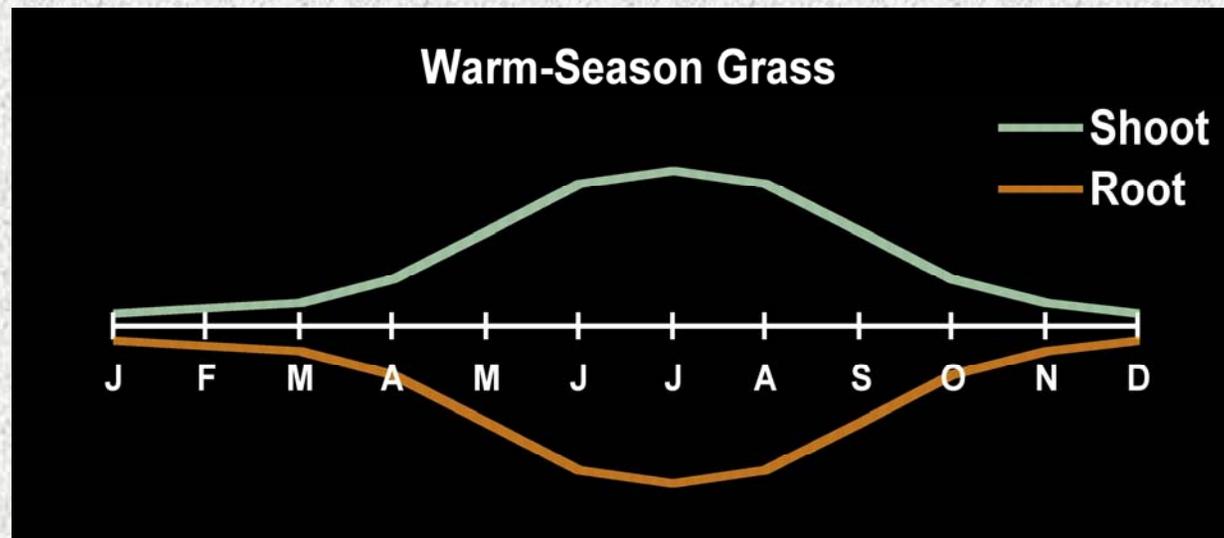
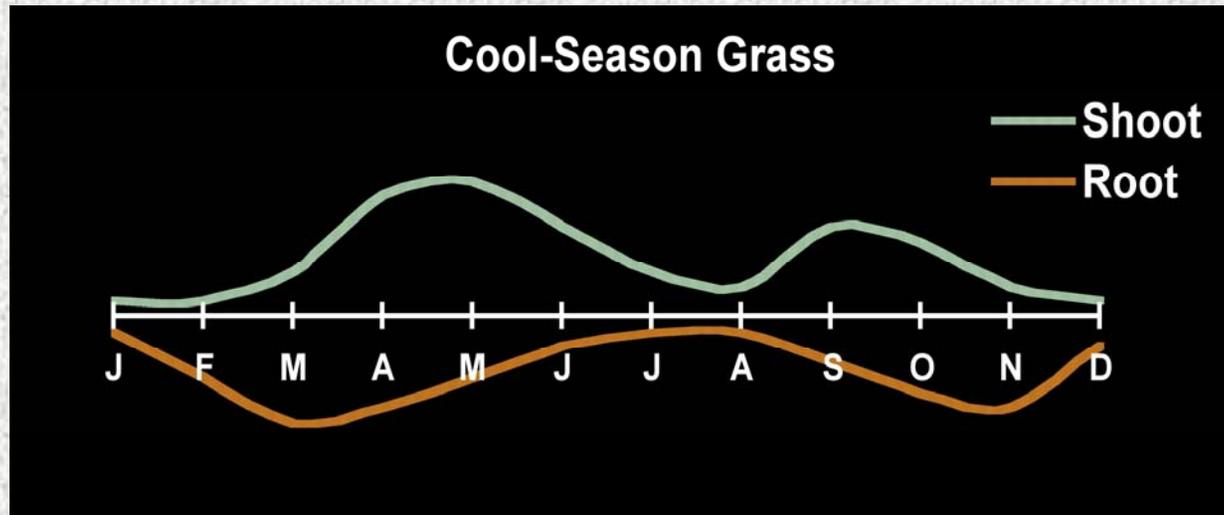
## Benefits of Turfgrass Fertilization

- Appearance - density, color, uniformity, recuperative ability
- Weed control
- Disease control
- Stress tolerance - leaf and stem strength, heat, cold, drought, traffic, diseases, insects, nematodes

# Turfgrass fertilization is usually based on:

- Turf seasonal growth
- Desired turf quality
- Turf species
- Turf use
- Fertilizer

# Seasonal Turfgrass Growth











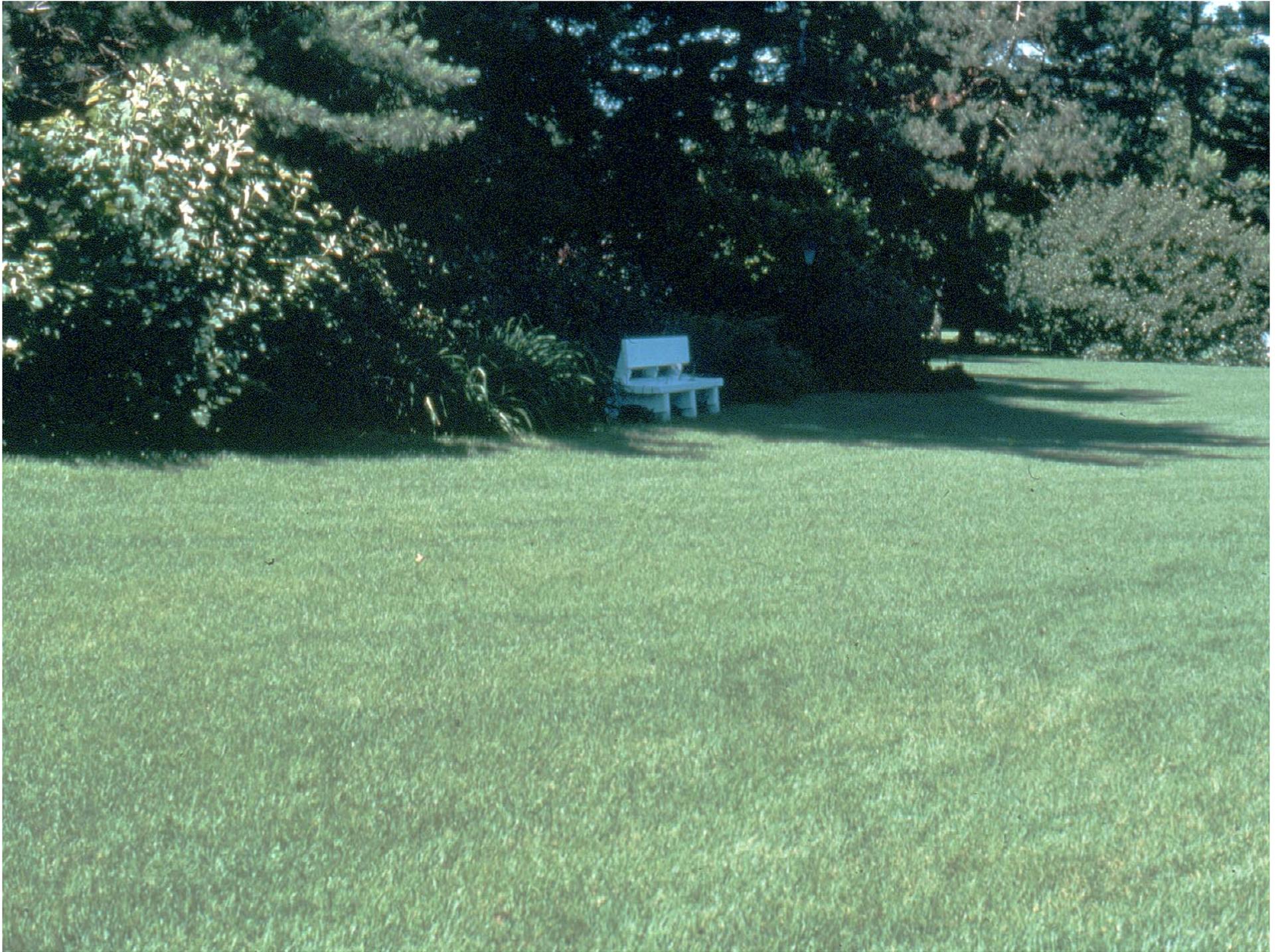
# Turfgrass Nitrogen Requirements

Pounds of nitrogen required by different turf species (per 1000 sq. ft. per year)

## Cool Season Grasses

|                             |     |
|-----------------------------|-----|
| Sheep and hard fescue       | 0-3 |
| Red fescue                  | 1-3 |
| Tall fescue                 | 1-4 |
| Perennial ryegrass          | 2-4 |
| Improved Kentucky bluegrass | 2-4 |
| Common Kentucky bluegrass   | 1-2 |
| Creeping bentgrass          | 3-8 |

Split the annual number of pounds of nitrogen to be applied equally into each application. Do not exceed one pound of nitrogen in a quick-release form at any one application.





**\*Scotts Patented Polyform Process**—makes Turf Builder lighter, smaller and easier to handle. Easier to use. As proven on home lawns and golf courses, this has the same non-burning, long-lasting characteristics of all Scott fertilizers.

**NET WEIGHT 26½ LBS (12.02 kg)**

**CAUTION:** PLEASE KEEP OUT OF THE REACH OF CHILDREN. EYE CONTACT WITH IRRITATION. FLUSH EYES WITH WATER AS SOON AS POSSIBLE.

Turf Builder 34-4-4

**Guaranteed Analysis**

Total nitrogen (N) .....  
    0.9% ammoniacal nitrogen  
    22.1% water soluble nitrogen  
    11.0% water insoluble nitrogen  
Available phosphoric acid (P<sub>2</sub>O<sub>5</sub>) .....  
Soluble potash (K<sub>2</sub>O) .....

Derived from: monoammonium phosphate, urea, methylene ureas, potassium  
US Process Pat Nos 3,231,363, 3,705,794 and 3,989,470

The O M Scott & Sons Company

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# Turf Fertilizer Nitrogen Sources

| <i>Carrier</i>          | <i>% Nitrogen</i> | <i>Analysis</i> | <i>Residual Response</i> | <i>Low temp. effects</i> | <i>Burn pot.</i> | <i>Leaching Pot.</i> |
|-------------------------|-------------------|-----------------|--------------------------|--------------------------|------------------|----------------------|
| Urea                    | 45-46             | 45 or 46-0-0    | short                    | rapid                    | high             | mod                  |
| Ammonium nitrate        | 33-34             | 33 or 34-0-0    | short                    | rapid                    | high             | high                 |
| SCU                     | 22 - 38           | 22 to 38-0-0    | mod                      | mod-low                  | low              | low                  |
| Activated sludge<br>low | 4 - 6             | 4 to 6-4-0      | long                     | very low                 | very low         | very                 |
| Manures<br>low          | 1.5 - 3           | variable        | long                     | very low                 | very low         | very                 |

# Cool-Season Turfgrass Fertilization Schedule

| <i>Number of N Application(s) per Year</i> | <i>early May</i> | <i>mid June</i> | <i>early Sept.</i> | <i>late Season*</i> |
|--|------------------|-----------------|--------------------|---------------------|
| 1  |                  |                 | X                  |                     |
| 2  | X                |                 | X                  |                     |
| 3  | X                |                 | X                  | X                   |
| 4  | X                | X               | X                  | X                   |

\*Make late season application approximately 1 week after the final mowing of the season.

# 2005 Biosolids and Turf - Research and Demonstration Activities

- Review project sites where the District's biosolids are currently used to establish and/or maintain turfgrass to evaluate turf performance
- Identify issues that reduce the acceptance of biosolids use in the turf industry.

## 2005 Biosolids and Turf - Research and Demonstration Activities

- Expand the District's contact base within the turf industry, and plan for future local demonstration projects, and presentations to various turf manager's associations or at professional turf events.

# 2005 Biosolids and Turf - Research and Demonstration Activities

- Develop demonstration and research projects to show biosolids use benefits and to enhance the acceptance of biosolids in the turfgrass industry.
- Design documents and reports to guide turf professionals in the use of biosolids for turf projects.

# Biosolids and Turf - Frequently Asked Questions (FAQs)

- Are heavy metals potentially damaging to me, turf, or the environment?
- Are salts a problem?
- Is there an odor?
- Is it free of weed seed?

# Biosolids and Turf - FAQs

- How physically and chemically uniform is the product?
- Are nutrient levels consistent from batch to batch?
- What are the nutrient release characteristics and are they consistent from batch to batch?

# Biosolids and Turf - FAQs

- Is it clean enough and ground finely enough to use without additional processing?
- How can I use it on my course - turf, flower, or shrub bed rootzone amendment; topdressing; divot repair mix; or fertilizer?
- What are appropriate application rates?

# Research Objectives

Because there proved to be general interest in the product among turf managers, a field study was initiated in 2006 to determine if MWRDGC biosolids could be used as a fertilizer:

- to improve golf, athletic, and lawn turf health and quality;
- to use turf to manage a recyclable product;  
and
- to improve turf manager acceptance of biosolids use.

# Study Timeline

- 2005 - Surveyed turf managers
- 2006 - Designed and installed study; fertilized athletic and lawn turf in Nov.; collected soil and turf tissue
- 2007 - Evaluated turf monthly (April - Oct.); fertilized athletic and lawn turf in May, Sept., Nov. and roughs in May and Sept.; collected soil and turf tissue Sept.
- 2008 - Evaluated turf monthly (April - Oct.); fertilized all turf in May, Sept.; collected soil and turf tissue Sept.
- 2009 - Report

# Materials and Methods

- 6 Chicago-area sites; 2 athletic turf, 2 golf course rough turf and 2 lawn turf
- 8 treatments
- Evaluated for quality, color, soil and tissue chemistry
- Autumn 2006 through Autumn 2008
- 5' x 10' plots, replicated 3 times
- Categorical Data Analysis and Ordinal Multinomial Data Analysis (SAS)

# Field Sites

**Golf Course Rough Turf (fertilized May, Sept.)**

- **Coyote Run Golf Course (CRGC), Flossmoor**
- **Knollwood Club (KC), Lake Forest**

**Athletic Turf (fertilized May, Sept., Nov.)**

- **Danny Cunniff Park (DCP) in Highland Park**
- **Lake Forest Academy (LFA) in Lake Forest**

**Lawn Turf (fertilized May, Sept., Nov.)**

- **North Shore Country Club (NSCC), Glenview**
- **Midwest Golf House (MGH), Lemont**

# Athletic Turf

## Lake Forest Academy and Park District of Highland Park

- Disturbed soils
- Mostly Ky. Bluegrass mowed at 1.5" - 2.5"
- Full sun
- LFA - irrigated as needed; no irrigation at PDHP
- LFA - soccer, football
- PDHP - youth baseball



# Golf Course Rough Turf

## Coyote Run Golf Course and the Knollwood Club

- Disturbed soils
- Mostly Ky. Bluegrass mowed at 2" - 3"
- No irrigation
- Mostly full sun



# Lawn Turf

## Midwest Golf House and North Shore Country Club

- Disturbed soils
- Mostly Ky.  
Bluegrass mowed  
at 2" - 3"
- No irrigation
- Mostly full sun



# Fertilizer Treatments

| <u>N Source<br/>(Analysis)</u>   | <u>N Per 1,000 ft.<sup>2</sup><br/>at each application</u> |
|----------------------------------|--|
| MWRDGC Biosolids 1 (2.2-2.5-0.3) | 1 pound  |
| MWRDGC Biosolids 2 (2.2-2.5-0.3) | 5 pounds   |
| Nature Safe (10-2-8)             | 1 pound  |
| Milorganite (6-2-0)              | 1 pound  |
| Sustane (5-2-4)                  | 1 pound  |
| Sulfur-Coated Urea (24-3-14)     | 1 pound  |
| Urea (46-0-0)                    | 1 pound  |
| Untreated Check                  |  |

# Turf Quality

- Monthly, April - October
- Subjective 1-9 with 1 = dead, 9 = perfect turf, and 5 = minimally acceptable quality
- Combination of uniformity, color, texture, density

# Turf Color Measurement



- TCM 500 NDVI Turf Color Meter\*
- Adjusted for each site and monthly (April - October) evaluations
- Mean of 6 random measurements per plot
- Measures reflected light from turf

\*Spectrum Technologies

# Results

# Midwest Golf House and North Shore Lawn Turf - Significant Color Differences\*

- 28 Evaluations over 2007 and 2008
- Between Biosolids Rates One and Two - 6 evaluations (Biosolids Rate Two always darker than Rate One)
- Biosolids Rate One vs. other treatments excluding Biosolids Rate Two and Check - 5 evaluations (Biosolids Rate One lighter than others in 4 evaluations)
- Biosolids Rate Two vs. other treatments excluding Biosolids Rate One and Check - 6 evaluations (Biosolids Rate Two darker than others in 5 evaluations)
- Untreated Check vs. all treatments - 10 evaluations (Lighter than other treatments in 10 evaluation)

\*P-value < 0.05

# Coyote Run and Knollwood Rough Turf - Significant Color Differences\*

- 25 Evaluations over 2007 and 2008
- Between Biosolids Rates One and Two - 1 evaluation (Biosolids Rate One darker than Rate Two)
- Biosolids Rate One vs. other treatments excluding Biosolids Rate Two and Check - 4 evaluations (Biosolids Rate One lighter than others in 3 evaluations)
- Biosolids Rate Two vs. other treatments excluding Biosolids Rate One and Check - 3 evaluations (Biosolids Rate Two lighter than others in 3 evaluations)
- Untreated Check vs. all treatments - 3 evaluations (Lighter than other treatments in 2 evaluation)

\*P-value < 0.05

# Lake Forest Academy and Highland Park Athletic Turf - Significant Color Differences\*

- 28 Evaluations over 2007 and 2008
- Between Biosolids Rates One and Two - 7 evaluations (Biosolids Rate Two darker than Rate One in 6 evaluations)
- Biosolids Rate One vs. other treatments excluding Biosolids Rate Two and Check - 5 evaluations (Biosolids Rate One lighter than others in 4 evaluations)
- Biosolids Rate Two vs. other treatments excluding Biosolids Rate One and Check - 2 evaluations (Biosolids Rate Two darker than others in 1 evaluation)
- Untreated Check vs. all treatments - 11 evaluations (Less than other treatments in 11 evaluation)

\*P-value < 0.05

# Color Summary

In 81 evaluations:

- Biosolids Rate One was darker than Rate Two at 2 evaluations, lighter than Rate Two at 12 evaluations, and equal to Rate Two at 67 evaluations.
- Biosolids Rate One was darker than the other fertilizer treatments at 3 evaluations, lighter than the others at 11 evaluations, and equal to the other fertilizer treatments at 67 evaluations.

## Color Summary (cont.)

In 81 evaluations:

- Biosolids Rate Two was darker than the other fertilizer treatments at 6 evaluations, lighter than the others at 5 evaluations, and equal to the other fertilizer treatments at 70 evaluations.

# Midwest Golf House and North Shore Lawn - Significant Quality Differences\*

- 28 Evaluations over 2007 and 2008
- Between Biosolids Rates One and Two - 12 evaluations (Biosolids Rate Two had better quality than Rate One in 12 evaluations)
- Biosolids Rate One vs. other treatments excluding Biosolids Rate Two and Check - 16 evaluations (Biosolids Rate One had lower quality than others in 16 evaluations)
- Biosolids Rate Two vs. other treatments excluding Biosolids Rate One and Check - 11 evaluations (Biosolids Rate Two had better turf quality than others in 6 evaluations)
- Untreated Check vs. all treatments - 20 evaluations (Lower turf quality than other treatments in 20 evaluation)

\*P-value < 0.05

# Coyote Run and Knollwood Roughs - Significant Quality Differences\*

- 25 Evaluations over 2007 and 2008
- Between Biosolids Rates One and Two - 5 evaluation (Biosolids Rate One had better quality than Rate Two in 4 evaluations)
- Biosolids Rate One vs. other treatments excluding Biosolids Rate Two and Check - 6 evaluations (Biosolids Rate One had lower quality than others to others in 6 evaluations)
- Biosolids Rate Two vs. other treatments excluding Biosolids Rate One and Check - 8 evaluations (Biosolids Rate Two had better turf quality than the other fertilizers in 1 evaluation)
- Untreated Check vs. all treatments - 10 evaluations (Lower turf quality than other treatments in 10 evaluation)

\*P-value < 0.05

# Lake Forest Academy and Highland Park Athletic Turf - Significant Quality Differences\*

- 28 Evaluations over 2007 and 2008
- Between Biosolids Rates One and Two - 12 evaluations (Biosolids Rate Two better turf quality than Rate One in 12 evaluations)
- Biosolids Rate One vs. other treatments excluding Biosolids Rate Two and Check - 7 evaluations (Biosolids Rate One had lower quality than others in 7 evaluations)
- Biosolids Rate Two vs. other treatments excluding Biosolids Rate One and Check - 5 evaluations (Biosolids Rate Two had better turf quality than the other fertilizer treatments in 5 evaluations)
- Untreated Check vs. all treatments - 25 evaluations (Lower turf quality than other treatments in 25 evaluation)

\*P-value < 0.05

# Quality Summary

In 81 evaluations:

- Biosolids Rate One had better turf quality than Rate Two at 4 evaluations, lower turf quality than Rate Two at 25 evaluations, and equal turf quality to Rate Two at 52 evaluations.
- Biosolids Rate One had lower turf quality than the other fertilizer treatments at 29 evaluations, and equal turf quality at 52 evaluations.

## Quality Summary (cont.)

In 81 evaluations:

- Biosolids Rate Two had better turf quality than the other fertilizer treatments at 12 evaluations, lower turf quality than the other fertilizer treatments at 12 evaluations, and equal to the other fertilizer treatments at 57 evaluations.

# Quality Summary (cont.)

## Quality Means

|             | Overall Quality | <u>A, M, O</u> | <u>J, J, A, S</u> |
|-------------|-----------------|----------------|-------------------|
| MWRDGC 2    | 5.8             | 5.7            | 5.7               |
| Nature Safe | 5.6             | 5.5            | 5.6               |
| SCU         | 5.6             | 5.7            | 5.6               |
| Milorganite | 5.3             | 5.5            | 5.2               |
| Sustane     | 5.3             | 5.4            | 5.3               |
| Urea        | 5.2             | 5.2            | 5.1               |
| MWRDGC 1    | 4.8             | 4.7            | 4.9               |
| Check       | 4.0             | 3.9            | 4.1               |

# Mean 2008 turf tissue test results comparing MWRDGC Biosolids Rate 2, 2006 pre-trial amounts, and common sufficiency ranges.

| Tissue Test Results | MGH              | NSCC             | Common Sufficiency Range <sup>1</sup> |
|---------------------|------------------|------------------|---------------------------------------|
| TKN (%)             | <b>3.8 (3.8)</b> | 3.2 (2.3)        | 2.8 - 3.5                             |
| Total P (%)         | 0.36 (0.36)      | 0.39 (0.39)      | 0.2 - 0.55                            |
| Total Ca (%)        | 0.54 (0.44)      | 0.52 (0.32)      | Variable                              |
| Total Mg (%)        | 0.28 (0.25)      | 0.24 (0.19)      | 0.15 - 0.5                            |
| Total K (%)         | <b>3.7 (2.0)</b> | <b>3.1 (2.4)</b> | 1.5 - 3.0                             |
| Total Na (%)        | 0.007 (Trace)    | Trace (Trace)    | NA                                    |
| Total Fe (ppm)      | <b>134 (187)</b> | <b>218 (103)</b> | 50 - 100                              |

<sup>1</sup> Carrow, R.N, D.V. Waddington, and P.E. Rieke. 2001. Turfgrass Soil Fertility & Chemical Problems: Assessment and Management. Ann Arbor Press. Chelsea, MI

# Mean 2008 turf tissue test results comparing MWRDGC Biosolids Rate 2, 2006 pre-trial amounts, and common sufficiency ranges.

| Tissue Test Results | CRGC             | KC               | Common Sufficiency Range <sup>1</sup> |
|---------------------|------------------|------------------|---------------------------------------|
| TKN (%)             | <b>3.8</b> (2.0) | <b>3.7</b> (3.5) | 2.8 - 3.5                             |
| Total P (%)         | 0.44 (0.41)      | 0.32 (0.44)      | 0.2 - 0.55                            |
| Total Ca (%)        | 0.4 (0.39)       | 0.79 (0.31)      | Variable                              |
| Total Mg (%)        | 0.25 (0.23)      | 0.3 (0.23)       | 0.15 - 0.5                            |
| Total K (%)         | <b>3.9</b> (2.0) | <b>3.1</b> (3.0) | 1.5 - 3.0                             |
| Total Na (%)        | Trace (Trace)    | 0.01 (Trace)     | NA                                    |
| Total Fe (ppm)      | <b>143</b> (98)  | <b>416</b> (105) | 50 - 100                              |

<sup>1</sup> Carrow, R.N, D.V. Waddington, and P.E. Rieke. 2001. Turfgrass Soil Fertility & Chemical Problems: Assessment and Management. Ann Arbor Press. Chelsea, MI

# Mean 2008 turf tissue test results comparing MWRDGC Biosolids Rate 2, 2006 pre-trial amounts, and common sufficiency ranges.

| Tissue Test Results | DCP              | LFA                 | Common Sufficiency Range <sup>1</sup> |
|---------------------|------------------|---------------------|---------------------------------------|
| TKN (%)             | <b>3.8 (3.8)</b> | 3.4 ( <b>4.6</b> )  | 2.8 - 3.5                             |
| Total P (%)         | 0.43 (0.36)      | 0.36 (0.34)         | 0.2 - 0.55                            |
| Total Ca (%)        | 0.43 (0.38)      | 0.44 (0.57)         | Variable                              |
| Total Mg (%)        | 0.27 (0.32)      | 0.23 (0.32)         | 0.15 - 0.5                            |
| Total K (%)         | 2.8 (2.6)        | <b>3.1 (2.7)</b>    | 1.5 - 3.0                             |
| Total Na (%)        | 0.009 (0.02)     | <b>0.02 (Trace)</b> | NA                                    |
| Total Fe (ppm)      | <b>527 (165)</b> | <b>172 (279)</b>    | 50 - 100                              |

<sup>1</sup> Carrow, R.N, D.V. Waddington, and P.E. Rieke. 2001. Turfgrass Soil Fertility & Chemical Problems: Assessment and Management. Ann Arbor Press. Chelsea, MI

# Tissue Test Summary

Major mineral nutrients were present in sufficient quantities in turf tissue when fertilized with MWRDGC Rate Two.

# Soil Chemistry

Comparison of 2008 mean Biosolids Rate Two soil test results with 2006 test results.

| <u>Soil Test</u>       | <u>CRGC</u>   | <u>KC</u>     |
|------------------------|---------------|---------------|
| pH                     | 7.4 (7.4)     | 7.2 (7.5)     |
| % Organic Carbon       | 3.4 (3.2)     | 6.0 (5.1)     |
| Extractable Ca (mg/kg) | 3,725 (3,805) | 5,393 (4,276) |
| Extractable K (mg/kg)  | 269 (313)     | 587 (635)     |
| Extractable Na (mg/kg) | 77 (49)       | 9.6 (28)      |
| Fe (mg/kg)             | 283 (281)     | 263 (378)     |

# Soil Chemistry

Comparison of 2008 mean Biosolids Rate Two soil test results with 2006 test results.

| <u>Soil Test</u>       | <u>LFA</u>    | <u>PDHP</u>   |
|------------------------|---------------|---------------|
| pH                     | 7.5 (7.6)     | 7.2 (6.8)     |
| % Organic Carbon       | 3.5 (3.0)     | 4.5 (5.2)     |
| Extractable Ca (mg/kg) | 4,410 (4,646) | 3,747 (3,340) |
| Extractable K (mg/kg)  | 170 (164)     | 206 (424)     |
| Extractable Na (mg/kg) | 139 (110)     | 36 (4.3)      |
| Fe (mg/kg)             | 247 (239)     | 214 (165)     |

# Soil Chemistry

Comparison of 2008 mean Biosolids Rate Two soil test results with 2006 test results.

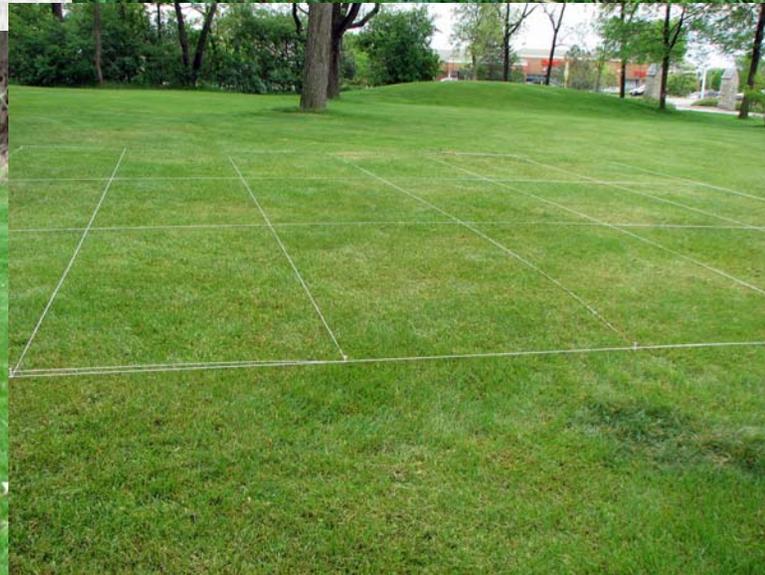
| <u>Soil Test</u>                  | <u>MGH</u>    | <u>NSCC</u> |
|-----------------------------------|---------------|-------------|
| pH                                | 7.3 (7.4)     | 7.0 (7.0)   |
| % Organic Carbon                  | 3.3 (3.2)     | 4.6 (4.7)   |
| Extractable Ca (mg/kg)<br>(3,716) | 3,747 (3,055) | 3,430       |
| Extractable K (mg/kg)             | 152 (258)     | 213 (284)   |
| Extractable Na (mg/kg)            | 44 (13)       | 81 (60)     |
| Fe (mg/kg)                        | 325 (182)     | 295 (360)   |

# MWRDGC Biosolids Concerns

- Physical characteristics
- Reliable availability when needed
- P and Na



# Manage Waste Product with Turf?



# Improve Turf Quality?



# Turf Manager Acceptance?



# Thanks to:

- Coyote Run Golf Course, Knollwood Club, Lake Forest Academy, Midwest Golf House, North Shore Country Club, Park District of Highland Park
- UIUC - Shelby Henning and Kevin Armstrong, Rich Pyter, Emily Thomas
- MWRDGC - Tom Granato, Albert Cox, Guanglong Tian, Kuldip Kumar, Pauline Lindo, Many MWRDGC Research Assistants



2. MWRDGC biosolids  
(2-2-0.2)  
5 pounds

**QUESTIONS?**