Plant Nutrition, Biostimulants, and Biotic Stress Tolerance of Turf

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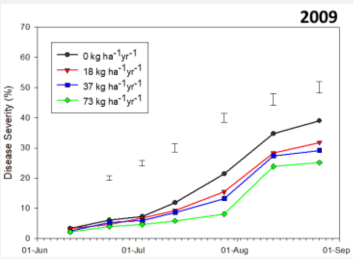
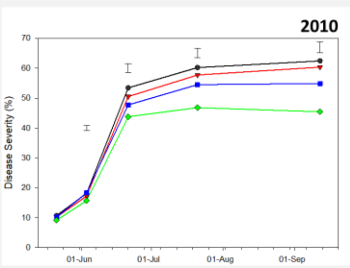
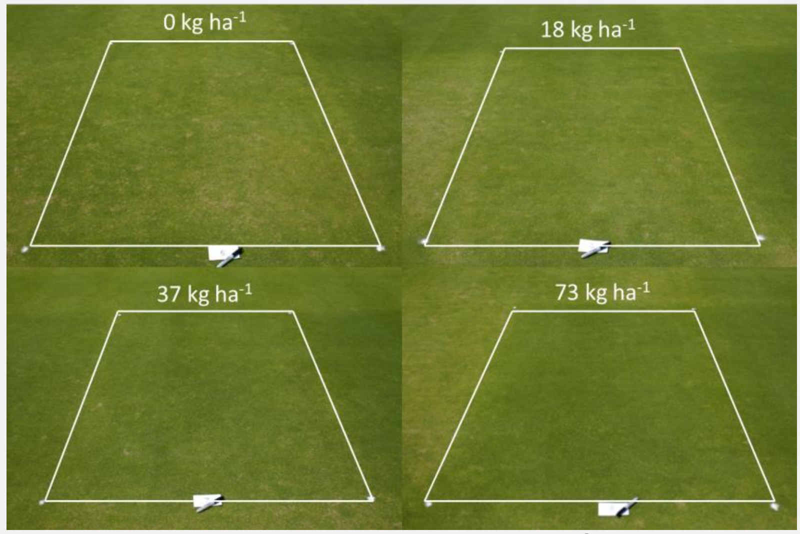
Effect of Granular and Soluble N Programs on Anthracnose

Effect of N Programs on Anthracnose

Effect of soluble N rate



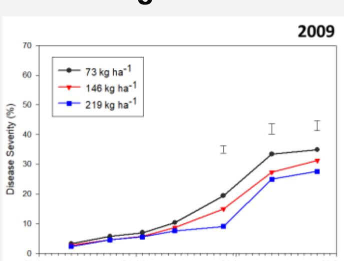


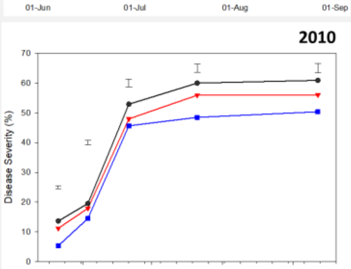


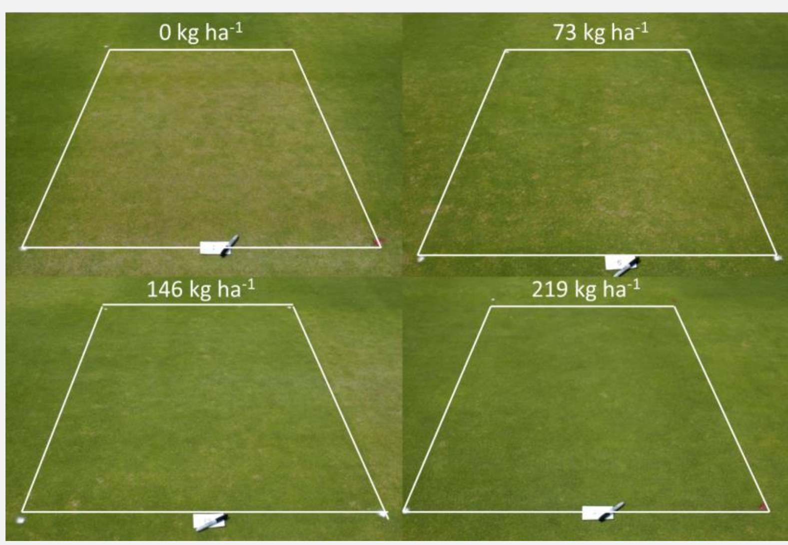
Spring, Granular N – 73 kg ha^{-1}

Effect of N Programs on Anthracnose

Effect of granular N rate



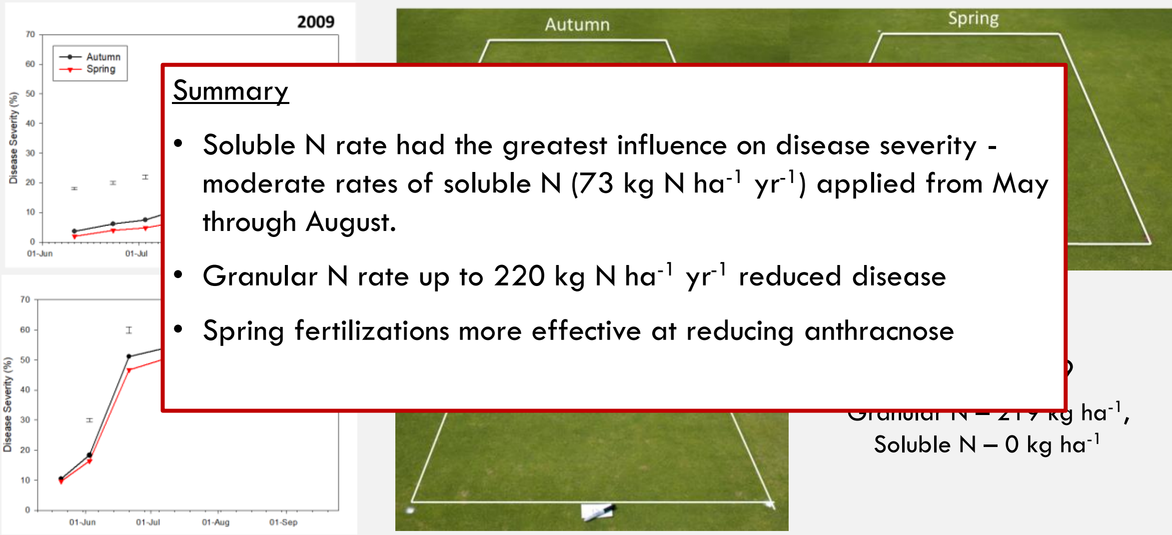




Spring, Soluble N – 0 kg ha^{-1}

Effect of N Programs on Anthracnose

Effect of season of granular N

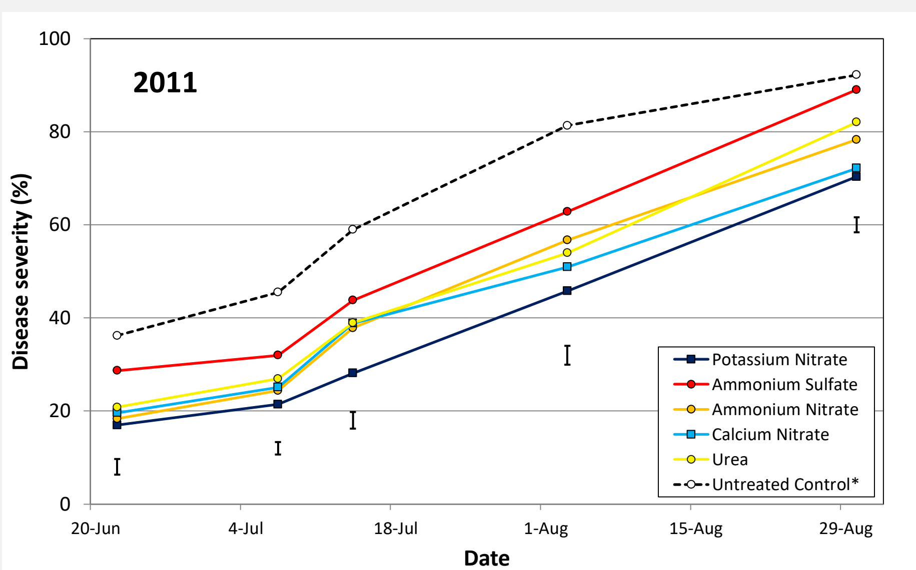


Summary

- Soluble N rate had the greatest influence on disease severity - moderate rates of soluble N (73 kg N ha^{-1} yr^{-1}) applied from May through August.
- Granular N rate up to 220 kg N ha^{-1} yr^{-1} reduced disease
- Spring fertilizations more effective at reducing anthracnose

… kg ha^{-1},
Soluble N – 0 kg ha^{-1}

Effect of N Source on Anthracnose



Crop Science. 2017. 57:S-285-S-292

* Untreated control included for comparison only - not included in factorial analysis

Objectives

1. Determine whether K source or rate influences anthracnose severity and overall performance of ABG turf
2. Establish a potassium index for annual bluegrass turf based on soil test level or leaf tissue concentration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EUROPEAN TURFGRASS SOCIETY CONFERENCE

Potassium Nutrition Affects Anthracnose on Annual Bluegrass

Charles J. Schmid,* Bruce B. Clarke, and James A. Murphy

ABSTRACT

Research Site

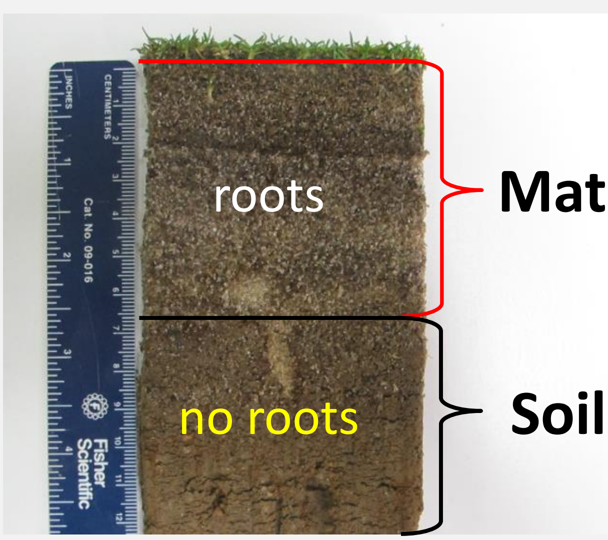
- Hort Farm 2, North Brunswick, New Jersey, U.S.A.
- *Poa annua* triplex mowed daily at 2.8 mm
- Soil: ~7-cm mat layer (sand topdressed) over sandy loam
  - ✓ Mat K: very low (35 mg kg^{-1})
  - ✓ Sandy loam K: moderate (75 mg kg^{-1})

Experimental Design

2 K sources: potassium sulfate (K_2SO_4) and potassium chloride (KCl)
3 K rates: 54, 109, and 218 kg K ha^{-1} yr^{-1}

- Also included
  - ✓ potassium nitrate (KNO_3) and potassium carbonate (K_2CO_3) applied K at 218 kg ha^{-1} annually
  - ✓ no potassium check
  - ✓ potassium check (no N)
- Treatments applied biweekly after urea application from May through November. Urea not applied to KNO_3 and potassium (no N) check plots

Soil and Tissue Sampling



Data Analysis

AUDPC was compared to soil test and tissue K using Non-linear regression models to determine critical levels

Linear plateau

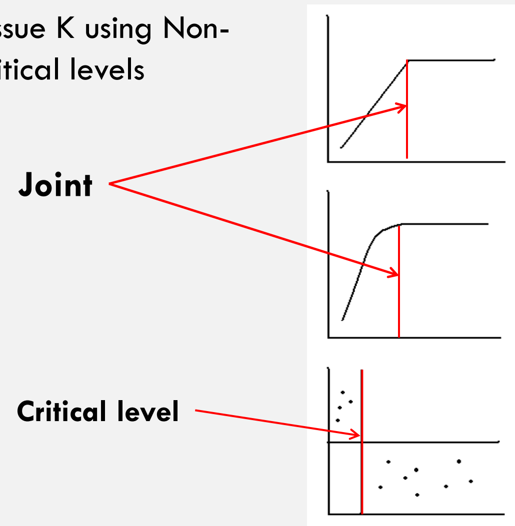
$$y = a + bX \quad \text{if } X \leq X_0$$
$$y = y_o \quad \text{if } X > X_0$$

Quadratic plateau

$$y = a + bX + cX^2 \quad \text{if } X \leq X_0$$
$$y = y_o \quad \text{if } X > X_0$$

Cate-Nelson

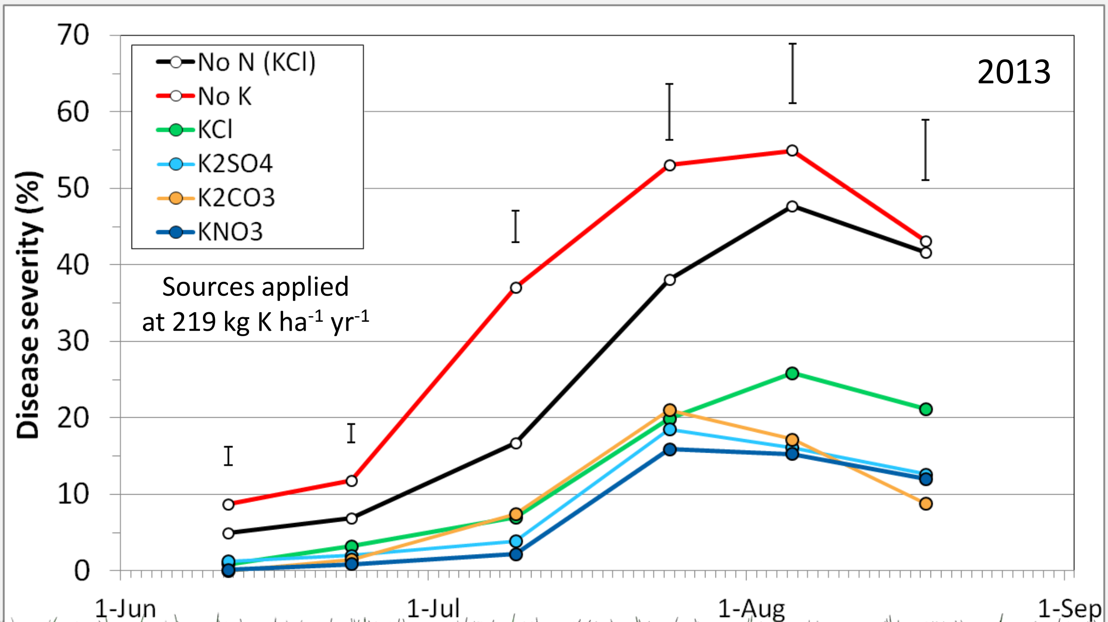
$$y = a + bX, \text{ where } \begin{cases} X = 0 \text{ if below critical level} \\ X = 1 \text{ if above critical level} \end{cases}$$



ANOVA

Orthogonal Contrasts		2012	2013	2014
	df	----------------	AUDPC	----------------
no K (N-only)		1,270	2,505	2,269
vs K-only	1	1,181^{NS}	1,796***	2,092^{NS}
vs all N + K	1	447***	807***	851***

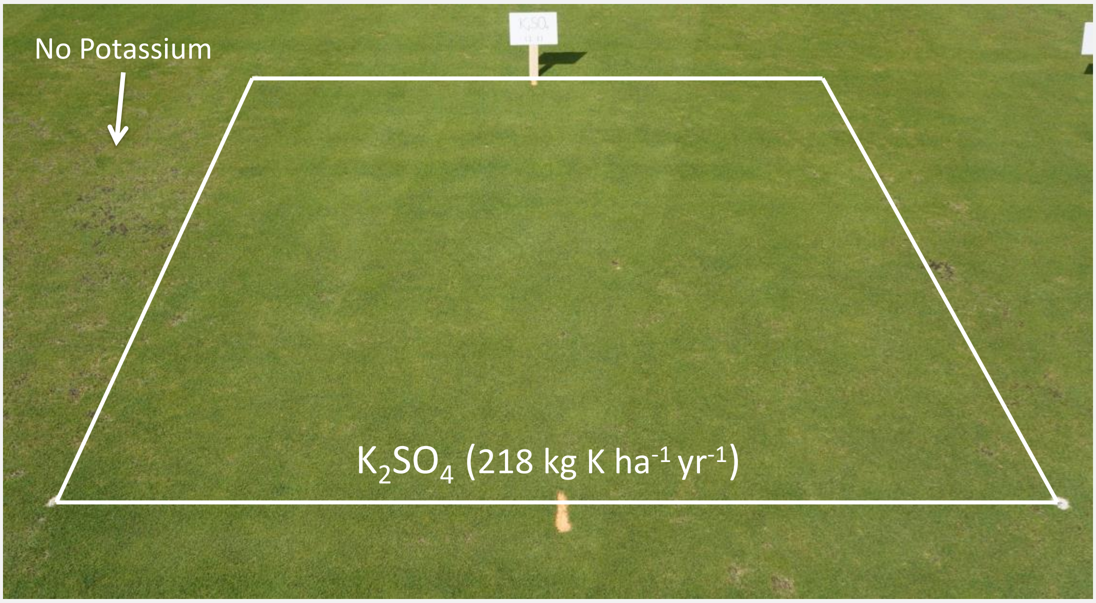
Potassium Source Effect on Anthracnose Severity



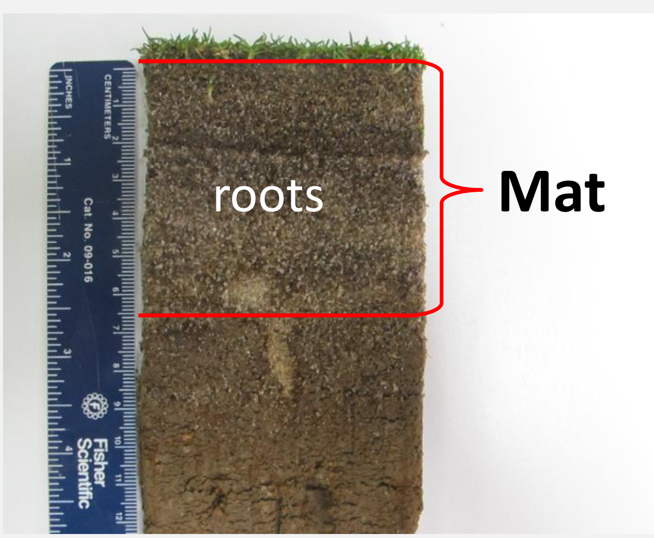
Potassium Rate Effect

K Rate (Cl & SO_4)	2012	2013	2014
kg ha^{-1} yr^{-1}	------------------------	AUDPC	------------------------
54	551	1,040	1,009
109	461	788	920
218	454	776	914
$LSD_{(0.05)}$	ns	179	ns

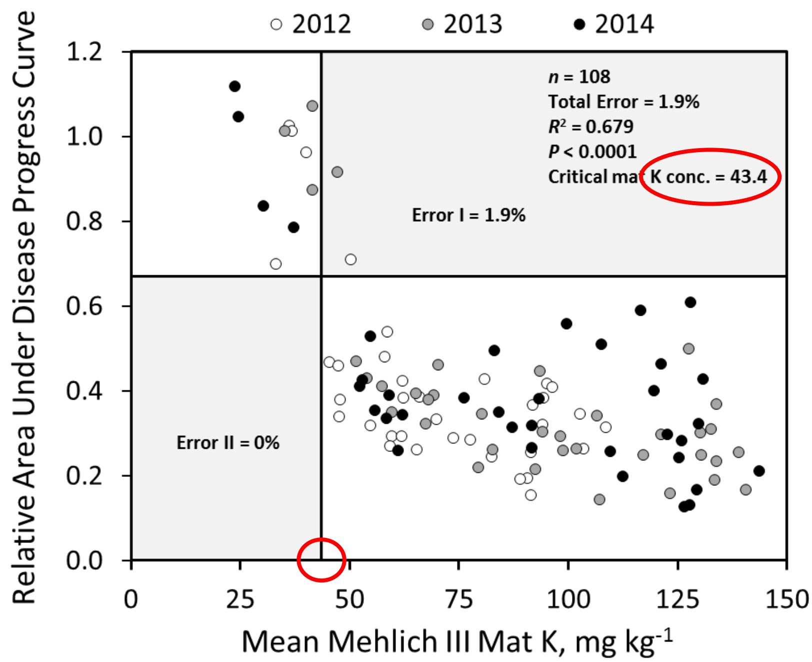
Potassium Study 10 Sept. 2012



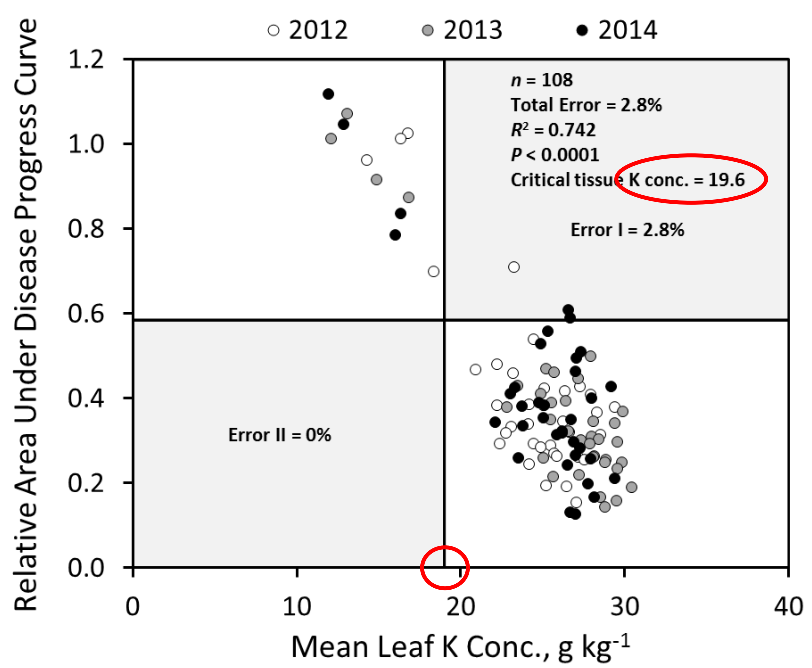
Soil and Tissue Results



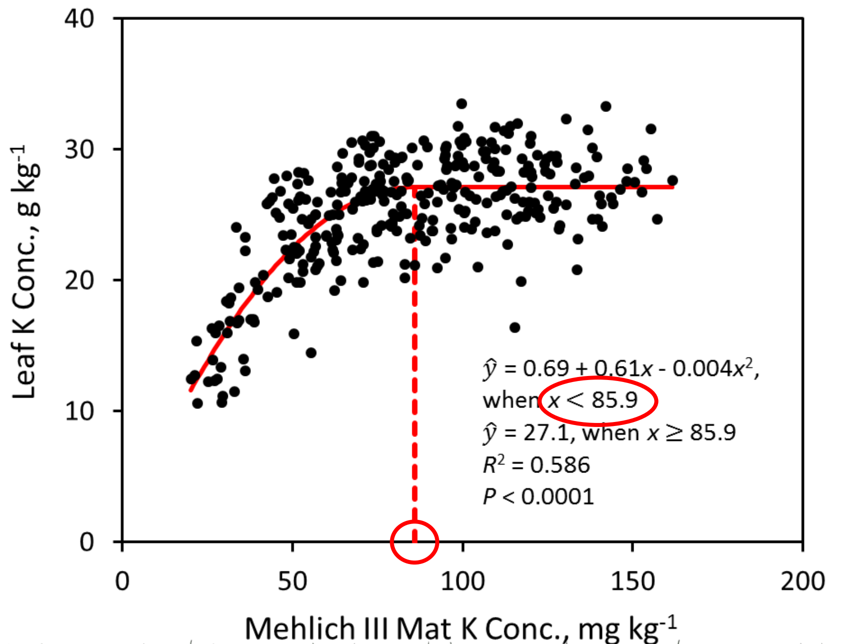
ANTHRACNOSE VS MAT K



ANTHRACNOSE VS LEAF K



Leaf K vs Mat K



Conclusion

- Low soil K increases anthracnose severity
- Critical Mehlich 3 soil test K level for annual bluegrass turf with respect to anthracnose is:

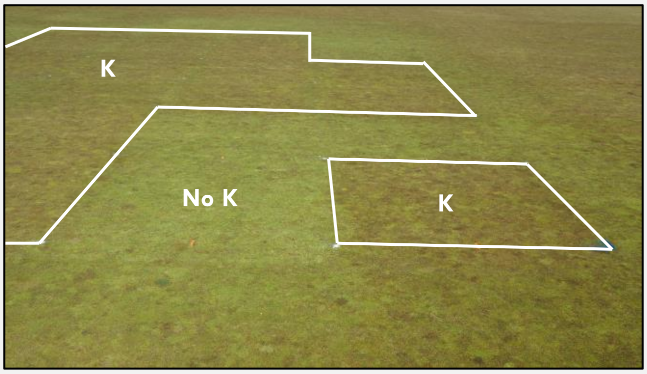
  43 mg kg^{-1}
- Critical leaf K concentration for annual bluegrass turf with respect to anthracnose is:

  20 g kg^{-1}
- Increasing soil or leaf K above these critical levels did not provide an additional reduction in disease severity

Agronomy Journal. 2018. 110:2171–2179

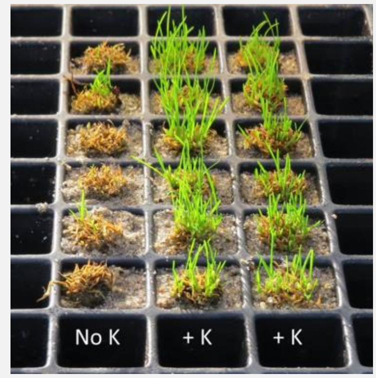
Potassium effect on winter injury

Cold Acclimation



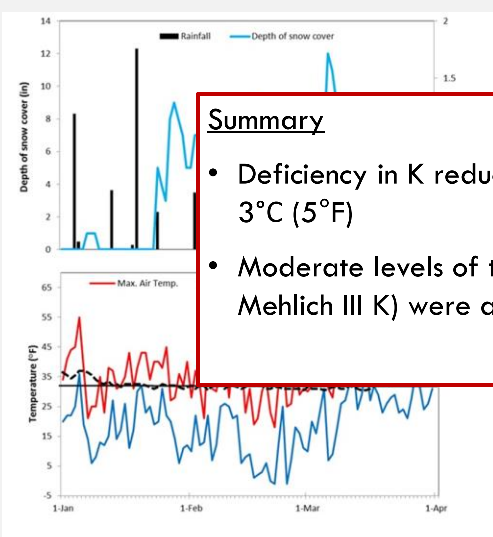
December 2014

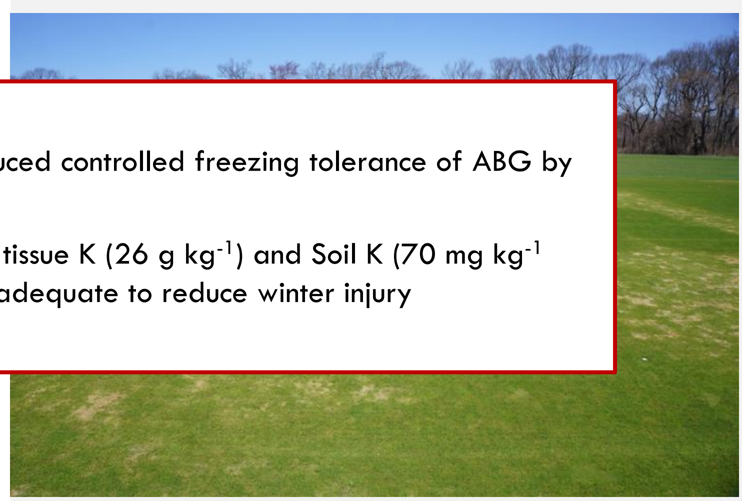
Controlled Freeze Tolerance Test



Controlled freeze stress at -15°C followed by 2 wks recovery at 24°C

Potassium effect on winter injury





<u>Summary</u>

- Deficiency in K reduced controlled freezing tolerance of ABG by 3°C (5°F)
- Moderate levels of tissue K (26 g kg^{-1}) and Soil K (70 mg kg^{-1} Mehlich III K) were adequate to reduce winter injury

5 April 2015

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Acknowledgments

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USGA

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Tri State Turf Research Foundation, Inc

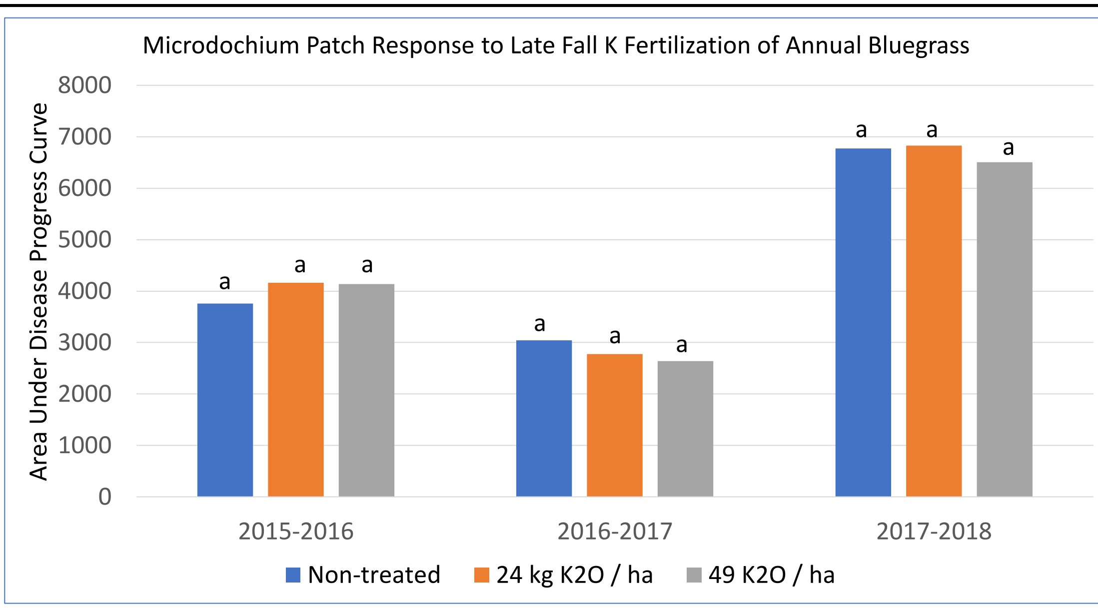
EIFG Environmental Institute for Golf

GCSAA Golf Course Superintendents Association of America

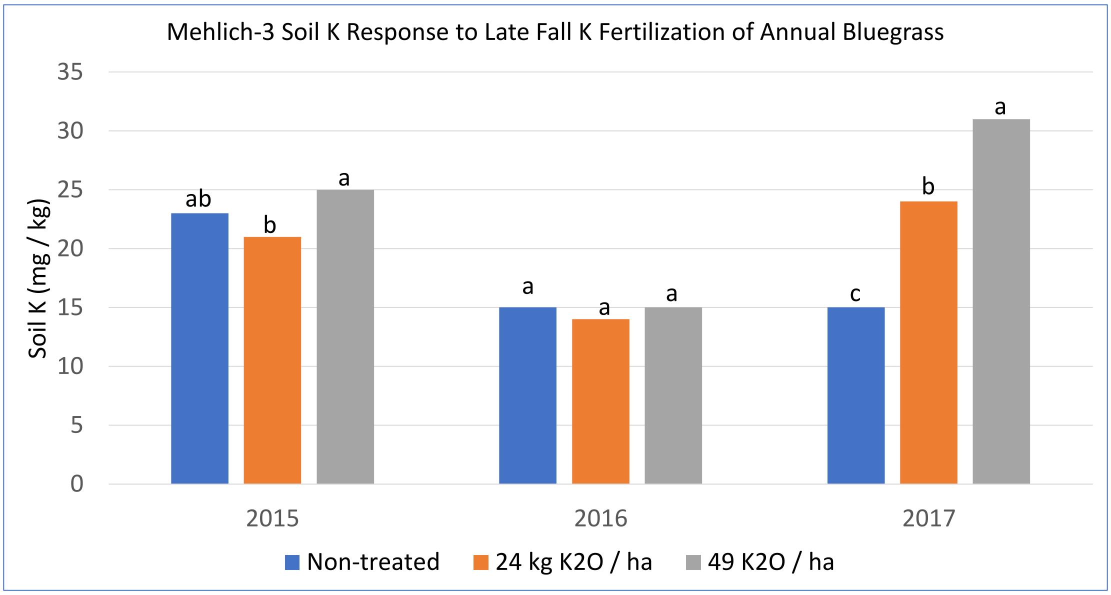
Rutgers New Jersey Agricultural Experiment Station

Center for Turfgrass Science

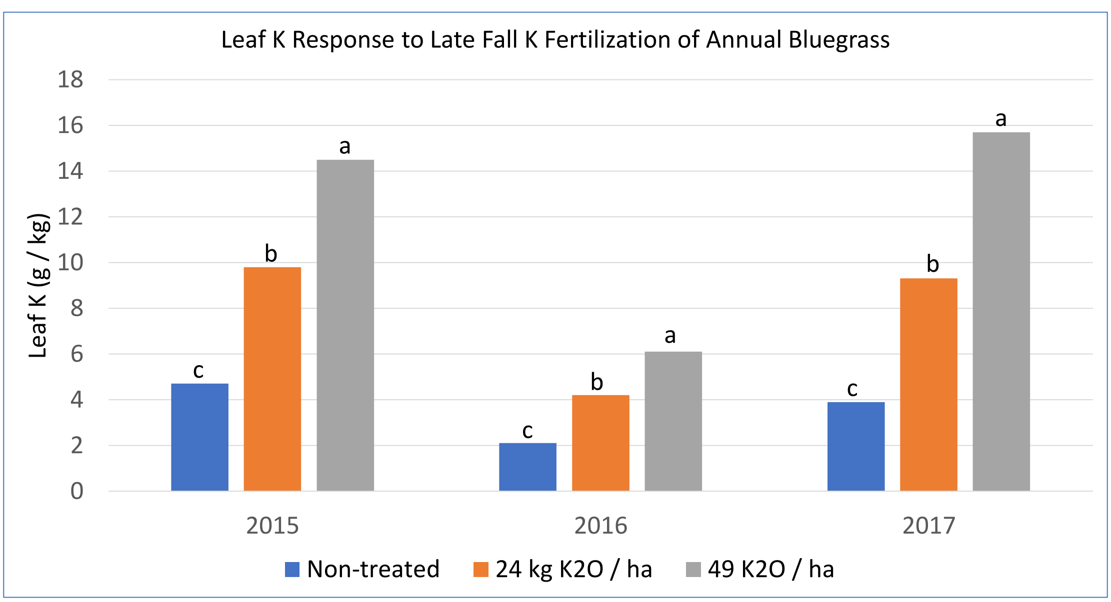
K Fertilization Effect on Pink Snow Mold (*Microdochium* Patch, Fusarium Patch)



Potassium sulfate treatments applied on 23 Nov. 2015, 24 Nov. 2016 and 24 Nov. 2017.
Plots inoculated on 11 Dec. 2015, 12 Dec. 2016 and 8 Dec. 2017.
Least significant difference at the 0.05 probability level.

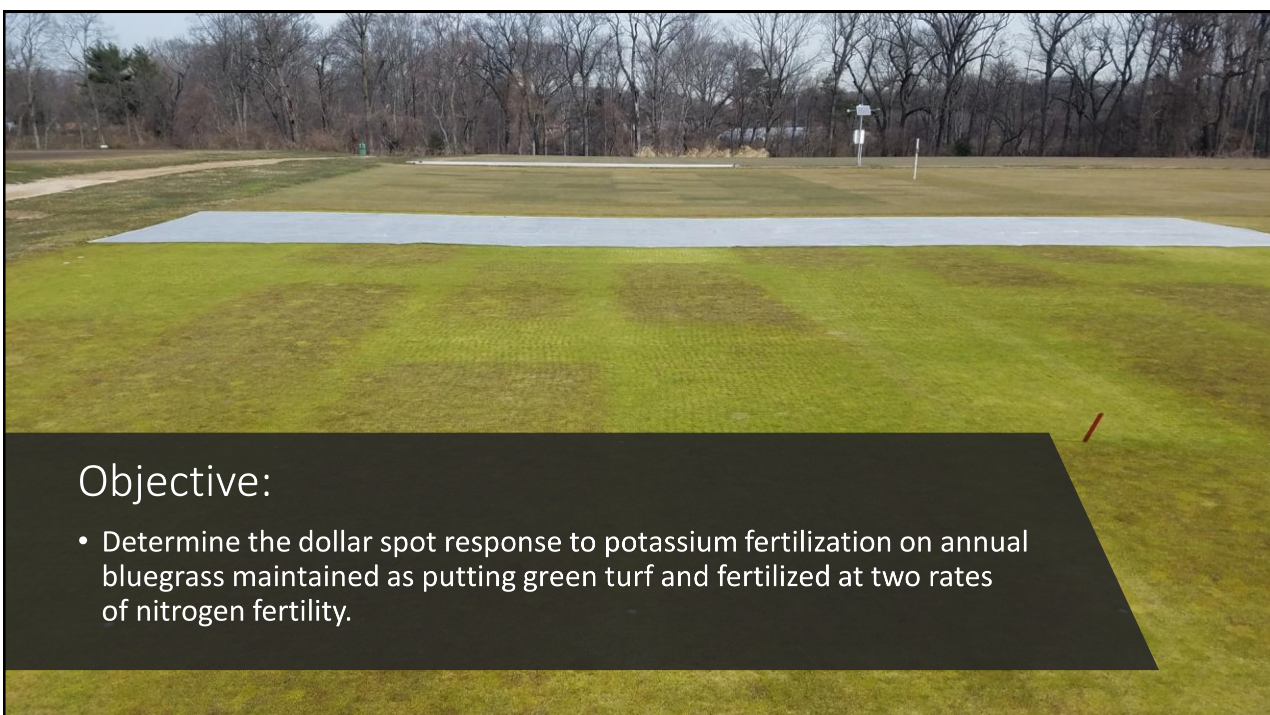


Soil sampling performed before November potassium sulfate applications.
Extractable K determined using Mehlich 3 method.
Least significant difference at the 0.05 probability level.



Potassium sulfate treatments were applied on 23 Nov 2015, 24 Nov 2016 and 24 Nov 2017.
Tissue sampling was performed 14 days after treatment.
Least significant difference at the 0.05 probability level.


Dollar Spot Response to K Fertilization
on Annual Bluegrass
Zhongqi Xu, Daniel Ward, Bruce B. Clarke, and James A. Murphy


Objective:
• Determine the dollar spot response to potassium fertilization on annual bluegrass maintained as putting green turf and fertilized at two rates of nitrogen fertility.

Factors:

Potassium Rate (kg of K per ha) -- potassium sulfate solution sprayed every 14-days

0
3.4
6.9
13.8

Nitrogen Rate (urea solution spray at 4.9 kg N per ha)

every 28-days
every 7-days

Treatments applied for 24 weeks initiated on 18 April 2019
and 20 weeks beginning on 13 May 2020.

Inoculation

- Dollar spot pathogen grown on oats, air-dried, ground to 1 mm
- 3-g mixed with 50-g of sand and applied to a 1.2- × 1.8-m area of each plot.

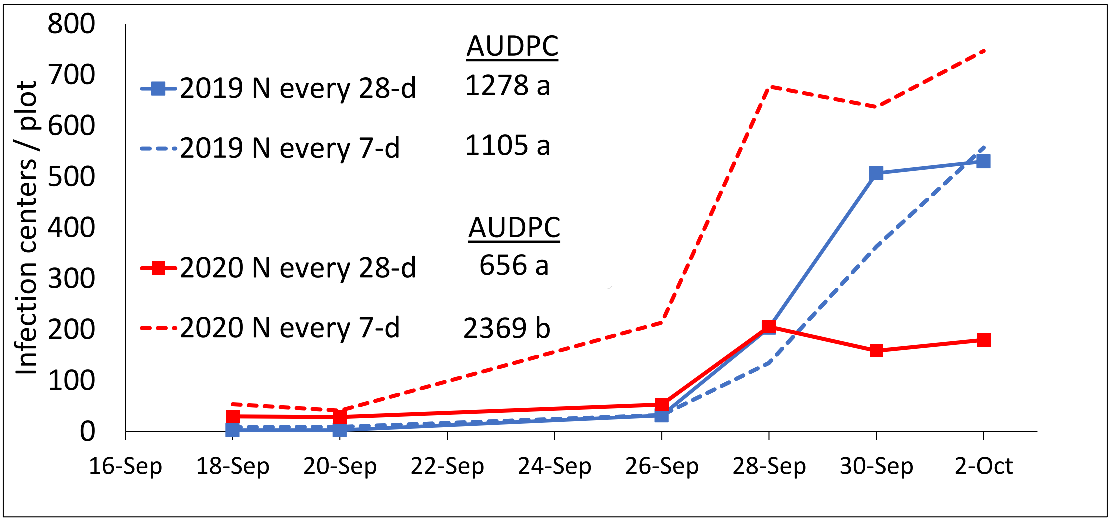
Data

- Dollar spot infection centers counted every 2- to 6-d
- Disease severity summarized as the area under disease progress curve (AUDPC)
- Turf clippings collected on 2 Oct. 2019 and 4 Oct. 2020.
- Soil samples collected on 2 Oct. 2019 and 12 Oct 2020 to determine soil K (Mehlich 3).

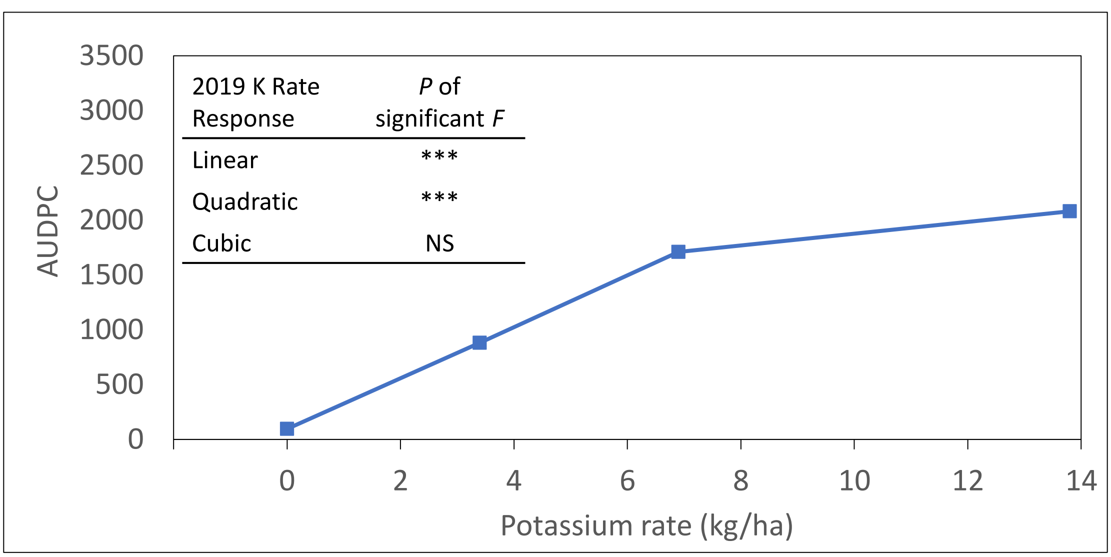
Dollar spot (AUDPC) response to K fertilization on annual bluegrass fertilized at two N fertilization rates and mowed at 2.8-mm during 2019 and 2020 in North Brunswick, NJ.

	AUDPC	
Source of Variation	2019	2020
	---------------- *P* of significant *F* -------------	
Nitrogen Rate	NS	***
Potassium Rate	***	***
Nitrogen Rate × Potassium Rate	NS	**

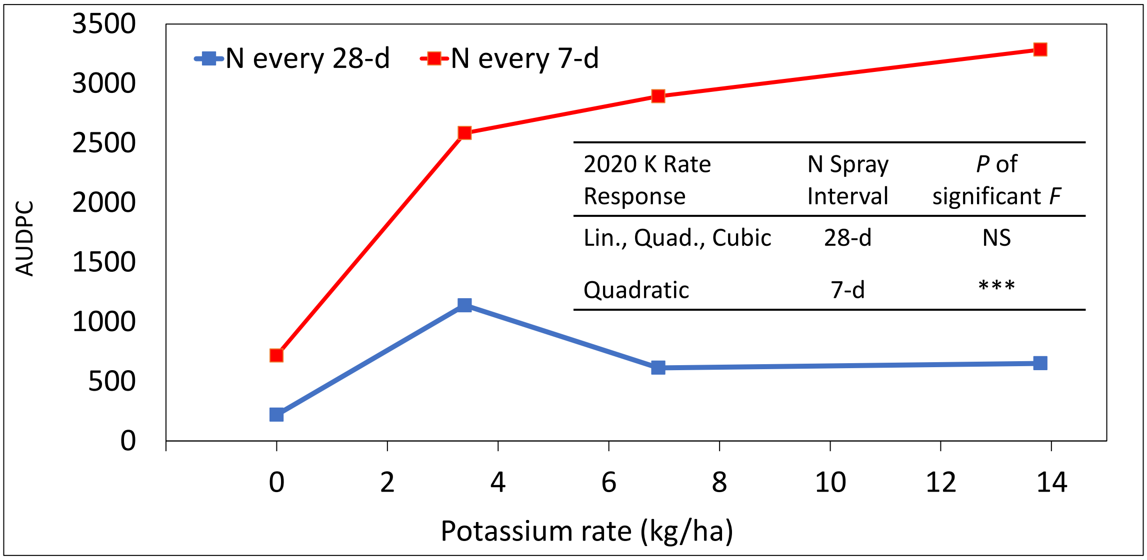
Dollar spot infection centers and AUDPC on annual bluegrass as affected by N applied either every 28- or 7-d (4.9 kg/ha) during 2019 and 2020 in North Brunswick, NJ.



AUPDC response to K fertilization rate (main effect) on annual bluegrass maintained at 2.8-mm during 2019 in North Brunswick, NJ.



AUDPC response to K fertilization as affected by N fertilization on annual bluegrass maintained at 2.8-mm during 2020 in North Brunswick, NJ.



2020 K Rate Response	N Spray Interval	*P* of significant *F*
Lin., Quad., Cubic	28-d	NS
Quadratic	7-d	***

Trace Elements, Silicon, Biostimulants

- Natural hormones or synthetic analogs
- Humic substances
- Sea kelp or seaweed extracts
- Amino acids and sugars
- Microbial products

Trace Elements

Iron – ferrous sulfate (David McCall at Virginia Tech)

- ferrous sulfate applied at 0.5 to 1 lb./1,000 sq. ft. every 14 days reduced dollar spot pressure without traditional fungicides on creeping bentgrass (Agrostis stolonifera) putting green and fairway turf
- ferrous sulfate can extend the longevity of dollar spot control with fungicide

Trace Elements

Manganese (Mn) and root diseases

Take-all Patch

- 2.25 kg/ha (2 lb/acre) of Mn effective at suppressing the severity of take-all patch on creeping bentgrass
- applied either in April or in October

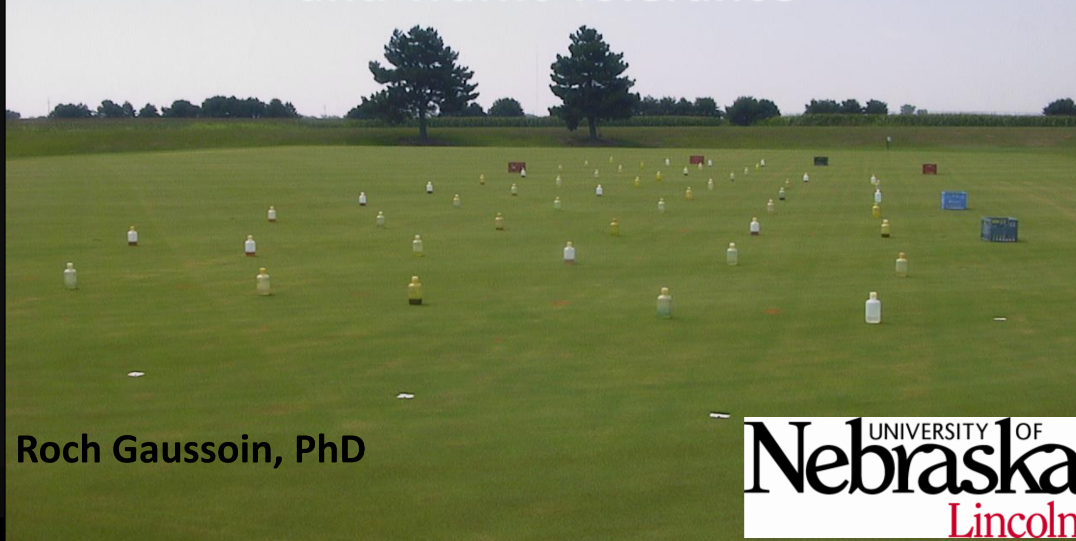
Summer Patch

- 2.25 kg/ha in the spring can reduce summer patch (disease affects *Poa* species and fine-leaved fescues)

Silicon

- Research looking at silicon to induce 'systemic acquired resistance' in plants, sometimes referred to as SAR.
- Silicon has reduced gray leaf spot on St. Augustinegrass (L. Datnoff, FL)

Silica for Increased Ball Roll and Traffic Tolerance



Roch Gaussoin, PhD

UNIVERSITY OF Nebraska Lincoln

Treatments

- 3 commercial products
- 3 technical grade materials
- 2-3 rates of each material
- Silica containing material
  - 0.2 to 85 g Si per 1000 ft^2
- Applications made every 14 days
- Stimpmeter (Ball Roll Distance) 1 and 3 DAT
- Traffic tolerance with traffic simulator

Results

- No differences among treatments for increased traffic tolerance or recovery unless K was the carrier
- No differences between
  - Ball Roll Distance
  - Color
  - Quality

Roch Gaussoin, PhD

University of Nebraska Lincoln

Wear Tolerance

Trenholm et al., 2001 -- University of Georgia

- Potassium silicate sprayed at 1.1 and 2.2 kg Si / ha or drenched into soil at 22.4 kg Si / ha
- Reduced wear injury about 20% on two greens-quality ecotypes of Seashore paspalum
- However, potassium alone or together with Si produced the same effect.
- Thus, potassium likely the element that enhanced wear tolerance

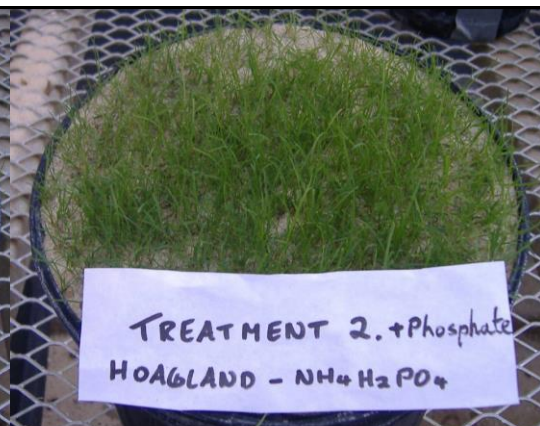
Elicitors

… molecules that stimulate plant defense mechanisms and promote plant health or wellness.

Less toxic than conventional pesticides, biodegradable, and may have an anti-senescent effect.

Phosphites

- Various phosphite salts increase resistance to numerous soil borne diseases
- Several phosphite salts are now registered as fungicides



Work at Michigan State Univ.
P deficiency with phosphite only (trmt 3)

Phosphite not a plant nutrient

Phosphites (PO_3) - Take Home

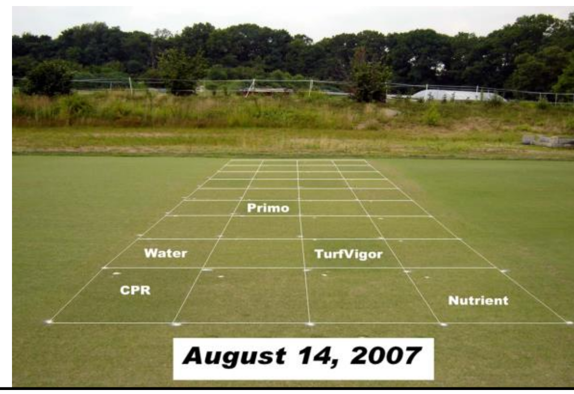
- May enhance turf quality
- Poor curative activity
- Few field disease resistance problems
- Phosphoric (PO_4) acid better choice for fertilizer
- Use phosphite (PO_4) products during heat/summer stress switch to phosphoric acid (PO_4) products during good growing weather
- Combination products (PO_3 + PO_4) available

Seaweed Extracts

- Contain organic and mineral compounds
- Rich in phytohormones, complex organic compounds, vitamins, simple and complex sugars, enzymes, proteins, and amino acids.
- Seaweed extracts have high concentration of **cytokinins, a natural hormone regulating cell division and senescence**.

Effects of Seaweed-based Biostimulants

- Stimulate shoot and root growth
- Promote summer stress tolerance, involved in leaf senescence such as heat and drought stress on creeping bentgrass.



Seaweed extract (SWE) contain cytokinins (75-100 ppm) improved bentgrass heat tolerance

Check Aca SWE OO SWE CK-check ashed-SWE

Zhang & Ervin. 2008. Crop Sci. 48:364; cytokinin (CK) equalized at estimated 10 uM; 35 C/25 C

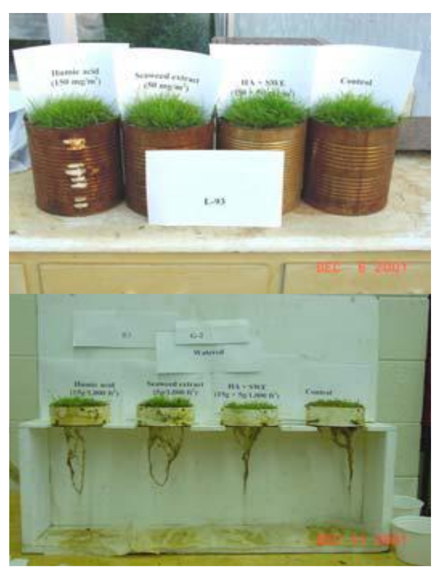
Effects of Humic Substances

Positive effects on…

- Shoot and root growth
- Seed germination
- Seedling establishment
- Soil structure, cation exchange capacity (CEC), and microbial activity

SWE + HA improve creeping bentgrass drought resistance

Had no effects under well-watered, optimal temperature conditions.



Source: Zhang and Ervin, 2004. Crop Science, 44:1737-45

Are Biostimulants Needed?

- Under normal growing conditions, plants do not respond to exogenous supply of hormones or other metabolites (amino acids) because they are self-sufficient.
- Under stress conditions, biostimulants may have potential uses
  - promote plant growth
  - responses may vary depending on biostimulant formulation

Proper Use of Biostimulants

- Begin applications before plant is stressed (pre-conditioning)
- Multiple applications likely needed
- Biostimulant is a supplemental practice - never a replacement for proven turfgrass management practices


Thank You
Best Wishes for 2021


QUESTIONS
Funding
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GOLF COURSE SUPERINTENDENTS ASSOCIATION NEW JERSEY 1926
USGA
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