

How Does Fertilization and Growth Rate Impact Turf Disease



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What is Disease?

- Any dysfunction or disruption of normal plant growth or development



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Biotic vs Abiotic Disease

- Biotic Disease
 - Caused by a living pest
 - Fungi and Bacteria
- Anything not caused by another organism
 - Micronutrient deficiency
 - Environmental stress
 - Traffic/wear

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Determining if it's abiotic vs biotic

- Look for patterns, colors, distribution, fungi
- Symptom:
 - Visually observable without a microscope
 - Yellowing/chlorosis
 - Rings
 - Thinning
- Signs:
 - Actually seeing the pathogen on the plant
 - Fungi hyphae and fruiting bodies
 - Bacterial Streaming

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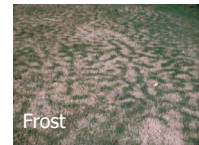
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Abiotic Disorders

- Site factors
 - Shade?
- Unfavorable weather
 - Too – dry, wet, hot, cold
- Poor soil conditions
 - compaction
 - thatch development
 - localized dry patches
- Chemical toxicities
 - fertilizers, herbicides



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Tested Different Forms of Iron at Heritage Hills



Cannot be immediately watered in otherwise it doesn't work

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TMT	Label Rates	Chelate	% FE	% N	Rate	oz Fe/M	oz N/M
1	Sprint 138	EDDHA	6%	4%	2.0	0.12	0.08
2	Iron Chelate 20	Citrate/EDTA	20%	0%	2.0	0.40	0.00
3	Sprint 330	DTPA	10%	0%	4.0	0.40	0.00
4	Extreme Green 20	None	20%	0%	2.0	0.40	0.00
5	Extreme Green 20	None	20%	0%	4.0	0.80	0.00
6	Extreme Green 20	None	20%	0%	8.0	1.60	0.00
7	N Alone	None	0%	46%	0.17	0.00	0.08
8	Control	None	0%	0%	0.0	0.00	0.00

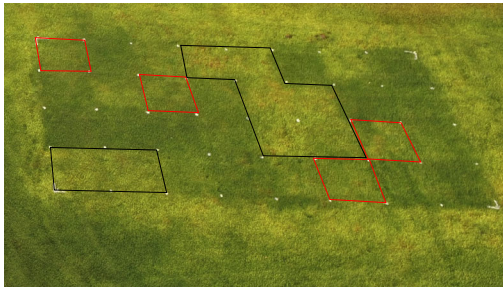
All treatments had equal N (from urea) except for TMT 8

4	3	2	8	7	5	1	6
5	1	4	2	7	8	6	3
6	3	5	1	8	7	4	2
7	8	1	5	2	4	3	6

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Testing Different Rates and Forms of Foliar Iron Fertilizer Products

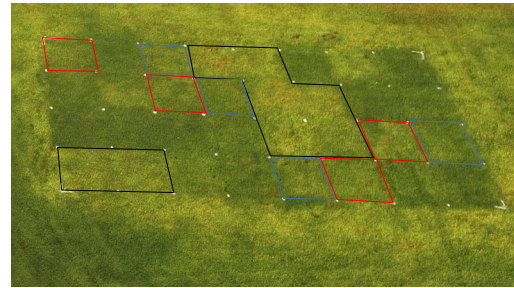
Black Outline is No Fertilizer Red is Iron Sulfate (2 oz/1000 ft²)



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Testing Different Rates and Forms of Foliar Iron Fertilizer Products

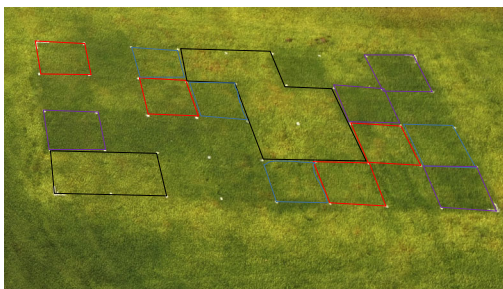
Black Outline is No Fertilizer Red is Iron Sulfate (2 oz/1000 ft²)
Blue is EDTA Iron (2 oz/1000 ft²)



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Testing Different Rates and Forms of Foliar Iron Fertilizer Products

Black Outline is No Fertilizer Red is Iron Sulfate (2 oz/1000 ft²)
Purple is Iron Sulfate (8 oz/1000 ft²)



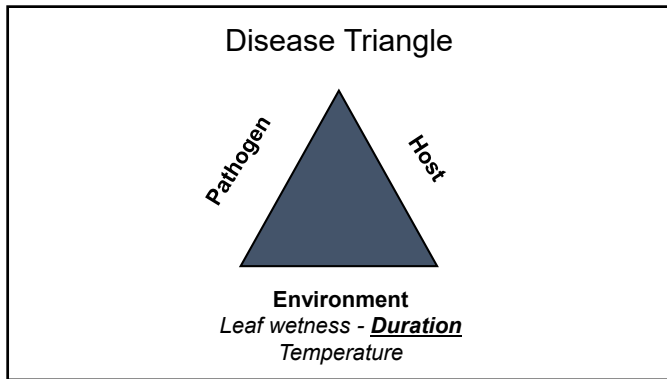
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Abiotic or biotic: Look for patterns

- What is the pattern in space?
- Is it spreading over time?



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Brown Patch

- **Turfgrass species affected:**
 - Tall fescue
 - Perennial ryegrass
 - Creeping bentgrass

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Brown Patch Timing

- Time of year most prevalent:
 - July, August
 - May occur from May-Sept
 - night ~~low~~ temperatures > 65 F
 - leaf wetness periods > 10 hours

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Cultural practices that suppress brown patch:

- Irrigate in the a.m.
- Increase air movement
- Use recommended seeding rates
- Excessive thatch
- Poor soil drainage
- **Avoid excessive N**, especially when disease is active

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Nitrogen fertilization commonly linked to turf disease, but it's likely more complex



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Brown Patch frequently linked to N fertilizer

- Brown patch (*Rhizoctonia solani*) is a troublesome pest in tall fescue (*Schedonorus arundinaceus*) turfgrass
- Standard Extension recommendation is to withhold nitrogen fertilizer during summer
- Under-fertilized lawns have severe brown patch in NE and NC during summer



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Research results are confounding

Research results are confounding

- High N increased brown patch
 - Watkins, 1992; Burpee, 1995; Cutulle et al., 2014
- N fertilizer did not increase brown patch
 - Settle et al., 2001; Watkins et al., 2001; Butler et al., 2019

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Research hypothesis & objective

Our Working Hypothesis

- Tall fescue lawns that are growing very slowly or quickly will have more brown patch incidence

Objective

- Use GA containing or GA inhibiting PGRs to decouple growth rate and tissue N content from nitrogen fertilization to determine they influence brown patch

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Tall fescue research plots in NC and NE



North Carolina

- Lake Wheeler Turf Research Facility in Raleigh, NE
- Two year old stand of 'Rain Dance', 'Coronado' & 'Cumberland' tall fescue



Nebraska

- East Campus Turf Plot in Lincoln, NE
- Four year old stand of 'Spyder' tall fescue

- Mowed twice weekly; 2.5 inches
- Irrigated three days per week (0.25 in)

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Treatments to decouple N fertilization from growth rate

- 3 x 3 factorial RCBD; four replicates at each site
 - 3 urea nitrogen rates (0, 0.25, 0.5 lbs N per 1000 ft²)
 - 3 PGR treatments
 - No PGR
 - **Primo Maxx (0.50 fl oz per 1000 ft²)**
 - **RyzUp (0.15 ounces per acre)**
- Treatments applied every two weeks with a CO₂ powered sprayer at 2.0 gallons per 1000 ft² (TeeJet AI 8006)

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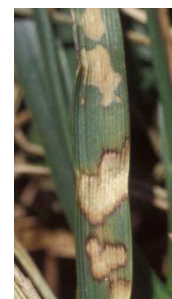
Data Collection

Weekly

- Clipping yield collection
- Visual estimate of brown patch incidence
- Turfgrass quality rating (NTEP guidelines)

August in Nebraska

- Clipping tissue nutrient content
 - 15 and 19 August 2019



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Treatments resulted in broad range of clipping production



Easy to visualize the differences in growth rate and turfgrass color & quality

N

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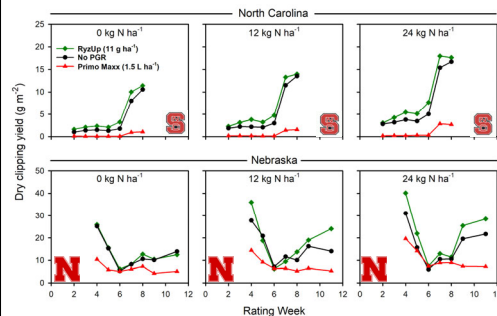
Treatments resulted in broad range of clipping production



N

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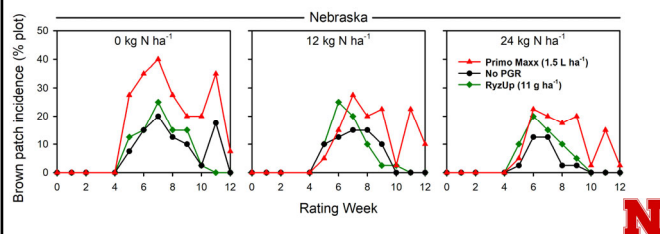
Treatments resulted in broad range of clipping production



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Significant brown patch development during week 4 to week 7 in Nebraska

The zero nitrogen fertilizer treatments with Primo Maxx had the most brown patch



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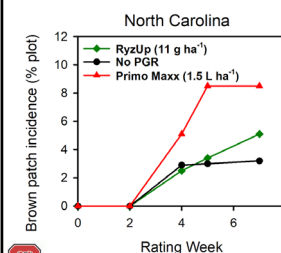
Significant brown patch development during week 4 to week 7 in Nebraska



N

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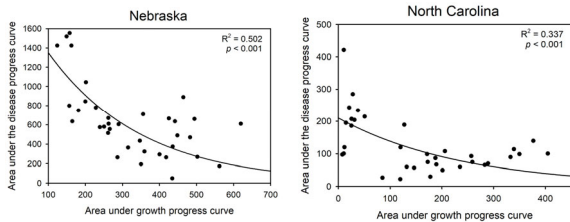
Less brown patch in North Carolina, but similar trends to Nebraska results



- Less conducive environment for brown patch in 2019 than average
- Brown patch developed during slow growth periods (Wk 2-5)
- Infection slowed as growth rate increased during week 6
- Increased brown patch with Primo Maxx

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Regression analysis reveals the relationship between growth rate and disease over a season



N Tissue N content was not related to AUDPC or Brown Patch the week of tissue collection **S**

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Future research and analysis

- Compare brown patch outbreaks with known models
- Logistic analysis of outbreaks to assess risk based on weather and growth rate of the turf
- Study other "high" & "low" N diseases with this approach

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Fungicides for Brown Patch

Conditions Favorable During the Summer

- QoI or strobiluron products (very good)
 - Azoxystrobin – 14-28 day control
 - Trifloxystrobin, others
- Flutolanil (very good) 14-21 day control
- DMI products (good) 7-14 days
- Iprodione (very good) 14 -28 day control
- Chlorothalonil (very good) 7-14 day control
- Thiophanate methyl (good) 10-14 day control

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Other diseases frequently linked to fertilization

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Leaf spot diseases

- Responsible for Kentucky bluegrass lawn boom
 - Merion KBG (1932,'50)
- Formally Helminthosporium Leaf, Crown, and Root Diseases
- Today Bigger Problem on Home Lawns than Golf Course



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Name	Factors
<i>B. sorokiniana</i>	Warm-Wet Mid-Summer, Increased Severity 68 to 95°F, High N Fertility
<i>D. poae</i>	Pathogen Active at Most all Temperatures
<i>D. dictyoides</i>	Disease Development in Cool Wet Weather
<i>D. siccans</i>	Film of Moisture Necessary for Infection
<i>D. erythrospila</i>	High N Fertility
	Warm, Wet Weather
	High N Fertility

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Fungicidal Options

- Common Fungicides are Effective at Control
 - i.e. chlorothalonil, iprodione, pyraclostrobin, vinclozolin
 - Homeowners Losing Many Effective Products
- Preventative Applications Most Effective for Problem Area
 - When weather conditions are favorable for disease development

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Select grass cultivars that are resistant



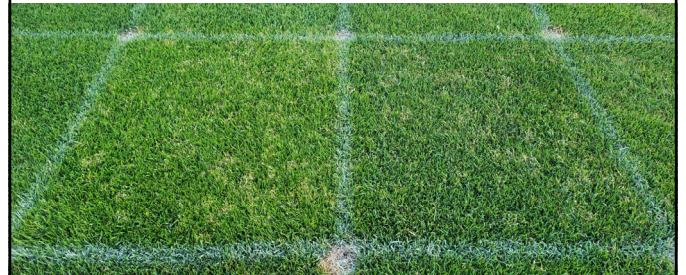
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Dollar spot disease also has cultivar differences in the latest NTEP Trial



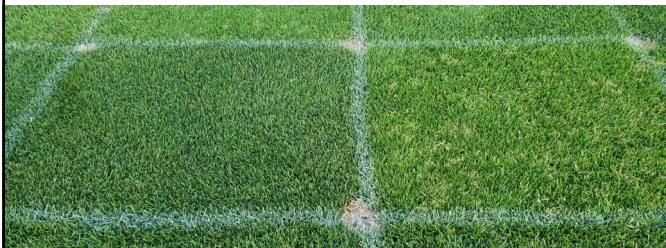
51

Dollar spot disease also has cultivar differences in the latest NTEP Trial



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Dollar spot disease also has cultivar differences in the latest NTEP Trial



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The Smith-Kerns model can help predict outbreaks

- How was it created?



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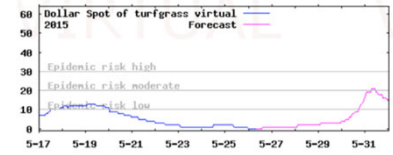
Smith-Kerns Dollar Spot Model

1. Generate 5-day moving averages of average daily air temperature (in Celsius!) and average relative humidity
2. Use that data to generate the logit (μ) and then the probability (SK):
 - $\mu = -11.4041 + (0.0894 \times \text{Avg RH}) + (0.1932 \times \text{Avg Temp})$
 - $SK = e^{(\mu)} / (1 + e^{(\mu)}) \times 100$

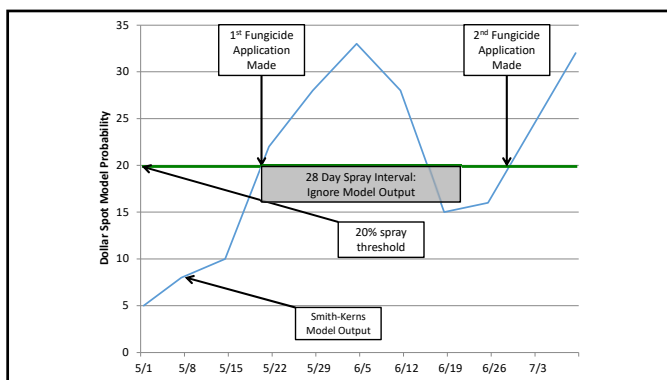
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Smith-Kerns Dollar Spot Model

- Computes a probability that dollar spot will appear on that day
- Set a spray threshold and a reapplication interval



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Fairy Ring Disease



- Hybrid-type disease
- Decaying Soil Organic Matter
- N Release

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Hard to Control 'Pathogen'



- Different type of organism than most plant pathogenic fungi
- Wetting agents, **nitrogen, & iron**
- Stroby, DMI, Prostar

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Rusts (*Puccinia* spp.)

- Complex lifecycle
 - Alternate hosts required
 - Spores blow up from south
- **Low N increases problem**
- Kentucky bluegrass highly affected
- Heritage, Banner Maxx



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Root Diseases: Summer Patch

- Heat and high soil moisture
- **High N**
- Several fungicide classes work – need to be watered-in



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How much growth do managers need?

Golf Putting Greens

- 1.2-1.5 Qts/1000 ft²



Lawns

- Roughly 1.5 inches of growth per week during the season
- Weekly mowing when mowing to the 1/3rd rule at 3"

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Microdochium nivale Pink Snow Mold (PSM)



Typhula incarnata Grey Snow Mold (GSM)



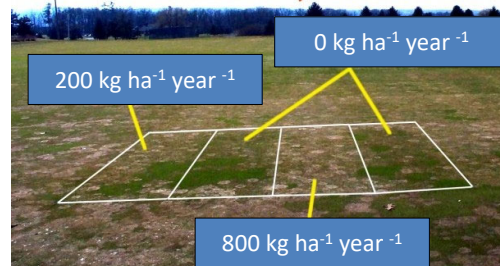
Potassium affects snow mold susceptibility?



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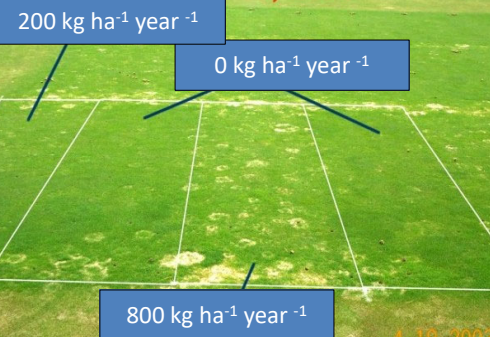
Dr. Micah Woods

March 24, 2003



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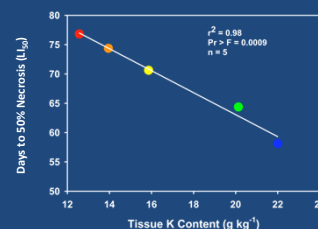
April 19, 2003



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Grey Snow Mold Regression of Day₅₀ by Tissue K Content

Mean days to 50% necrosis versus tissue K content
at time of inoculation with *T. incarnata*



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Wrap Up

- Nutrients are frequently related to nitrogen status
 - May be more related to growth rate
- New genetics and disease models offer options to minimize inputs
- Other nutrients usually have minimal impact on disease
 - Potassium can increase snow mold

Thank You



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