RUTGERS
New Jersey Agricultural Experiment Station

Developing Best Management Practices for the Control of Anthracnose on Annual Bluegrass

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http://www.turf.rutgers.edu/

Over the Past Decade - Increase in the Prevalence of Anthracnose Disease on Putting Green Turf

- *Anthracnose* is now one of the most destructive diseases on golf course greens in the North America

- Within the last 10 yrs we have seen and increase in anthracnose basal rot; it has been suggested that changes in *Management Practices* have contributed to this phenomenon by increasing abiotic stress and thus predisposing turf to anthracnose

- Prior to recent field research, anthracnose control recommendations were based on many assumptions that we now know were wrong (e.g., anthracnose is wound induced disease)

Anthracnose Disease of Turfgrass

Causal Agent *Colletotrichum cereale*

(Formerly known as *Colletotrichum graminicola)*

Symptoms Poa - yellow, irregular patches (1 to 2 in)

Bent - red to bronze patches (size varies)

Appearance Usually on greens

Spring through late-summer (variable)

Foliar blighting and thinning of *Poa annua* caused by *Colletotrichum cereale (formerly Colletotrichum graminicola)*

Acervuli structures and setae on *Poa annua* leaf from *C. cereale (*formerly *C. graminicola*, the causal agent of anthracnose disease

(photo from Univ. of Guelph)

Anthracnose Symptomology

Chlorotic Leaves

Acervuli on Infected *Poa annua* Tillers

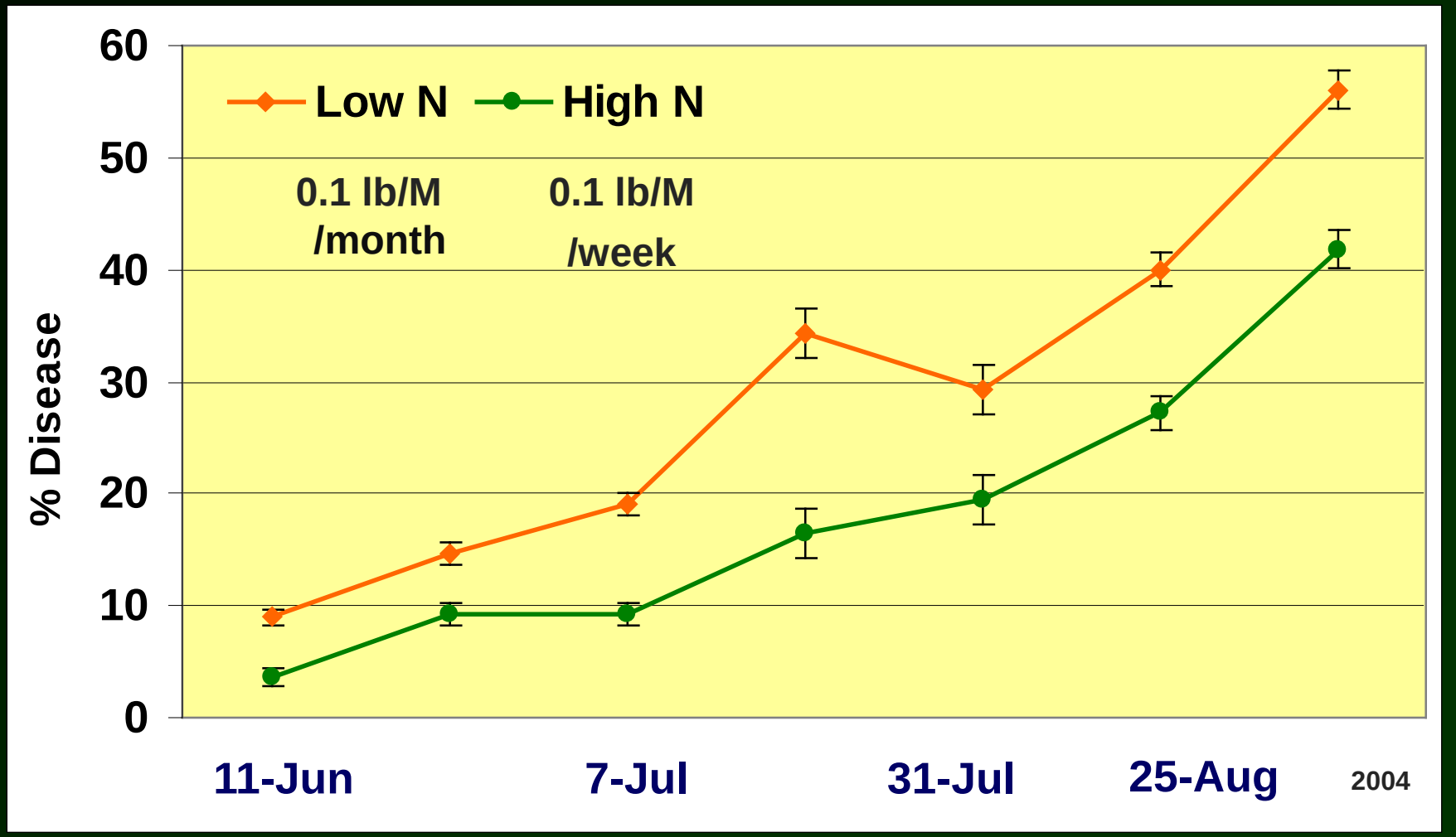
Key Factors

- Plant Species - annual bluegrass
- Fertilization
- Mowing Practices
- Rolling
- Topdressing
- Soil Water / Irrigation
- Plant Growth Regulators
- Fungicide Selection and Resistance Management Strategies

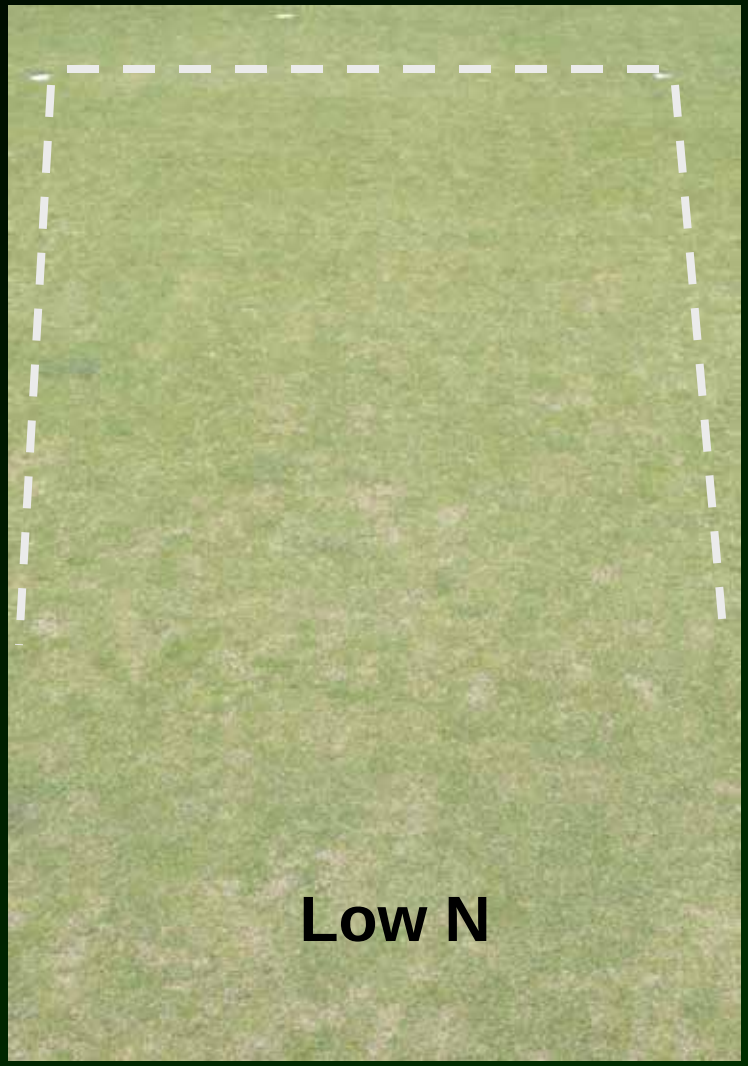
Nitrogen Fertilization

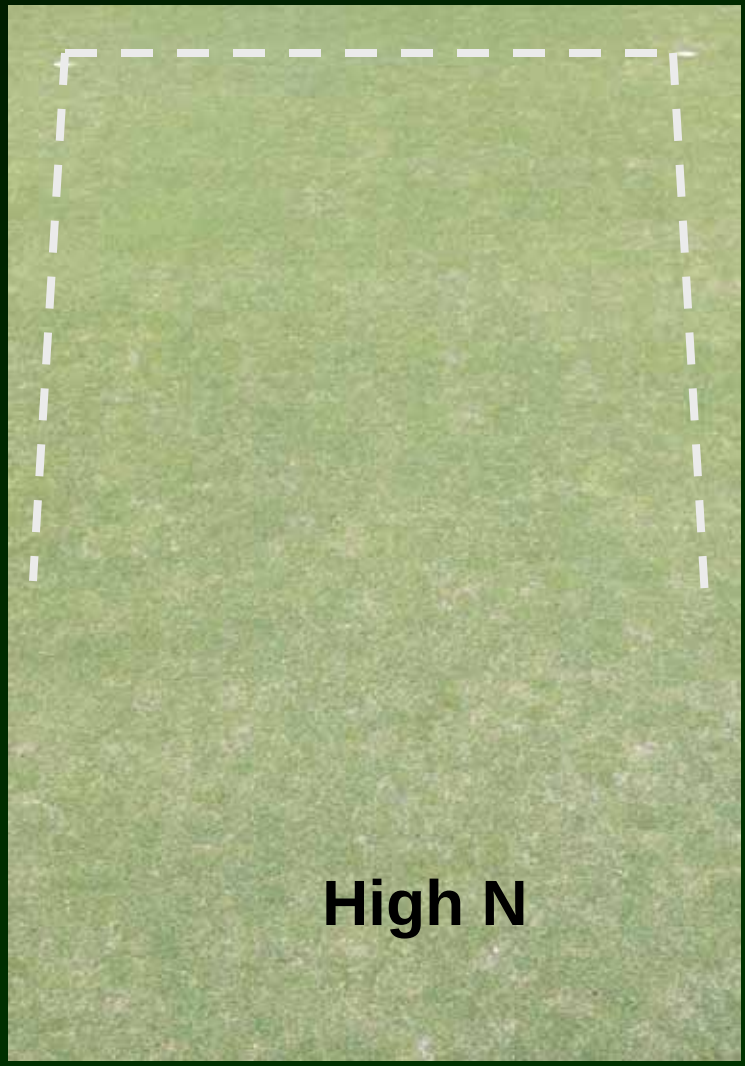
- Major nutrient controlling plant vigor
- Influences many turfgrass diseases:
  - Dollar spot (Markland et al., 1969)
  - Red thread (Cahill et al., 1983)
  - Brown Patch (Burpee, 1995; Fidanza et al., 1996)

Effect of Low Rate Soluble N on Anthracnose on an ABG green – Rutgers



N Effect on Anthracnose of *Poa annua*





2004

To Answer these Questions, We Embarked on a USGA Funded N Study (2008-10) to:

1. Identify the optimum frequency for low rate soluble-N fertilization.
2. Evaluate effect of late-fall or early-spring granular-N fertilization rate on anthracnose.
3. Determine whether late- or early-season granular-N fertilization alters (interacts with) the effect of frequent low rate soluble-N fertilization during the summer.

Objective 1

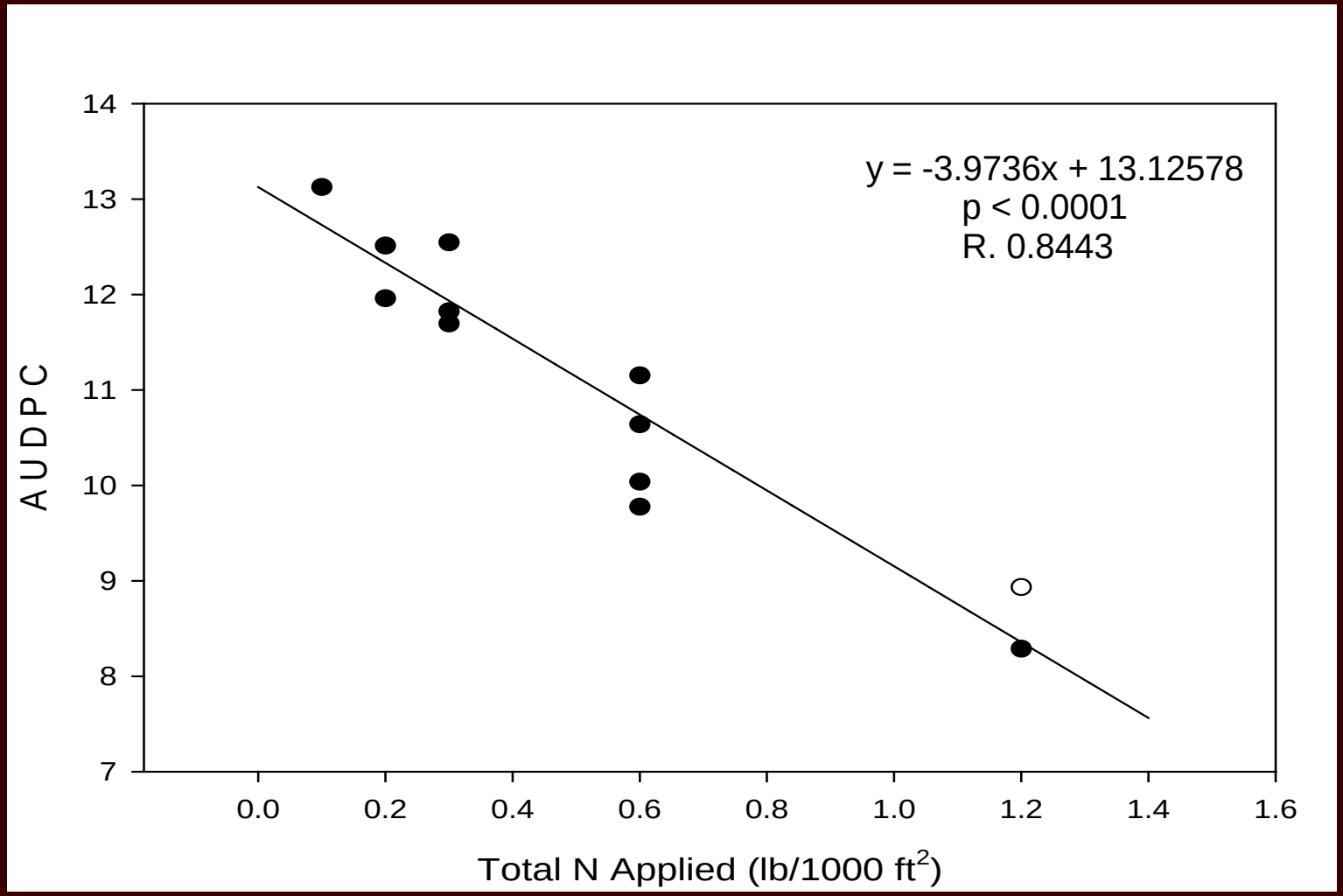
Rate	Frequency	Initiation Date	Seasonal N
lb 1,000-ft^{-2}	weeks		lb 1,000-ft^{-2}
0.1	1	15-May	1.2
0.1	2	15-May	0.6
0.1	4	15-May	0.4
0.1	8	15-May	0.2
0.2	2	15-May	1.2
0.2	4	15-May	0.6

Objective 1

Rate	Frequency	Initiation Date	Seasonal N
lb 1,000-ft^{-2}	weeks		lb 1,000-ft^{-2}
0.1	1	15-May	1.2
0.1	2	15-May	0.6
0.1	4	15-May	0.4
0.1	8	15-May	0.2
0.2	2	15-May	1.2
0.2	4	15-May	0.6
0.1	1	18-June	0.6
0.1	2	18-June	0.3
0.1	4	18-June	0.2
0.1	8	18-June	0.1
0.2	2	18-June	0.6
0.2	4	18-June	0.3

Total N = 0.1, 0.2, 0.3, 0.4, 0.6, and 1.2 lb 1,000-ft^{-2}

Anthracnose severity response to total N applied to annual bluegrass in 2008



Treatments initiated on 15 May and 18 June 2009

Summary: Low Rate Soluble-N Results

- Increased nitrogen resulted in decreased anthracnose
  - Treatments that applied a larger rate (0.1 lb / 1,000 sq ft every week or 0.2 lb / 1,000 sq ft every 2 weeks) resulted in the least anthracnose
  - Applying treatments in May (before symptoms appear) allows for a buildup of N before the onset of disease resulting in decreased anthracnose

Objectives 2 & 3 – research will continue in 2010

Preliminary Results

- Spring granular fertilization reduced disease, autumn granular fertilization did not
- Greater N rate in spring granular fertilization reduced disease severity more than lower rates
- Summer soluble N fertilization very effective at reducing disease, POSSIBLY more effective than granular N (still important)

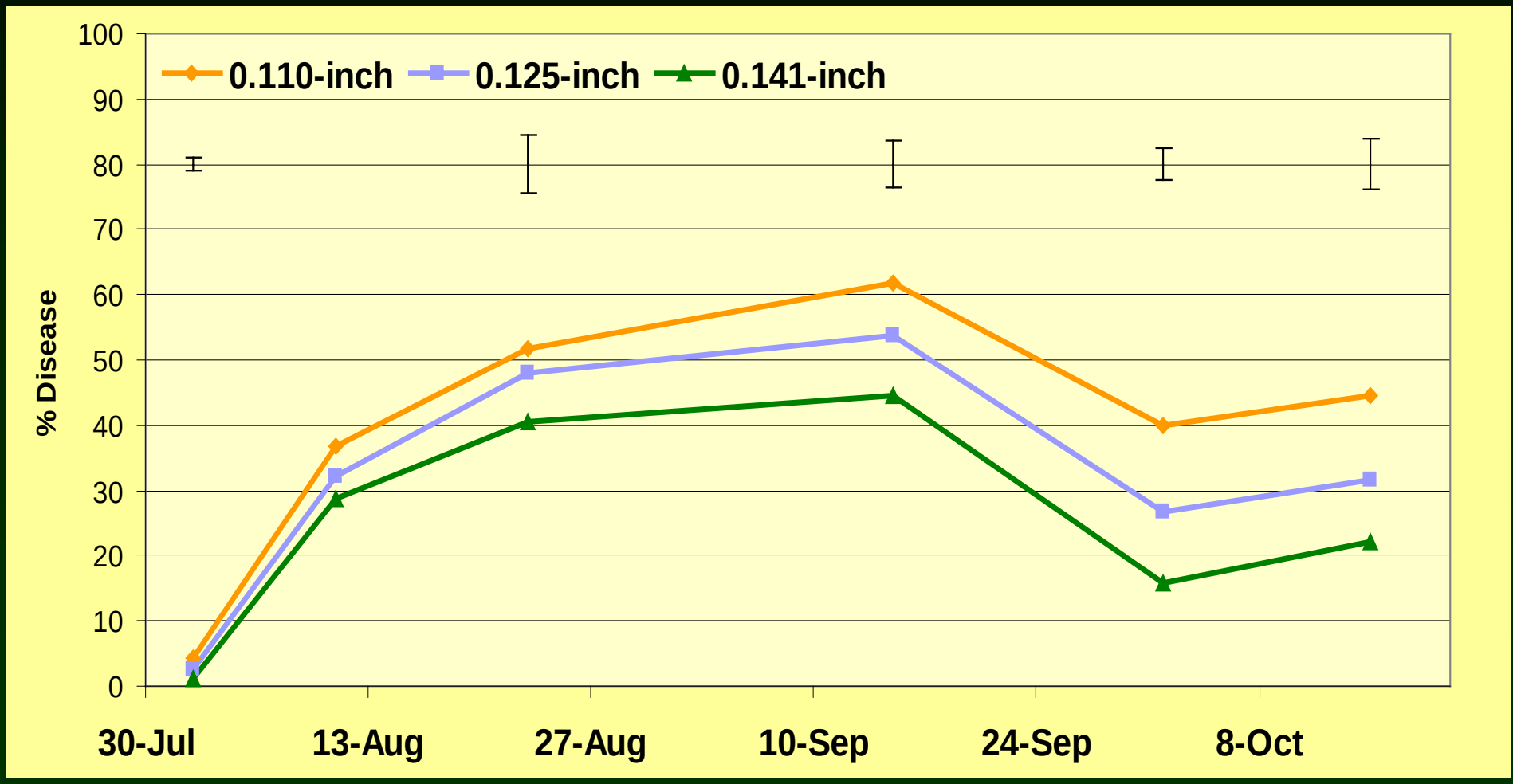
Impact of Mowing Practices on Anthracnose Severity

- Mowing Height
  - 0.110 in.
  - 0.125 in.
  - 0.141 in.

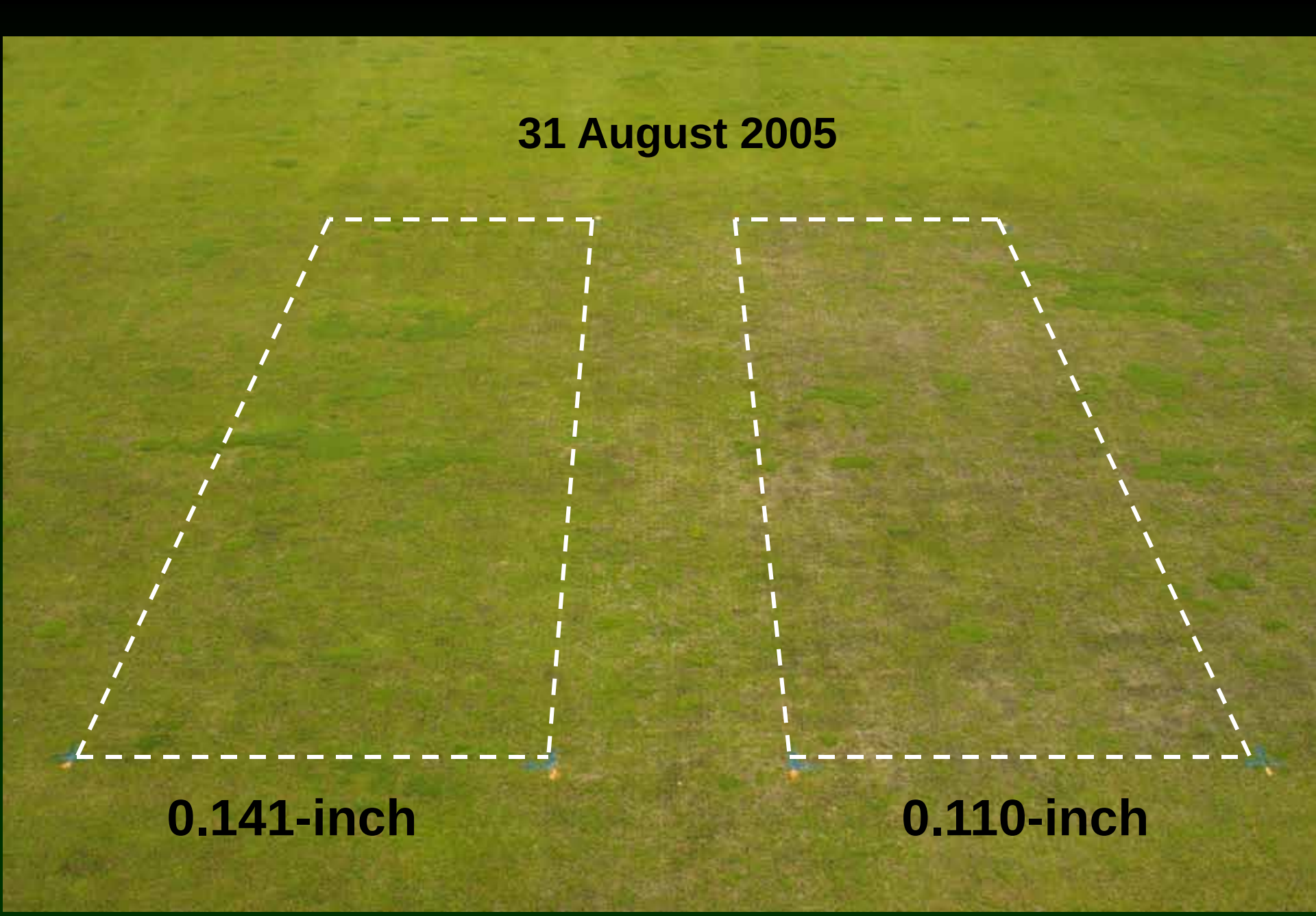
- Mowing Frequency
  - Single cut each day (7x / wk)
  - Double cut each day (14x / wk)

John Deere 220B—Grooved Front Roller

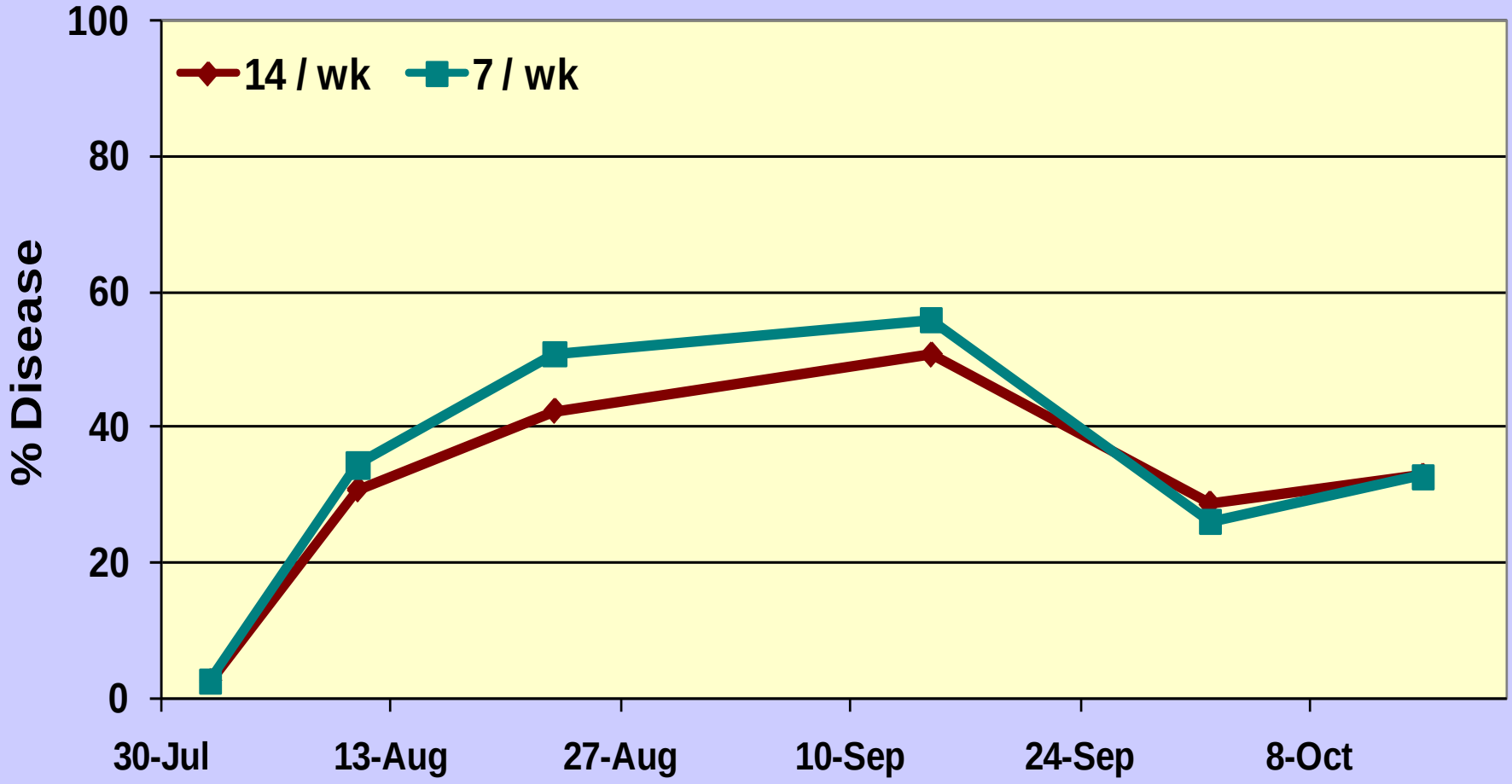
Mowing Height Effect on Anthracnose – Rutgers University



2004


31 August 2005
0.141-inch
0.110-inch

Mowing Frequency Effect on Anthracnose Severity



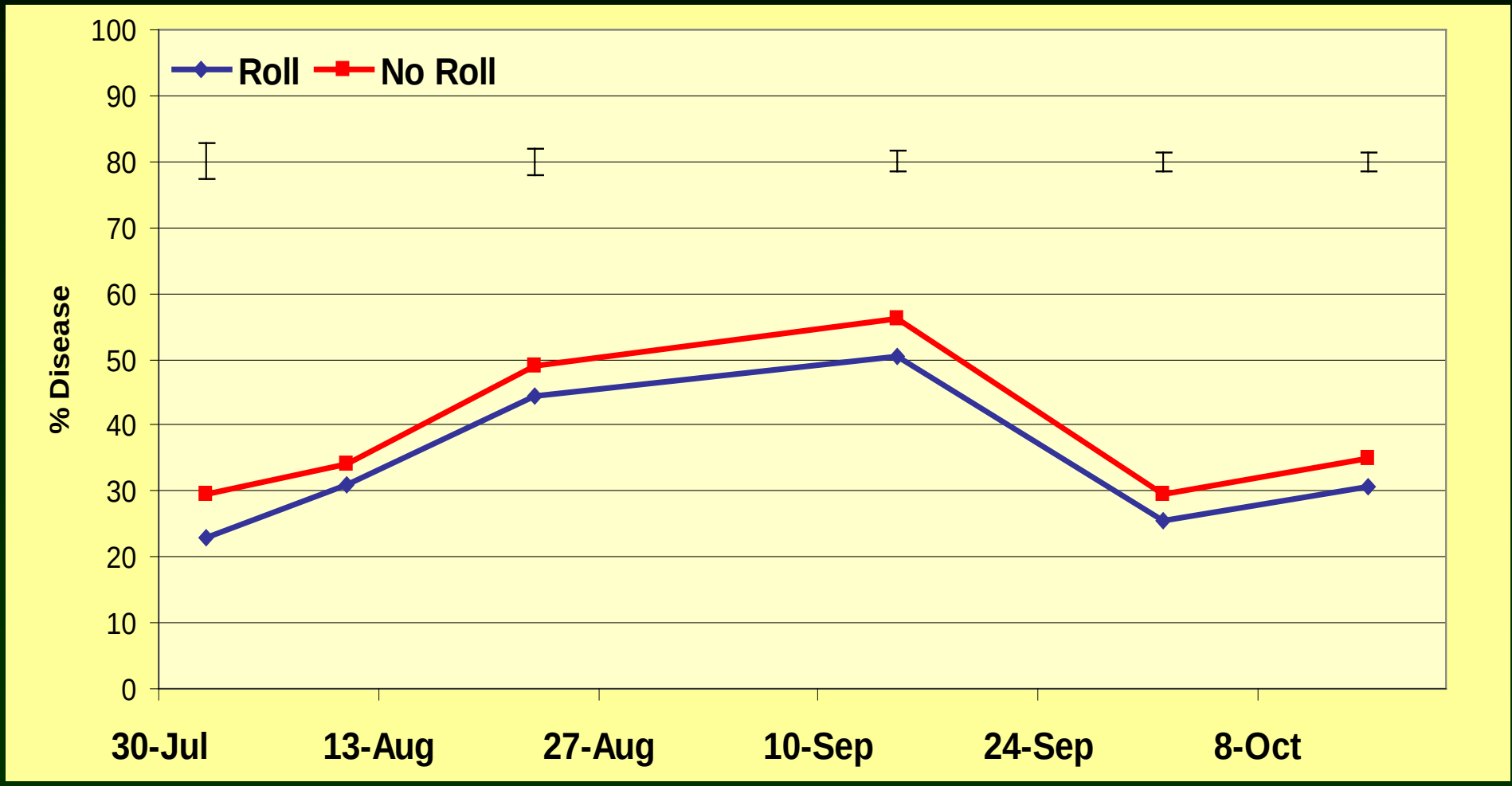
Lightweight Rolling Practices Effecting Anthracnose

Rolled every other day

No rolling

TRUE-SURFACE$_{TM}$ vibratory rollers

Lightweight Vibratory Rolling Effect on Anthracnose Severity



2004

Materials & Methods

Strip-Plot Design

3 x 2 factorial with 8 reps

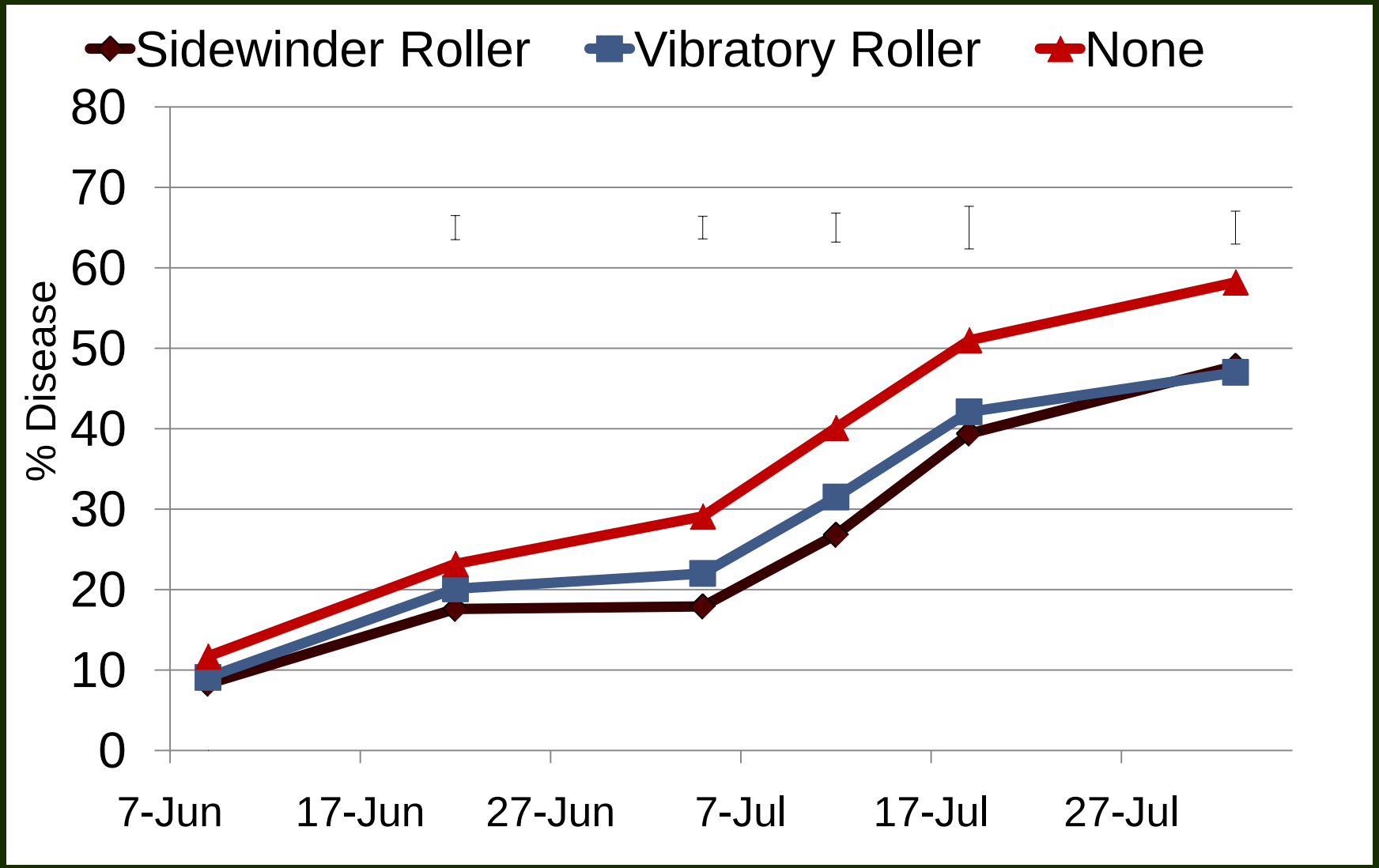
Roller Type

- Vibratory Roller
- Sidewinder Roller
- No Rolling

Location

- Center
- Periphery

Anthracnose disease response to lightweight rolling practices in 2007



- Rolling initiated on 10 May 2007

The Take-Home message is …

… you can significantly reduce anthracnose and maintain green speed (ball roll distance) by:

(1) increasing heights of cut AND either

(2) increasing mowing frequency, and/or

(3) initiating frequent lightweight rolling

Sand Topdressing

Routine light sand topdressing:

- Dilutes organic matter
- Improves infiltration rate
- Smoothes putting surface

However, does it enhance infection through wounding ?

Impact of Topdressing Rate and Frequency on Anthracnose: 2006-2007

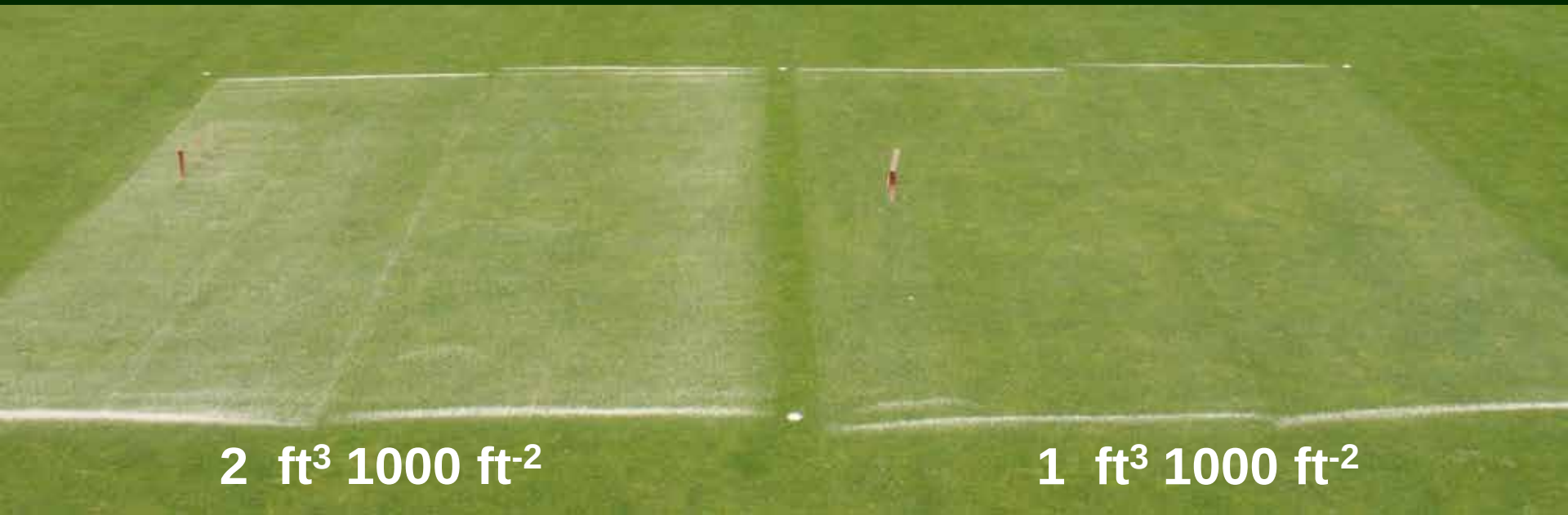
Interval (days)

- 7
- 14
- 28

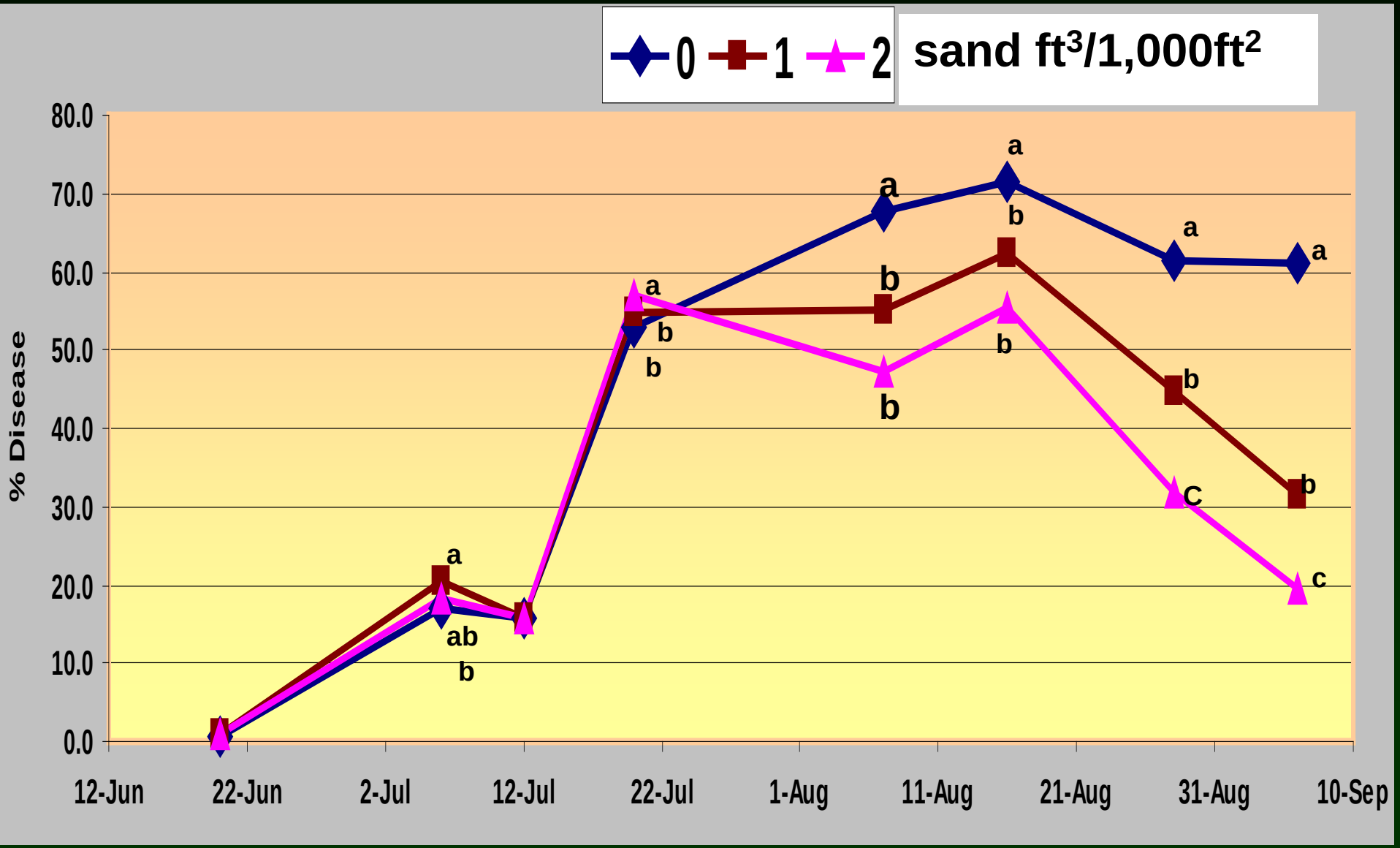
Rate (ft^3 1000-ft^{-2})

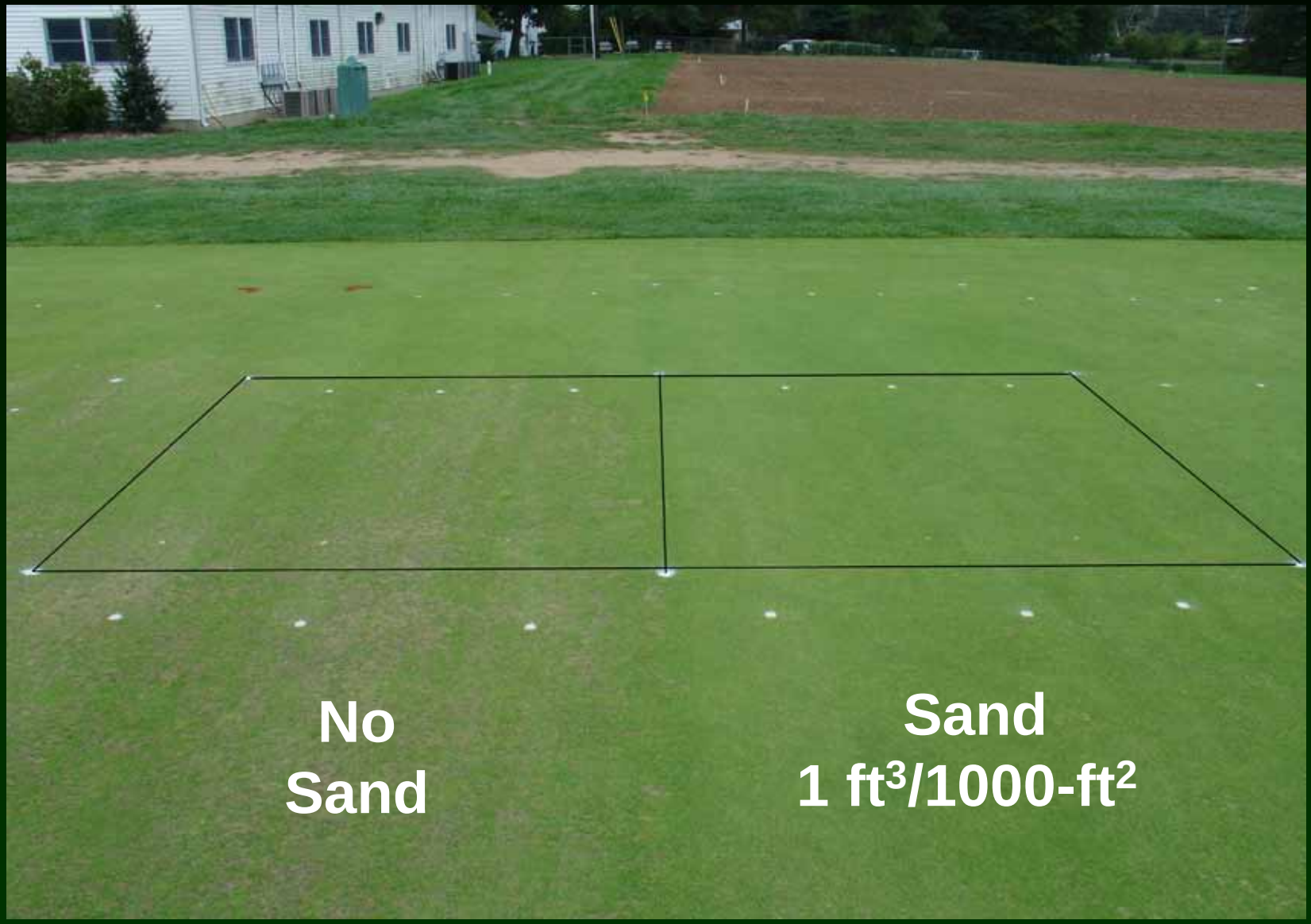
- No sand
- 1
- 2

All plots brushed uniformly

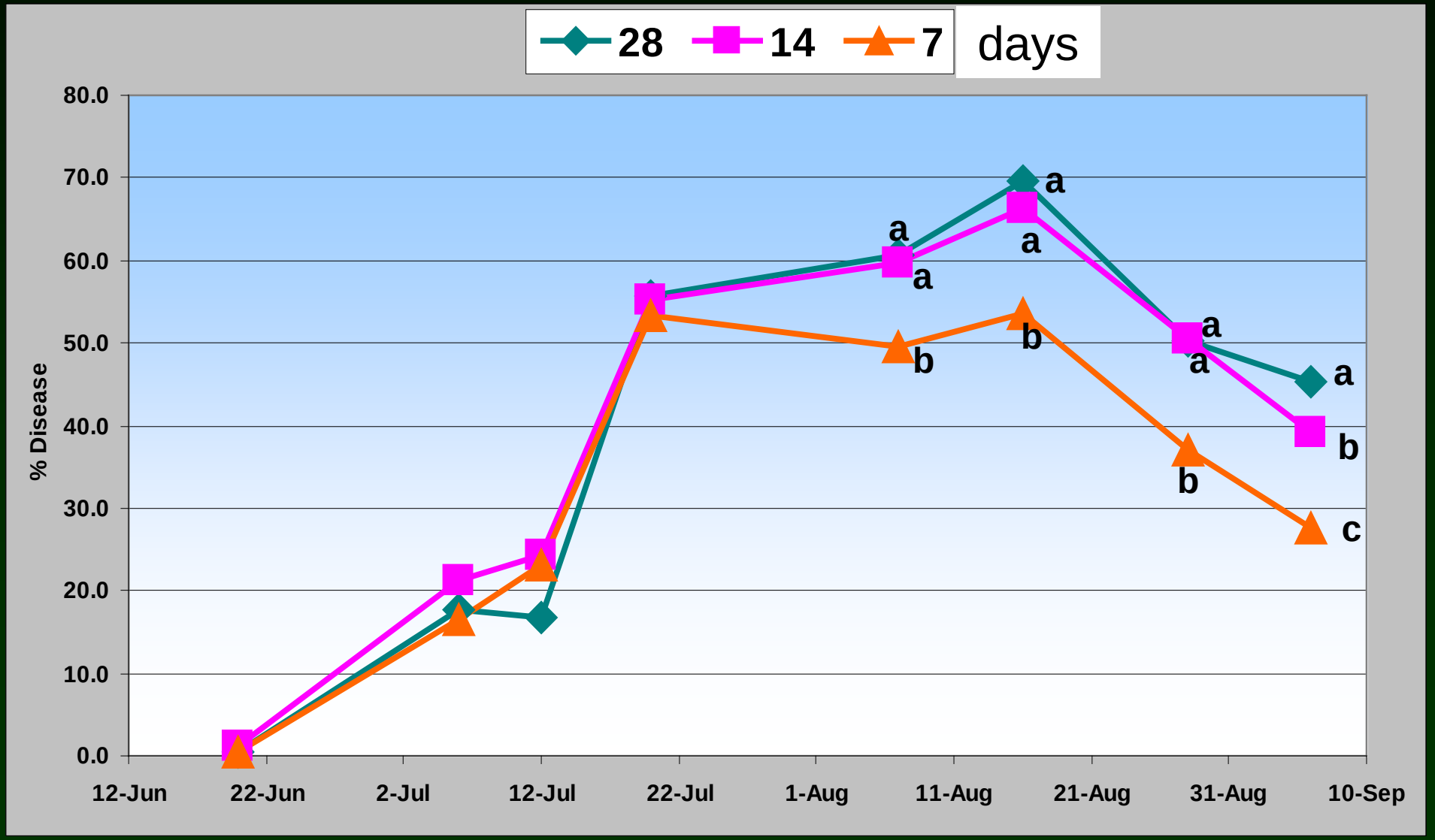


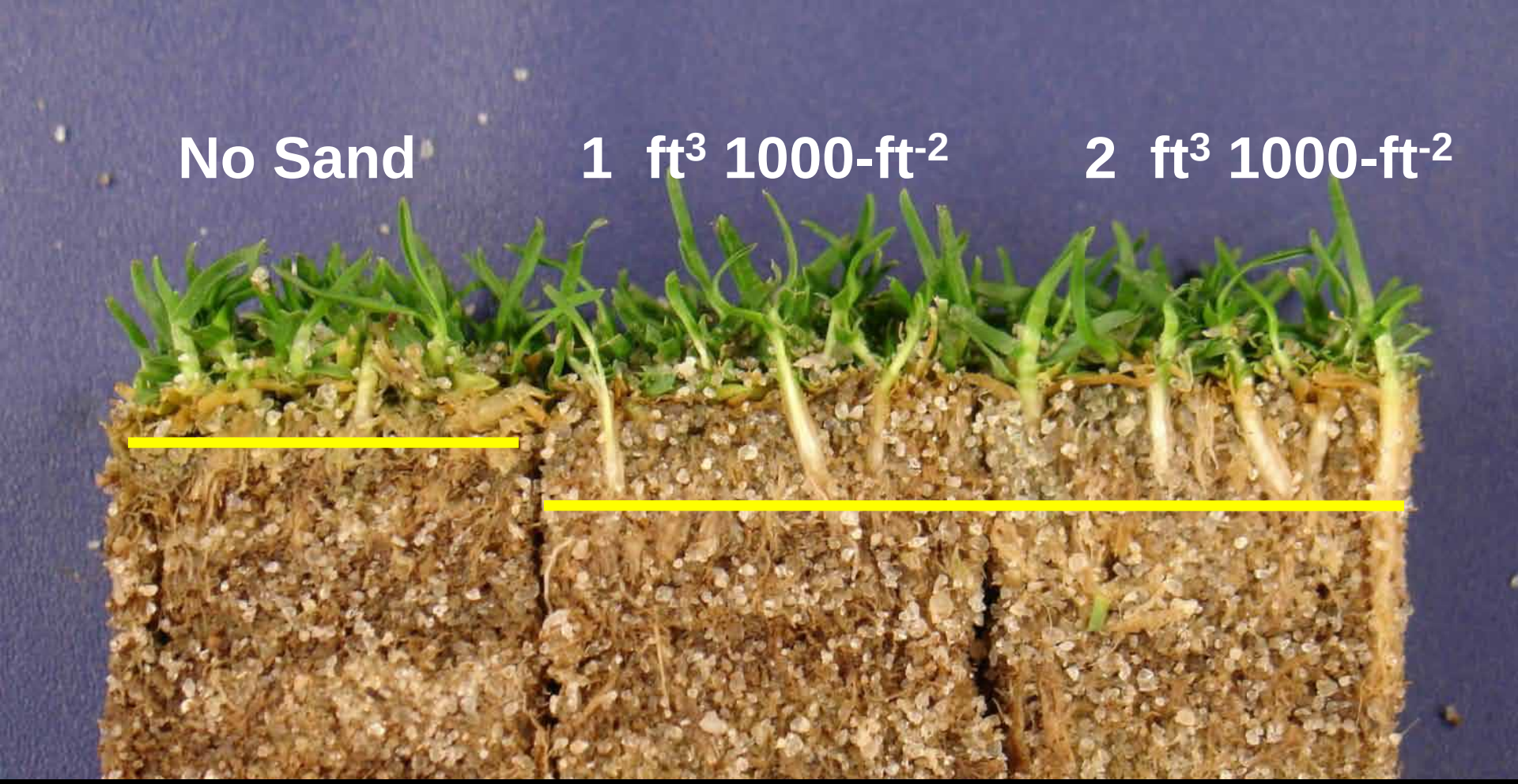
Effect of Topdressing Rate on Anthracnose of Annual Bluegrass - 2006




No
Sand
Sand
1 ft3/1000-ft2

Impact of Topdressing Frequency on Anthracnose of Annual Bluegrass - 2006



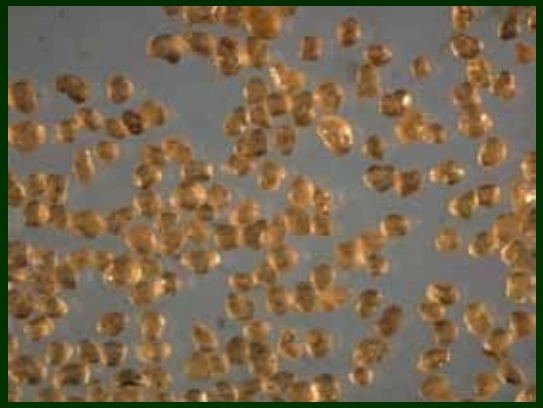


- Topdressing improves surface characteristics
- Firmer surface raises effective height of cut
- Deeper crowns reduces stress

What About Sand Type and Incorporation Method?

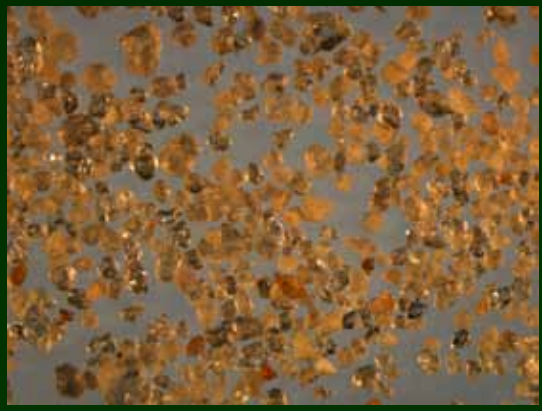
Incorporation

- None
- Vibratory roller
- Soft-bristled broom
- Stiff-bristled broom



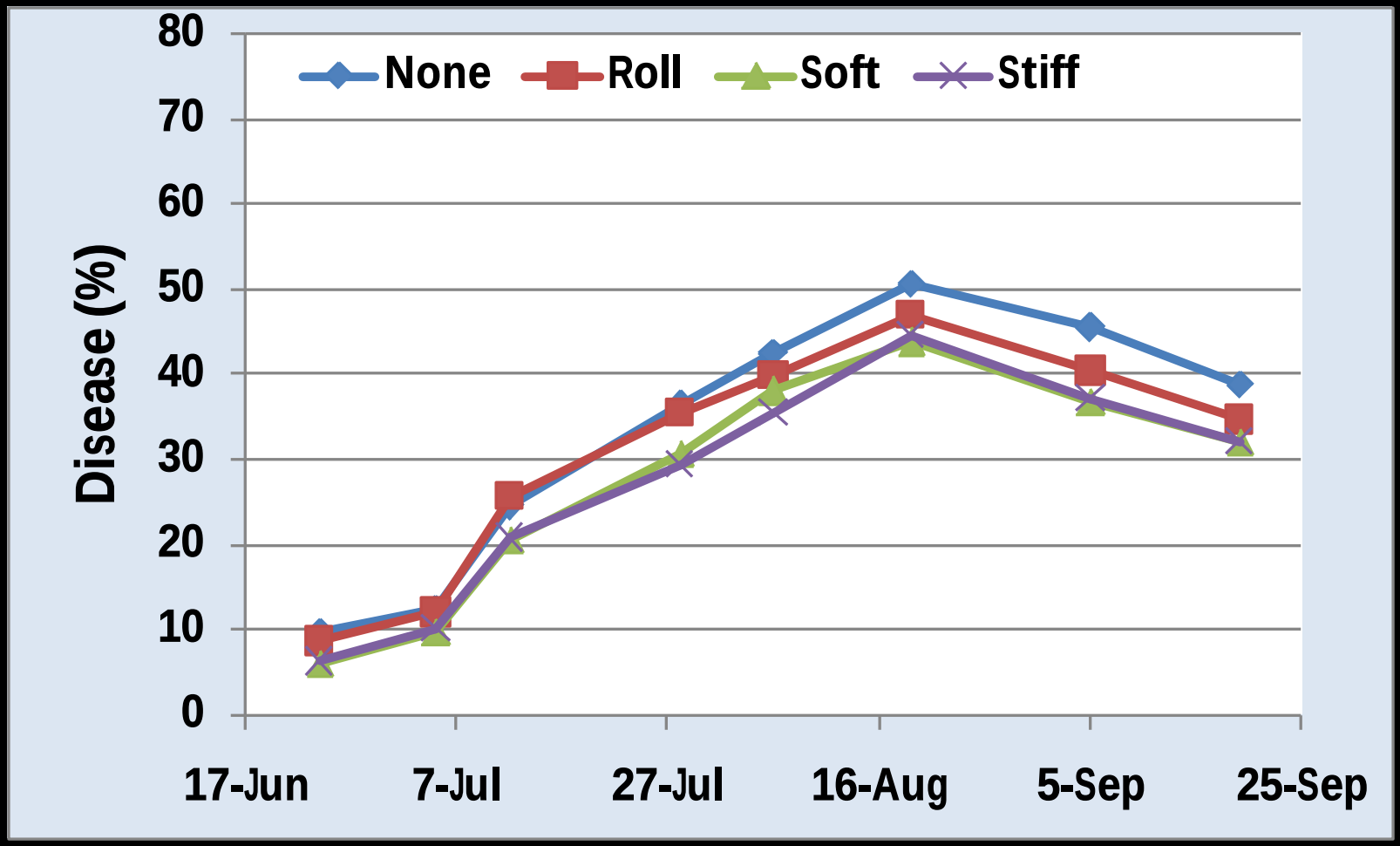
Sand Type

- Round
- Sub-angular

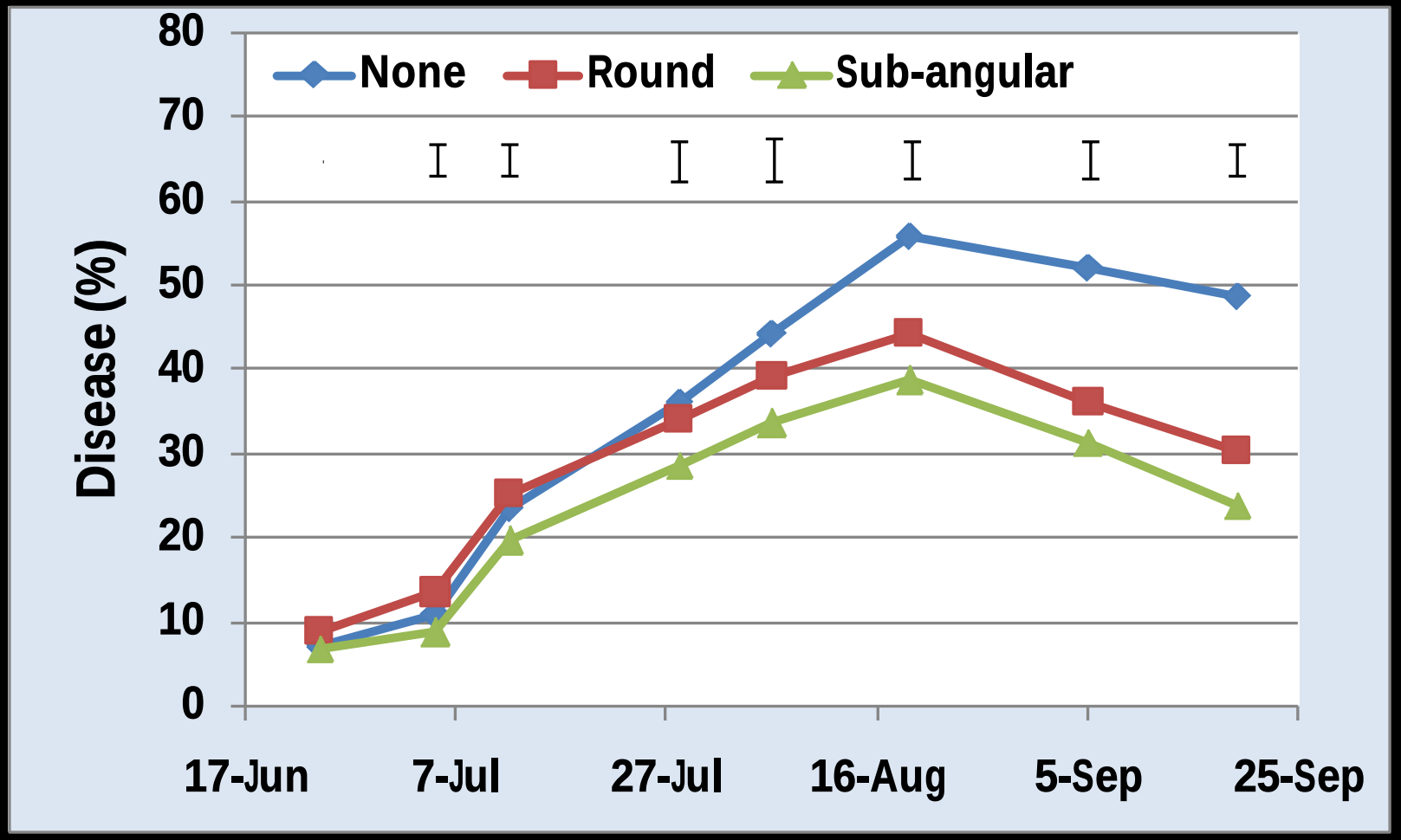


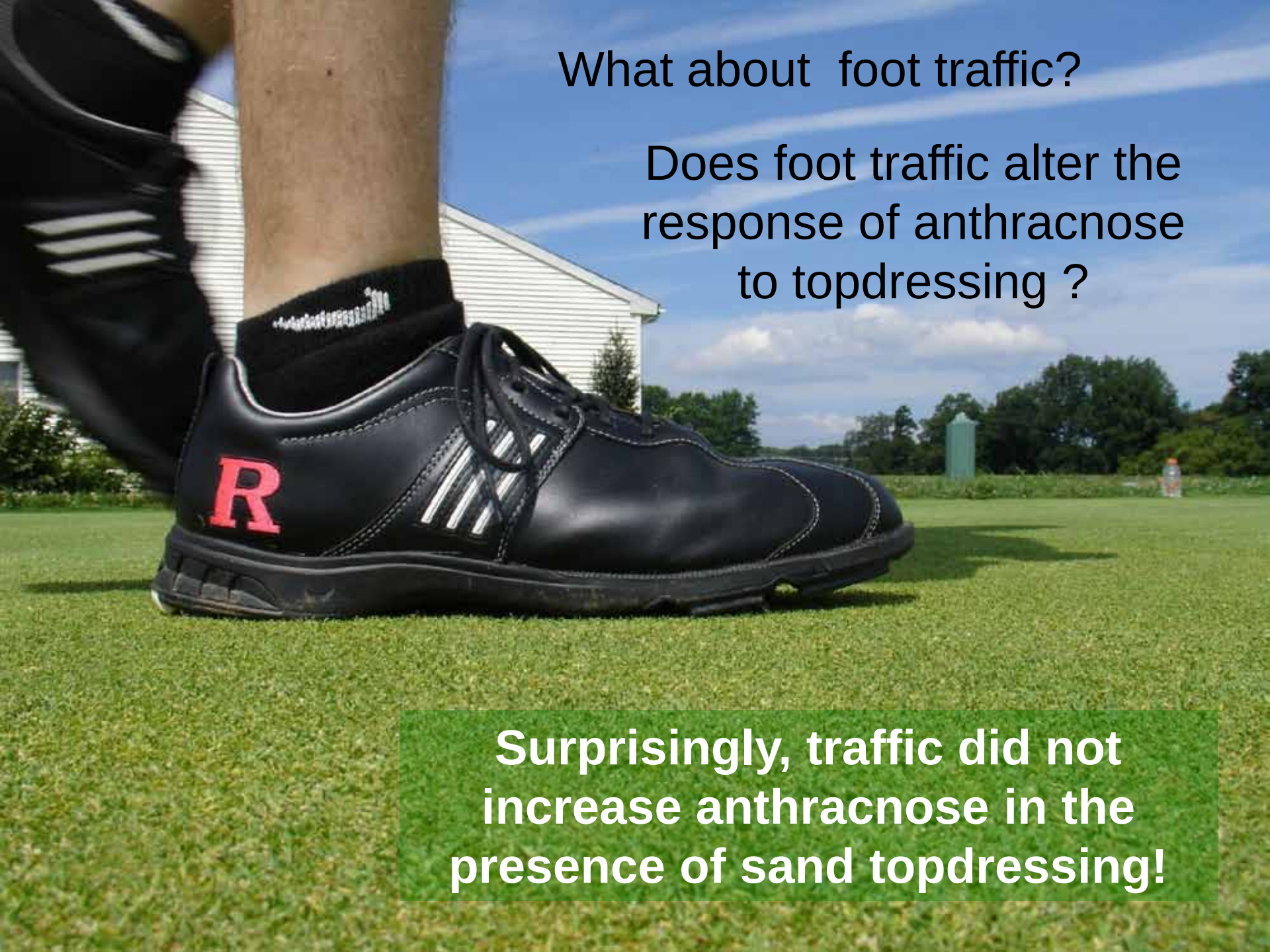
Brushing Method

Incorporation Method Influence on Anthracnose Severity – 2007



Sand Particle Shape Effect on Anthracnose Severity – 2007




What about foot traffic?
Does foot traffic alter the response of anthracnose to topdressing ?
R
Surprisingly, traffic did not increase anthracnose in the presence of sand topdressing!

Materials and Methods

Traffic

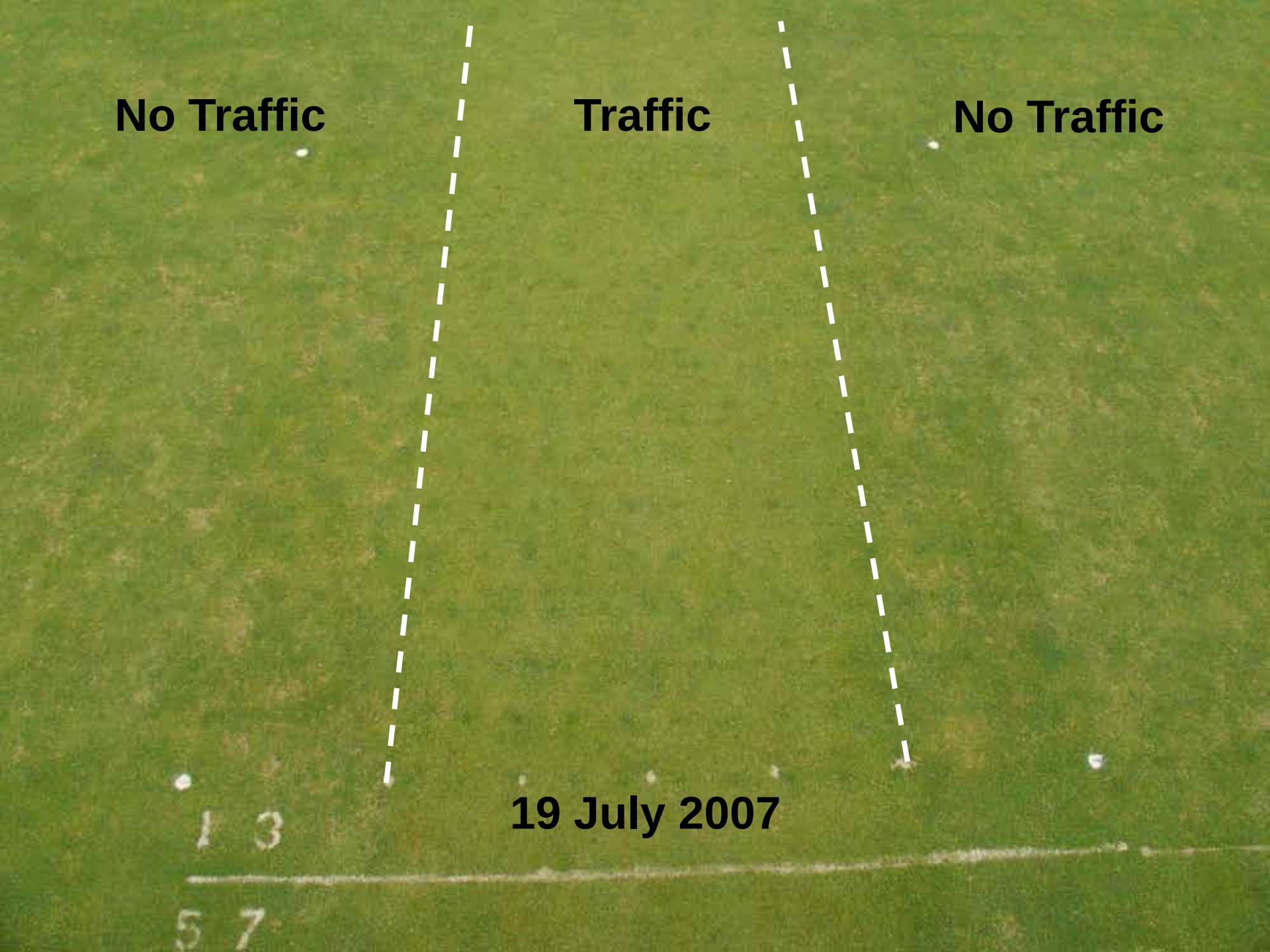
i) none

ii) 5 days wk^{-1} at rate of 200 rounds day^{-1}

Topdressing

i) none

ii) weekly at 1 ft^3 per 1000-ft^2


No Traffic
Traffic
No Traffic
19 July 2007

Irrigation

First reported observations on the influence of cultural practices on anthracnose were related to poor irrigation and soil conditions (Sprague and Evaul, 1928)

So we decided to:

evaluate the effects of irrigation quantity on anthracnose

Effects of Irrigation Quantity

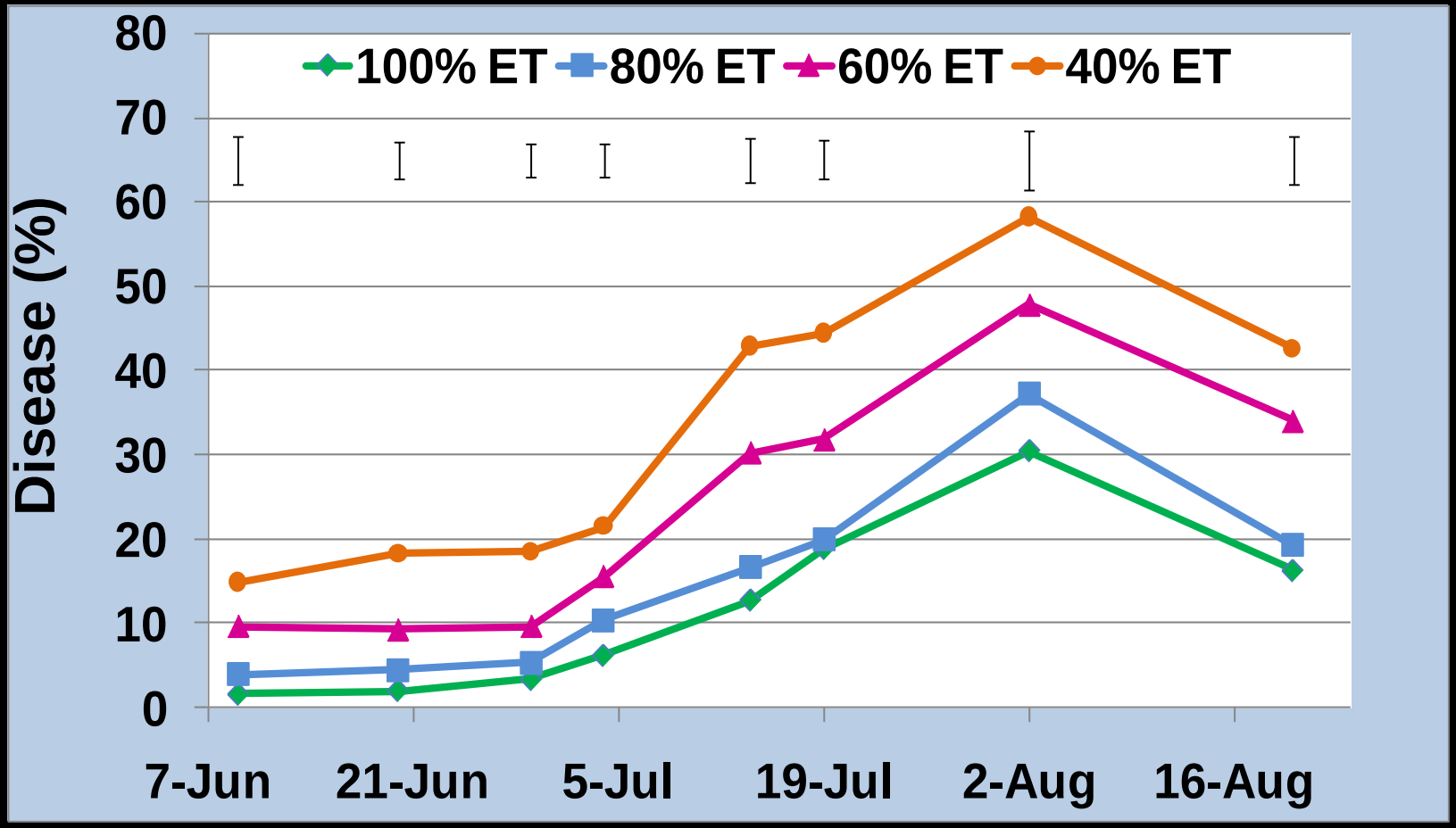
100% replacement of ET_o
Excessive Irrigation

80% replacement of ET_o
Moderate Irrigation

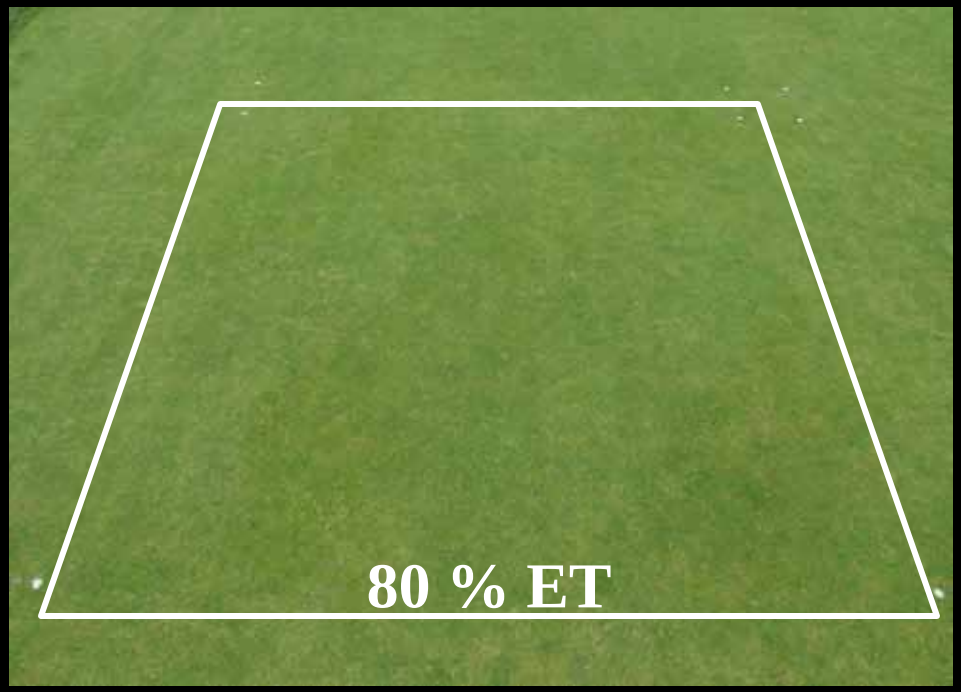
60% replacement of ET_o
Stress, plus syringing

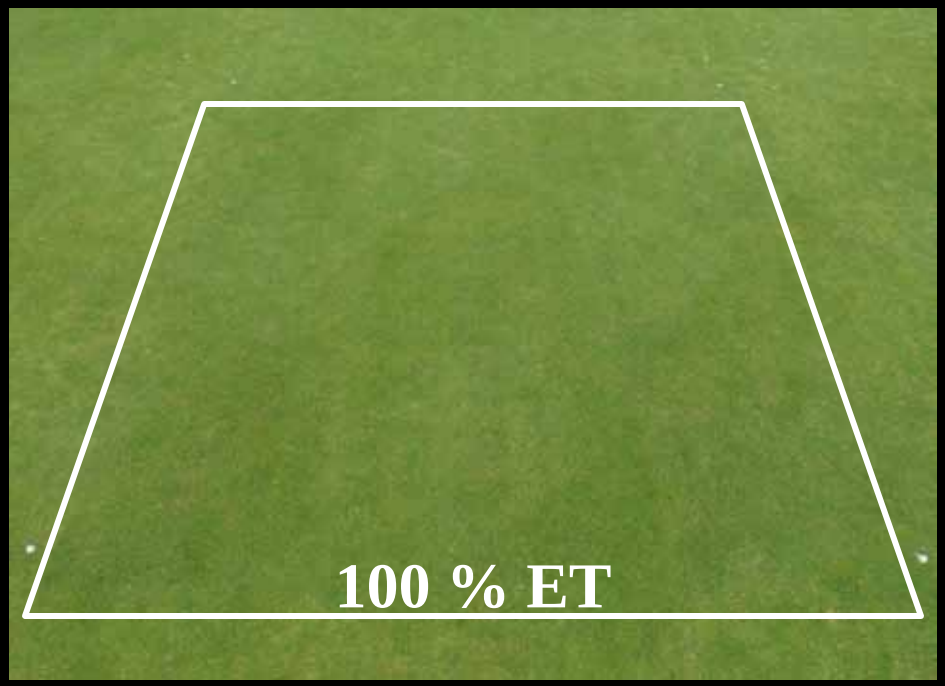
40% replacement of ET_o
Severe Stress, extensive syringing

Irrigation Quantity Effects on Anthracnose Severity - 2007



July 11, 2007





Studies with Plant Growth Regulators

Mefluidide (Embark 0.2L)

- None
- 30 fl oz 1000 ft^{-2} applied twice late-March to early-April

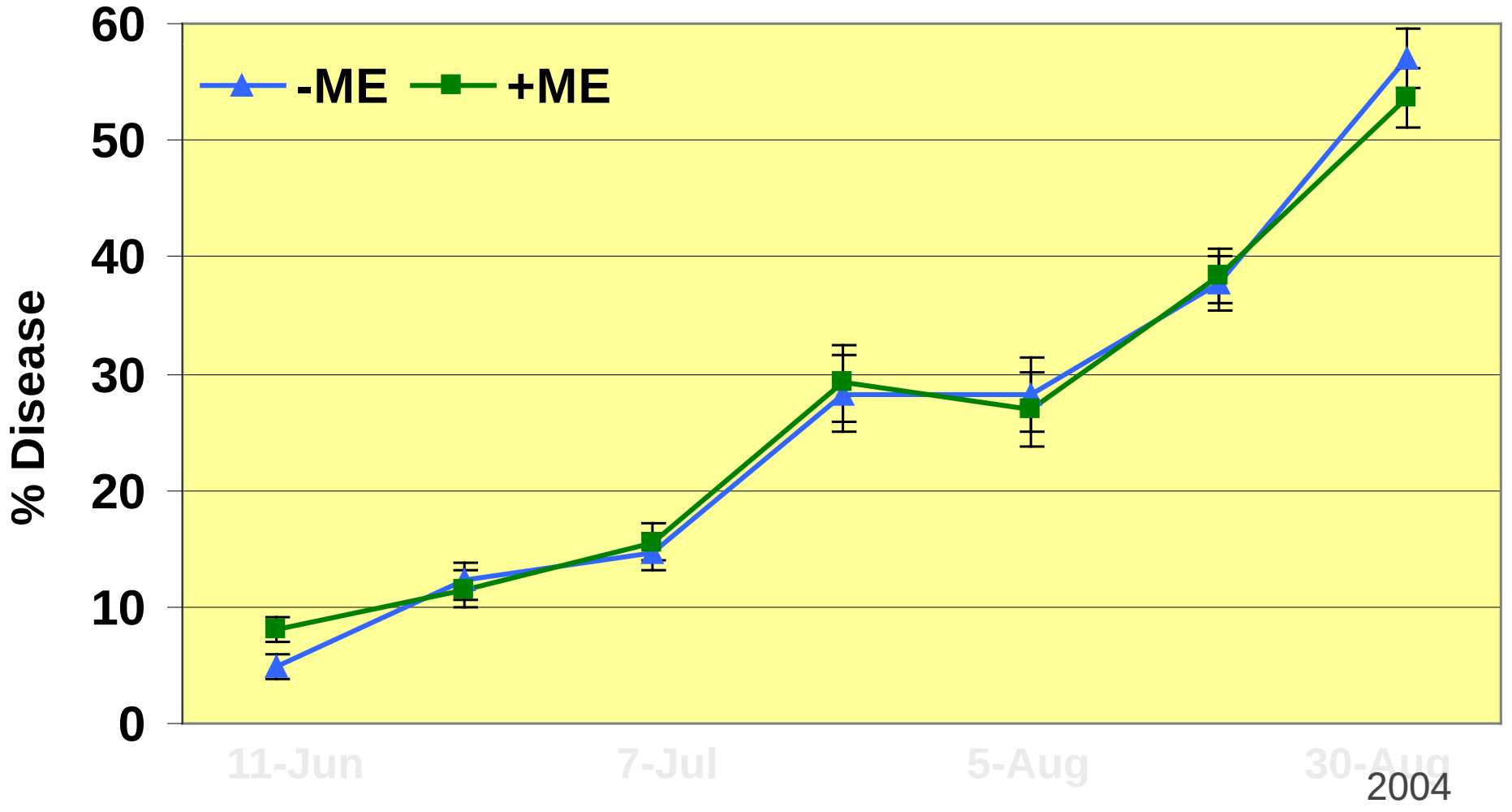
Trinexapac-ethyl (Primo MAXX)

- None
- 0.125 fl oz. 1000 ft^{-2} every 14-d late-April to August

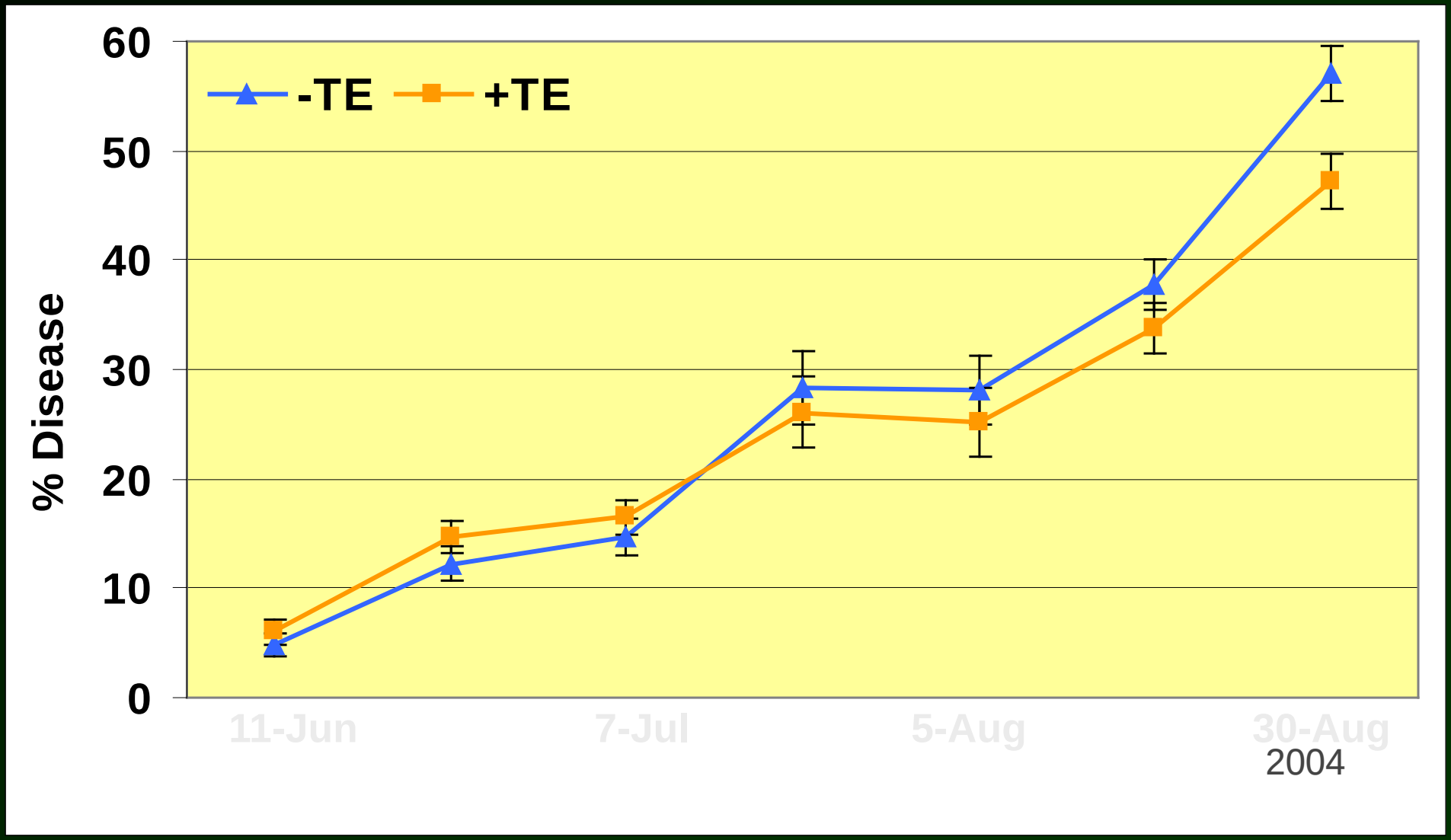
Mefluidide and Trinexapac-ethyl

- also looked at Proxy-Primo

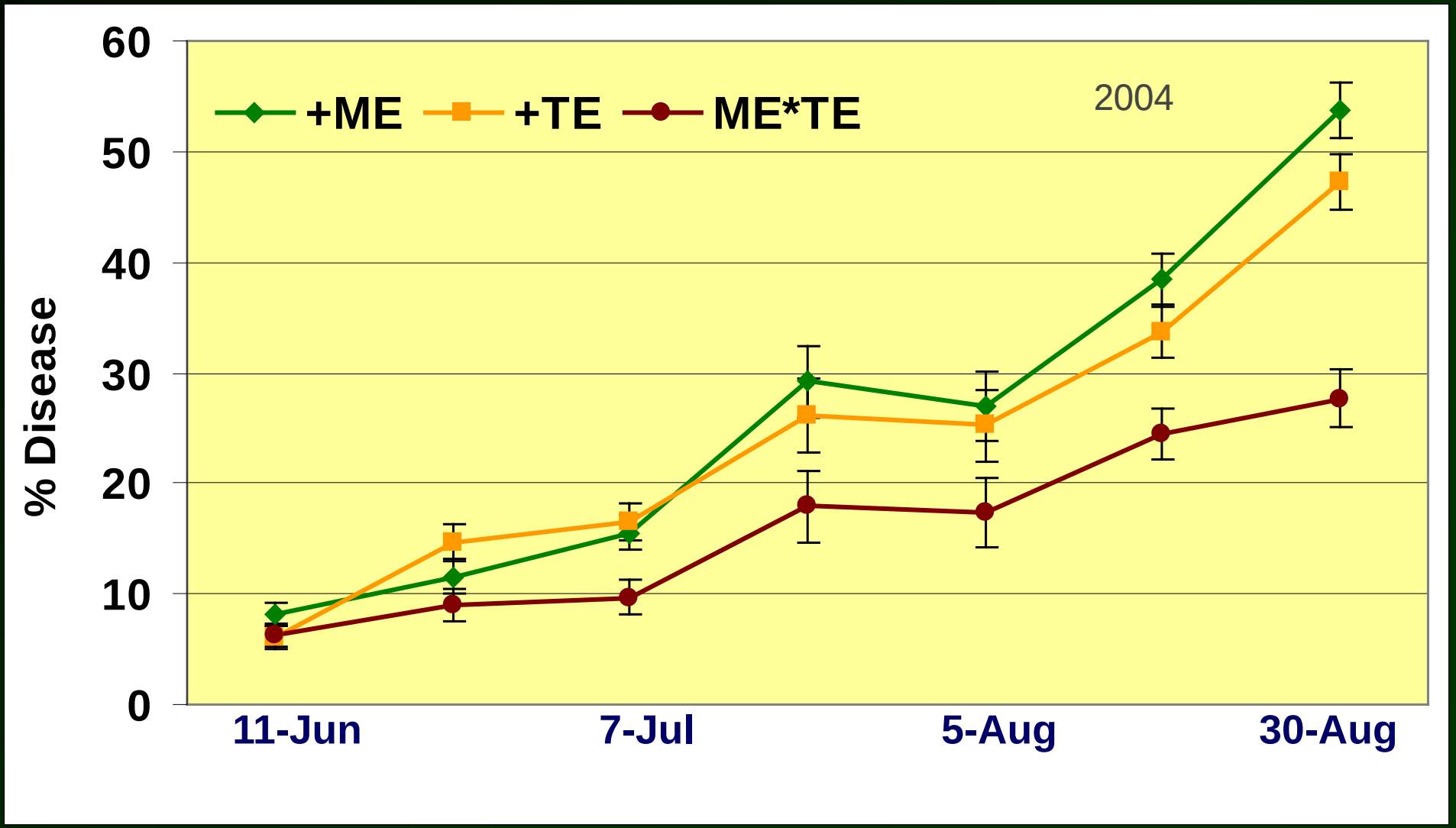
Mefluidide Effect on Anthracnose in Absence of Trinexapac-ethyl



Trinexapac-ethyl Effect on Anthracnose in Absence of Mefluidide



Mefluidide and Trinexapac-ethyl Interaction on Anthracnose Severity



Growth Regulation Recommendations

Continue to use these PGRs to produce a quality playing surface ...

1) Embark or Proxy at label rates during Mar/Apr

2) Follow-up with subsequent apps of Primo
   - every 7 to 14 days @ 0.1 to 0.125 fl oz / 1000 ft^2

Will not increase anthracnose ...

... may actually reduce it, particularly when using seedhead suppressants and Primo together with weekly N fertility

Controlling Anthracnose Basal Rot with a Sound Fungicide Program

Chemical Control of Anthracnose

I. Demethylation Inhibitors

(Sterol Inhibitors)

- Banner, Bayleton, Eagle, **Trinity, Tourney, Triton**

II. Strobilurins

- Heritage, Compass Insignia, **Disarm**

III. Benzimidazoles

- Fungo, Cleary 3336, Systec 1998

IV. Nitriles

- Daconil, ChloroStar, Echo, Concorde

V. Combinations (III + IV)

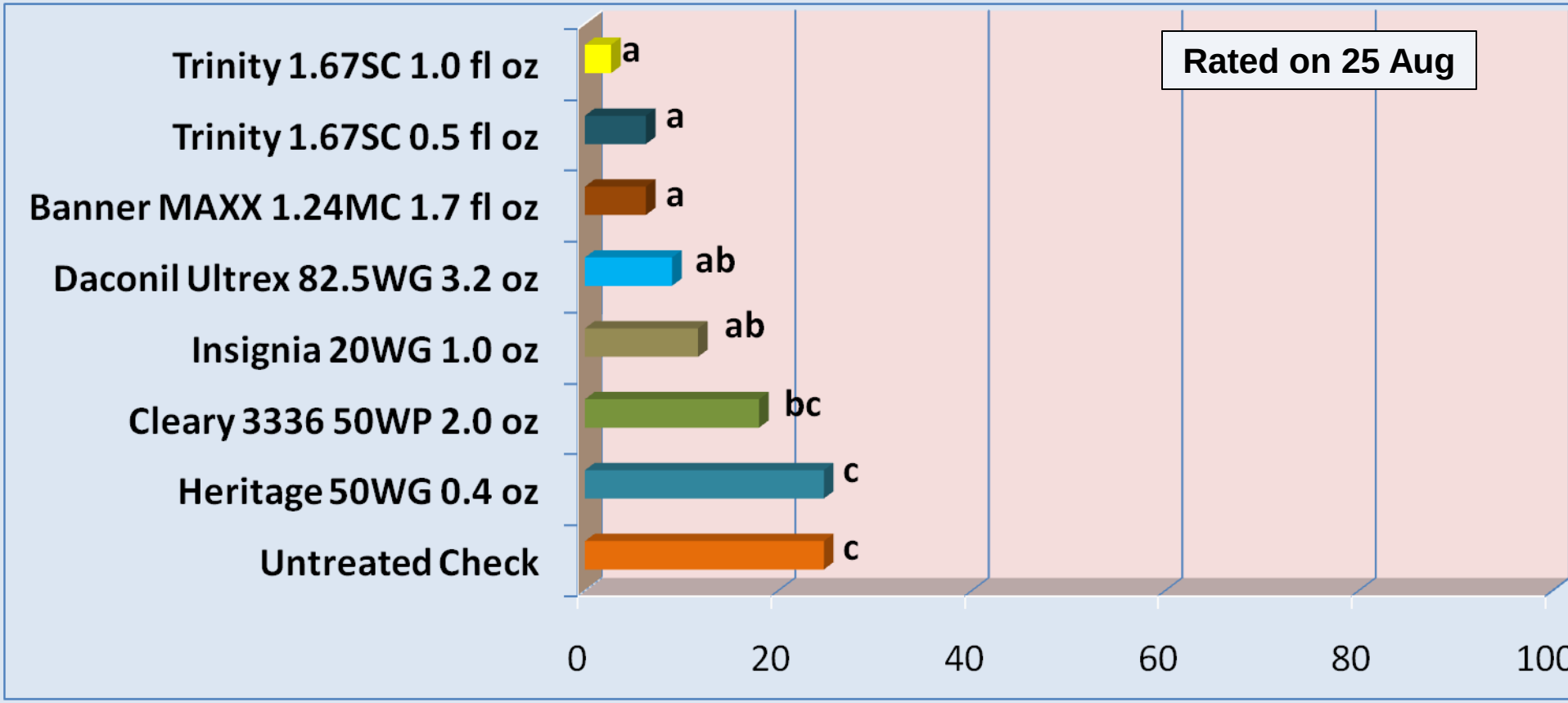
- ConSyst, Spectro, **Headway, Tartan**

Excellent Control of ABR : Single Products

- Nitrile – chlorothalonil
  - Daconil Ultrex 82.5SDG (3.2 oz)
- DMI - propiconazole
  - Banner MAXX 1.3MC (1.0 fl oz)
  - triticonazole
  - **Trinity 1.67SC (1.0 fl oz)**
- Antibiotic – polyoxin-D
  - Endorse 2.5W (4.0 oz)

14 – d interval

Evaluation of Fungicides for the Control of Anthracnose on an Annual Bluegrass Green - PSU



pplied every 14 days from 25 May – 1 Aug,

Disease severity (%) / plot

Uddin & Soika (2001) F & N Tests 56:T17

Civitas 98 AS (Mineral Oil)

1. New Product 2009

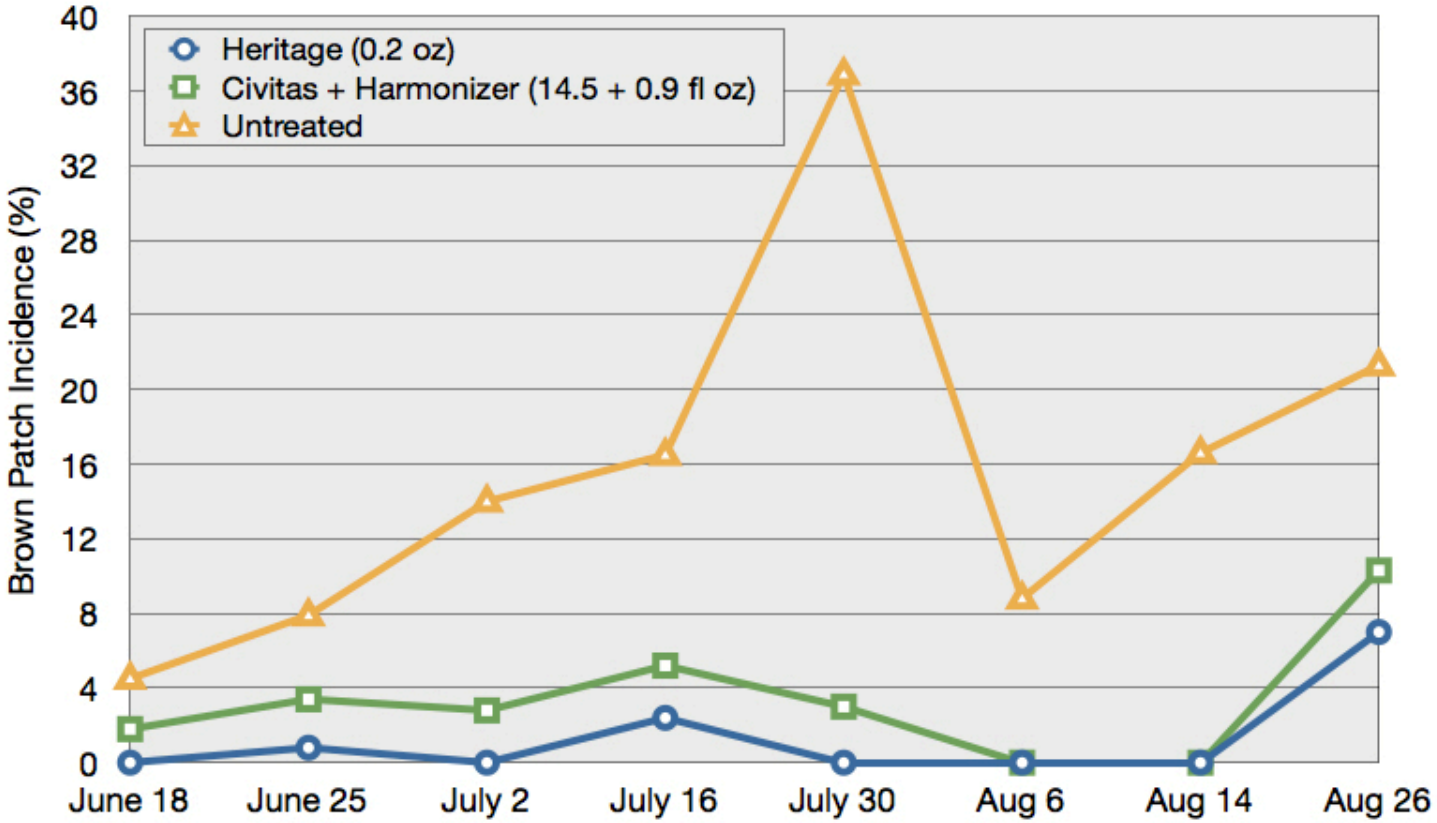
Use of Mineral Oil in Pest Control -

- Often referred to as " horticultural oil"
- Hort oils have been used for insect & disease control on crops for many years
- Disease Control
  - PM on Grape (Martin et el 2005; Spain)
  - Mycosphaerella Leaf Spot of Banana (Jacome et el 2002, Cuba)
- Civitas MOA – Reported as SAR by Suncor (formerly Petro Canada), but this has yet to be published.

Civitas 98 AS (Mineral Oil)

1. Recently evaluated at several Univ (NC, NJ, NY, PA)
2. Preliminary results promising on: Anthracnose, Brown Patch, Dollar spot

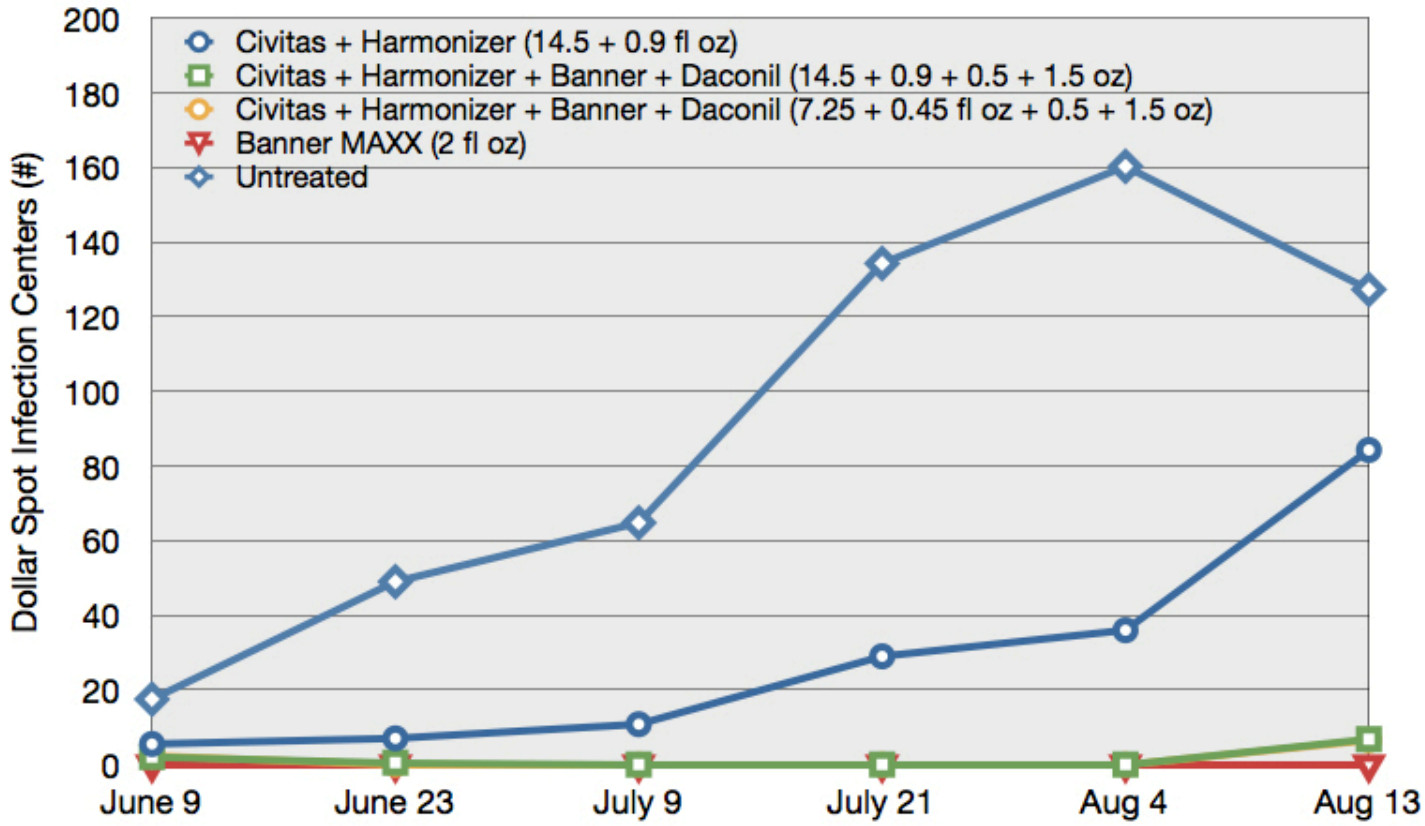
Control of brown patch with Civitas, 2009



Turfgrass Pathology

Treatments applied on 14-day interval beginning on June 4

Control of dollar spot with Civitas, 2009



Turfgrass Pathology

Treatments applied evey 14 days beginning on May 13

Civitas + Civitas Harmonizer

Untreated

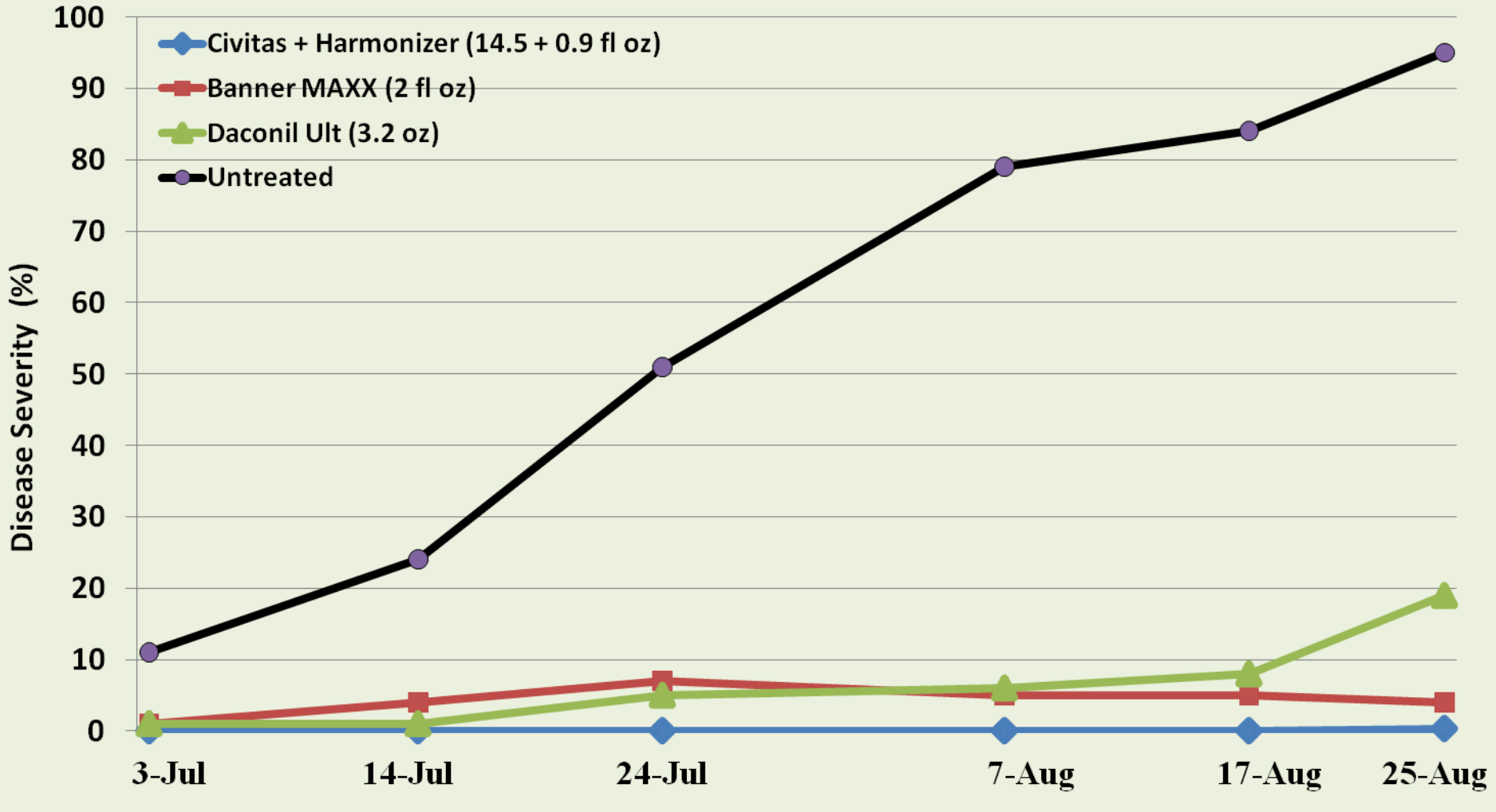
Turfgrass Pathology

Civitas 98 AS (Mineral Oil)

At Rutgers, we examined the efficacy of Civitas for the control of anthracnose on ABG Putting Green Turf during the summer of 2009–

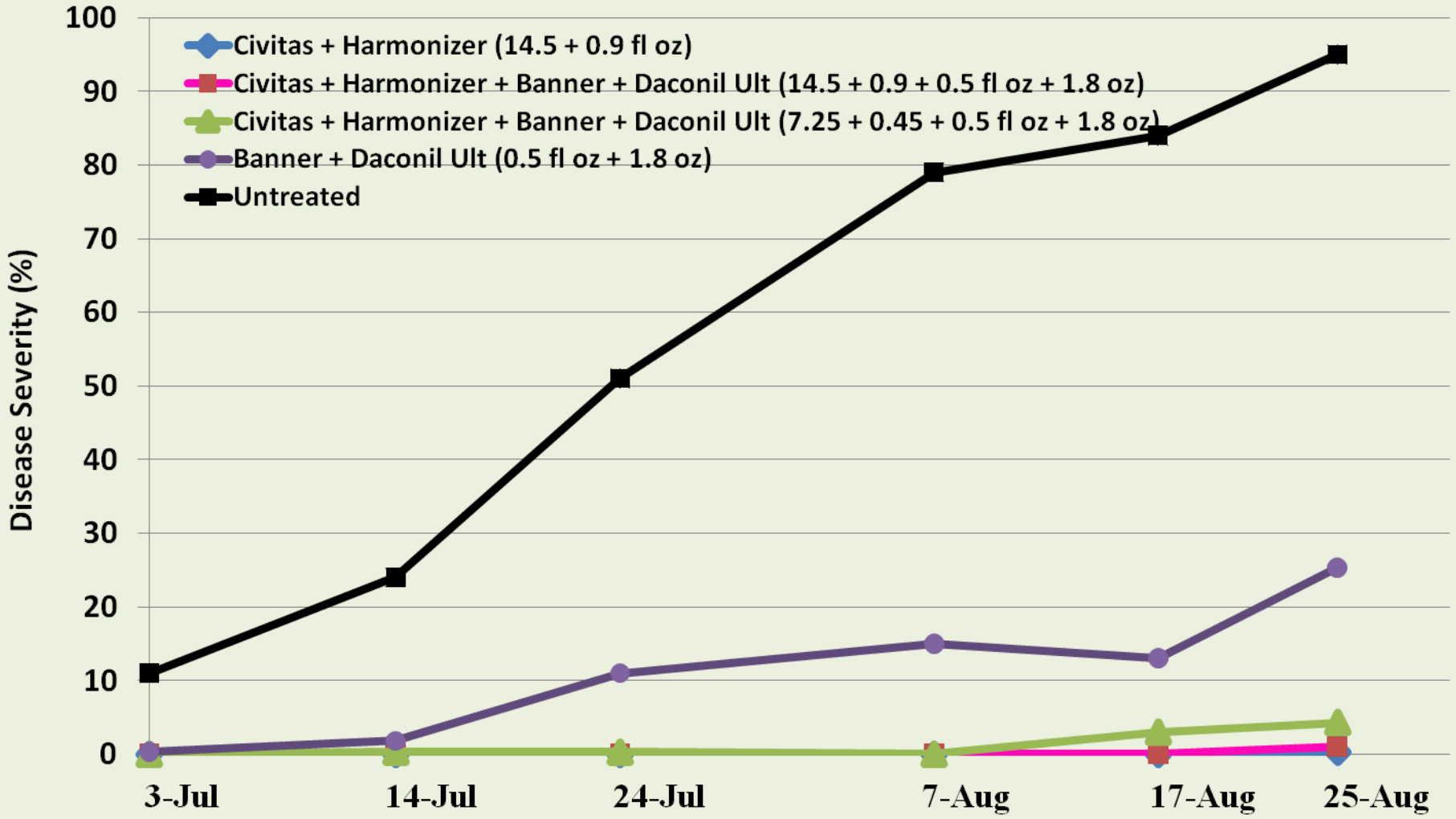
- **Applied as Civitas (7.25 & 14.5 fl oz) + Harmonizer (Pigment @ 0.45 + 0.9 fl oz) every 14 day**

Control of Anthracnose on ABG Green with Civitas, Rutgers 2009



Treatments applied on 14-day interval from 15 May – 21 August

Control of Anthracnose on ABG Green with Civitas, Rutgers 2009



Treatments applied on 14-day interval from 15 May – 21 August

Civitas 98 AS (Mineral Oil)

Conclusions:

- **Preliminary results indicates that Civitas + Harmonizer may do a good job controlling anthracnose on ABG putting green turf on a "preventive" basis.**

- **Although, additional research is needed before Civitas can be recommended, it would appear from 1 season's results that this product may be another effective chemistry that can be used in an alternation program to reduce the potential for fungicide resistance.**

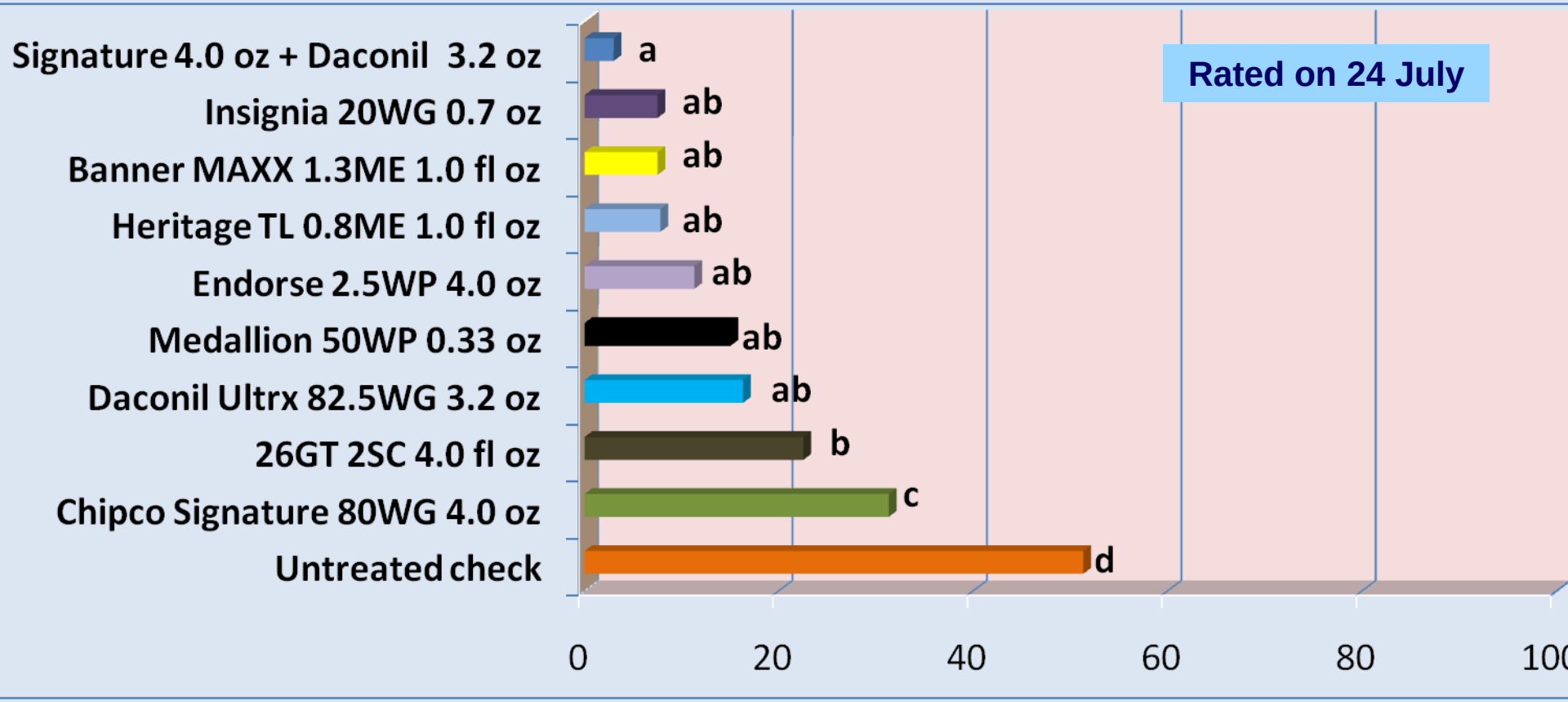
Good Control of ABR until Late August

- Phosphonate – fosetyl-Al
  - Chipco Signature 80WG (4.0 oz)
- DMI – myclobutanil
  - Eagle 40W (1.0 oz)
- Dicarboximide – iprodione
  - Chipco 26GT 2SC (4 fl oz)
- Phenylpyrrole - fludioxonil
  - **Medallion 50W (0.25 oz)**

14 – d interval

Evaluating Tank Mixtures for the Control of Anthracnose

Curative Control of Anthracnose Basal Rot on an Annual Bluegrass Green – Univ. Riverside, CA



Applied every 14 days from 15 Jun – 1 Sept

Wong et al (2002) Plant Dis Mgm't Rpt 1:T064

A Programmatic Approach to Controlling Anthracnose Basal Rot

Excellent Control of ABR: Programs (Alt/R)

Rutgers Alternation Program

- Banner MAXX 1 fl oz/ 1000 ft^2
- Daconil Ultrex 3.2 oz/ 1000 ft^2
- Chipco Signature 4 fl oz + Daconil Ult. 2.4 oz/ 1000 ft^2
- Chipco 26GT 4 fl oz/ 1000 ft^2
- Medallion 0.18 oz + Banner MAXX 0.75 oz/ 1000 ft^2
- Chipco Signature 4 fl oz+ Daconil Ultrex 2.4 oz/1000 ft^2
- Endorse 3.0 oz + Banner MAXX 0.75 oz/ 1000 ft^2
- Chipco Signature 4 fl oz+ Daconil Ultrex 2.4 oz/1000 ft^2

14 – d interval

Summary : Rutgers Anthracnose Fungicide Studies

- Preventive better than Curative Control
- Nitrogen (0.1 -0.25 lb @ 7-14 day intervals) will reduce anthracnose severity & improve fungicide efficacy
- DMI, Nitrile, Polyoxin-D = Excellent Control (Banner) (Daconil) (Endorse); (DMI's variable)
- Benzimidazole (3336) and QoI's (Insignia) provide excellent control as long as resistant strains are not present
- Phosphonate, Dicarboximide, Phenylpyrrole = Good (Signature) (Chipco 26GT) (Medallion) Control
- Tank Mixes and Rotation Programs typically provide the Best Control