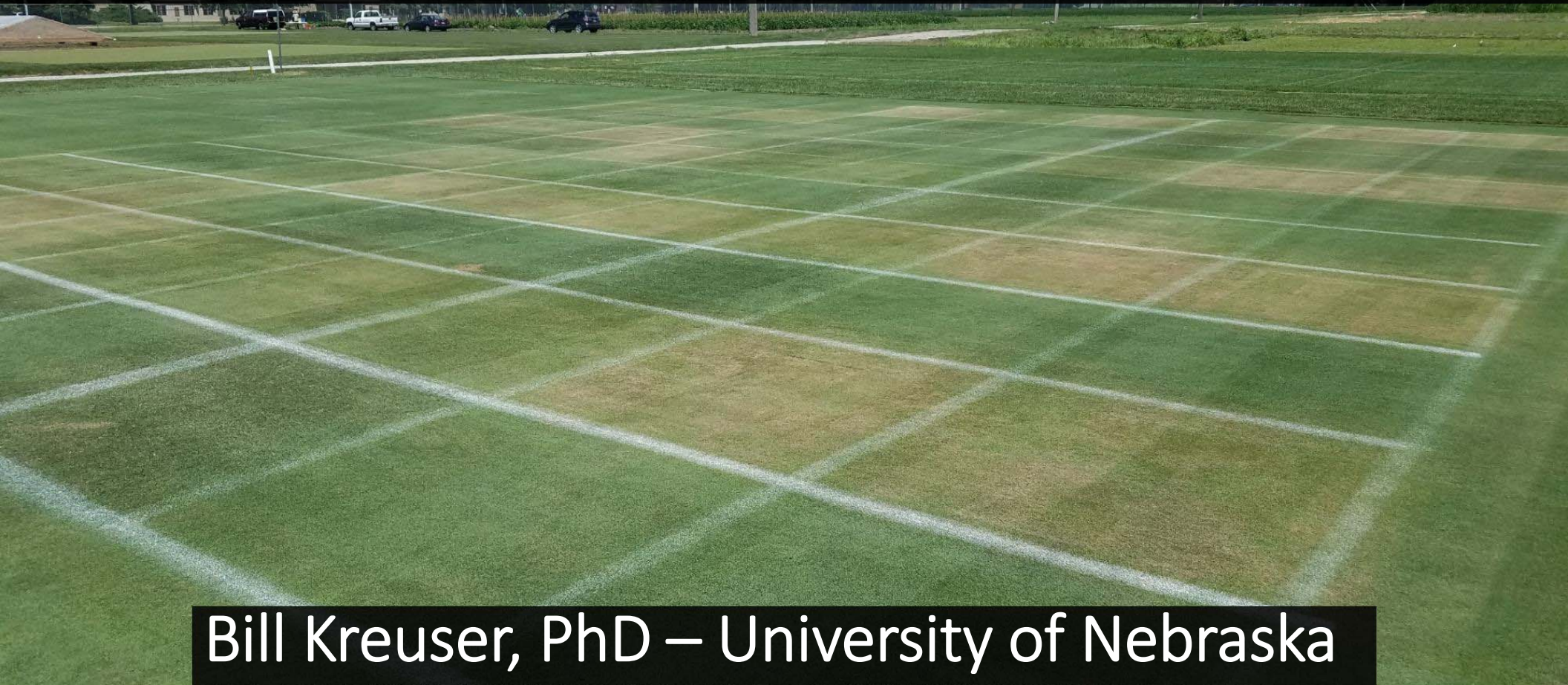


# Plant Growth Regulators and Collar Decline: Warm and Cool-Season Turf



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# PGR Over-Regulation on a Bentgrass Fairway





Over-regulation in the foreground on this  
Bent/Poa putting green



# Bentgrass green with bermudagrass collars and fairway turf





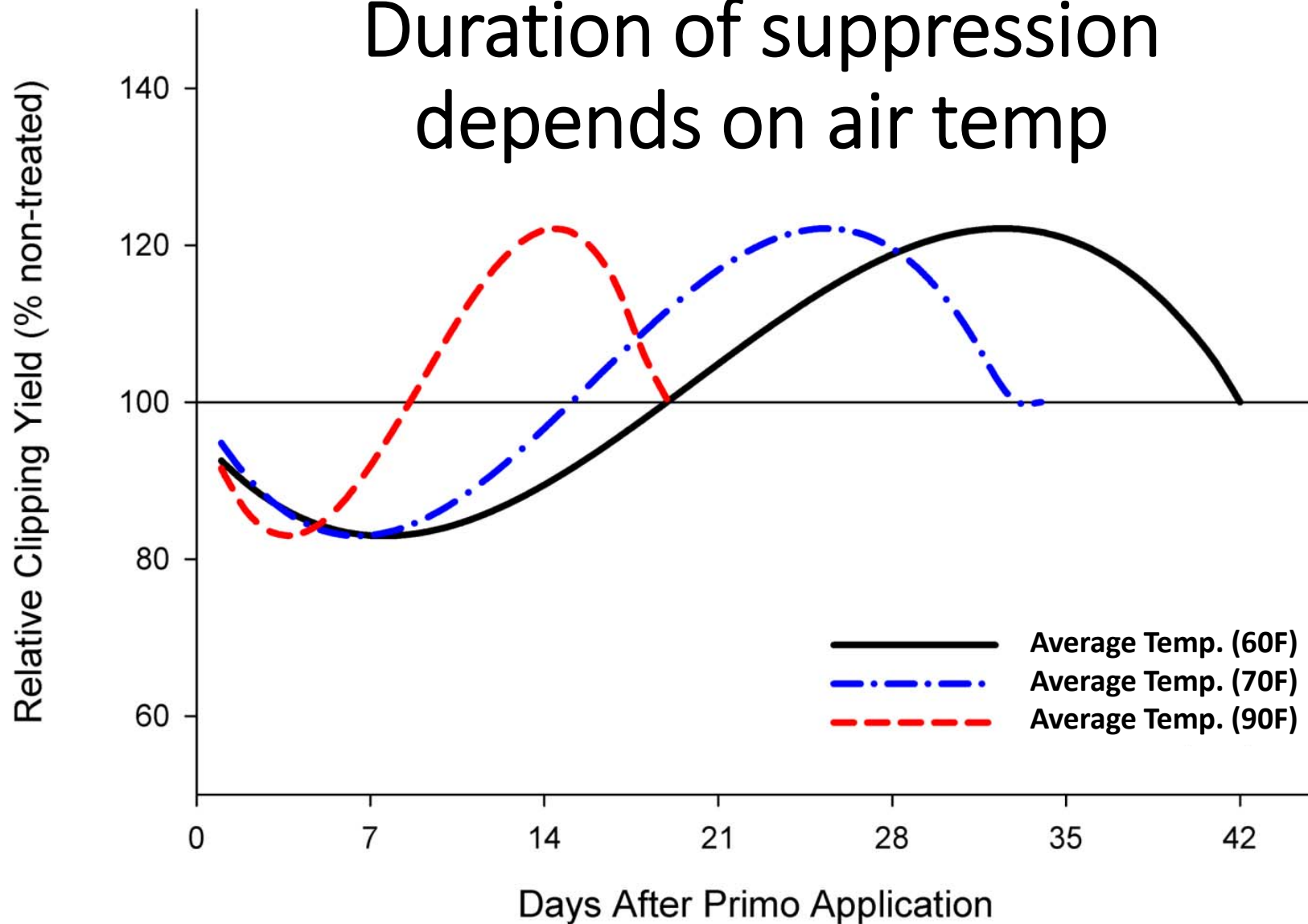
# PGR application rate, air temperature, and mowing program impact PGR performance

- PGR Duration: Air temperature (GDD) and mowing practices
- PGR Intensity: Application rate\*

\*Applications that are more frequent than ideal will increase amount of suppression



# Duration of suppression depends on air temp





# Fairways and roughs have longer PGR intervals than greens

PGR Common Name	Bentgrass Green Intervals (GDD)	Bentgrass Fairway Intervals (GDD)
Anuew	250	320-350
Primo Maxx	200	320-350
Trimmit	250-280	450-600
Cutless	180-240	350-380
Legacy	240-270	290-360
Musketeer	260	320-370



# Comparing PGR Performance on cool-season greens

Active Ingredient	Common Name	Growth Suppression	Duration of Effect	Ideal GDD
<b>Trinexapac-ethyl</b>	<b>Primo Maxx</b>	<b>20%</b>	<b>800 GDD</b>	<b>230 GDD</b>
Paclobutrazol	Trimmit	30-50%*	850-950 GDD*	280-310 GDD*
Flurprimidol	Cutless	20-30%*	600-800 GDD*	210-270 GDD*
Prohexadione-Ca	Anuew	25%	840 GDD	280 GDD
Flurprimidol + Trinexapac-ethyl	Legacy	20-35%*	810-910 GDD*	270-300 GDD*
Flurprimidol + Paclobutrazol + Trinexapac-ethyl	Musketeer	25-40%*	880 GDD	290

\* Range from low to high application rate



## Bentgrass Fairway Models: Much longer intervals and more suppression than greens

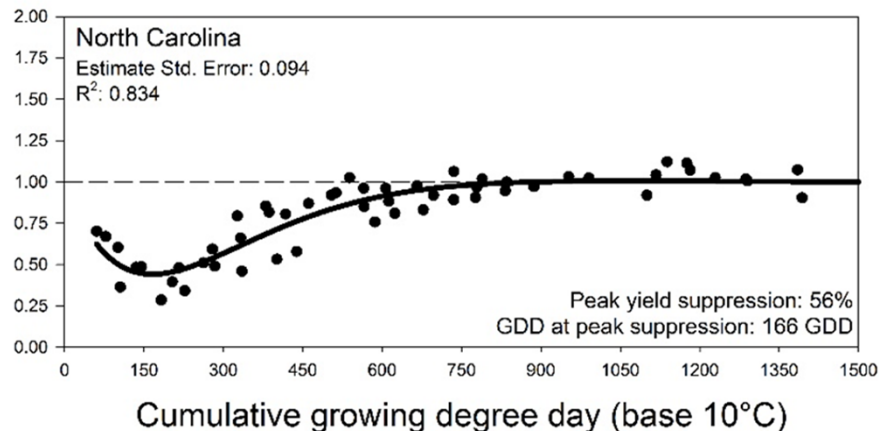
Active Ingredient	Common Name	Growth Suppression	Ideal GDD
<b>Trinexapac-ethyl</b>	<b>Primo Maxx</b>	<b>55-80%</b>	<b>350-380</b>
Paclobutrazol	Trimmit	70-80%	480-640
Flurprimidol	Cutless	30-40%	380-410
Prohexadione-Ca	Anuew	60-75%	350-380
Flurprimidol + Trinexapac-ethyl	Legacy	40-70%	320-390
Flurprimidol + Paclobutrazol + Trinexapac-ethyl	Musketeer	55-70%	350-400

# Now GDD models for ultradwarf greens

**Primo Maxx – 4 fl oz/acre**

**55% Suppression**

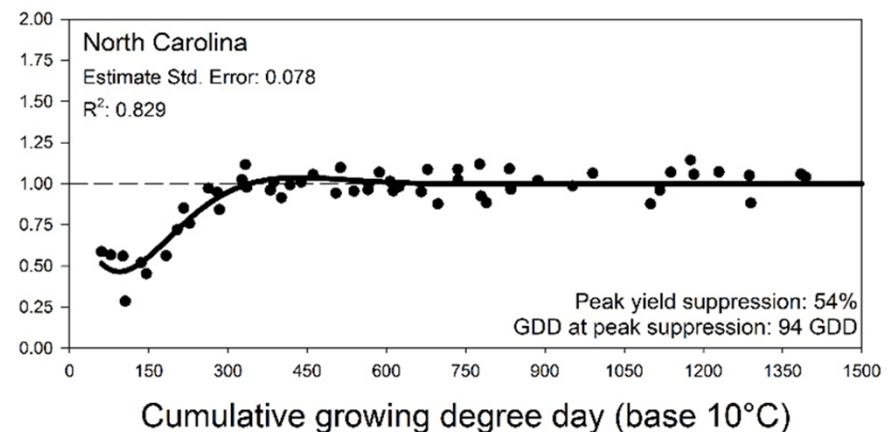
**220 GDD Interval (base 10C)**



**Anuew – 8 oz/acre**

**55% Suppression**

**125 GDD Interval (base 10C)**

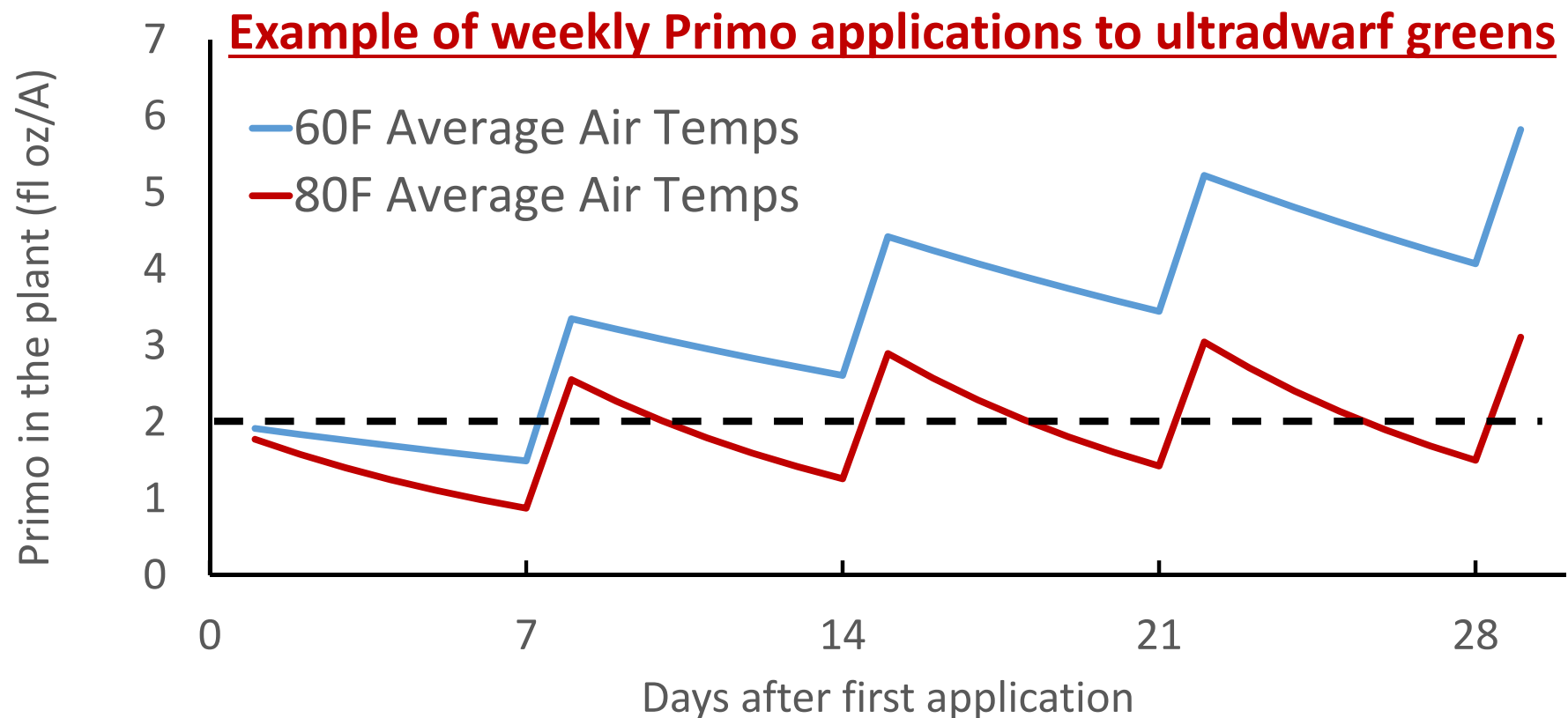




# Converting GDDs to Calendar Intervals

<b><u>Average</u> Air Temp (F)</b>	<b>Average Air Temp (C)</b>	<b>GDD (Base 10C)</b>	<b>Primo Maxx (220 GDD)</b>	<b>Anuew (125 GDD)</b>
40	4	0	Long Time!	Long Time!
60	16	6	36 days	21 days
70	21	11	20 days	11 days
80	27	17	13 day	7 days
90	32	22	10 day	6 days

# Re-applying PGRs too early intensifies growth suppression





# What is PGR over-regulation?

- Clipping yield that doesn't provide enough growth to support healthy turf
  - Poor traffic tolerance
  - Slow disease recovery
  - Mower injury lingers
- PGRs at high rates can cause discoloration

# How does PGR over-regulation occur?

- Misapplications less serious than most fear (rare)
- Summer re-application intervals during cold weather (seasonal)
- Overspray of fairways, collars, rough when treating greens (extremely common)



# Golf Collar Decline History

- Collar decline is a widespread issue across the golf industry
- Causes: Mower turns, soils, slower growing turf, PGRs?
  - **Hypothesis:** Collars and warm-season turf have longer intervals and more suppression than cool-season greens. Greens applications lead to excessive amounts of growth suppression.

# Collar Decline Research

## PGRs Applied at Green Rates/Intervals on a Creeping Bentgrass Fairway

- Primo Maxx – 5.5 fl oz/M @ 200 GDD
- Trimmit 2SC – 8.0 fl oz/M @ 260 GDD

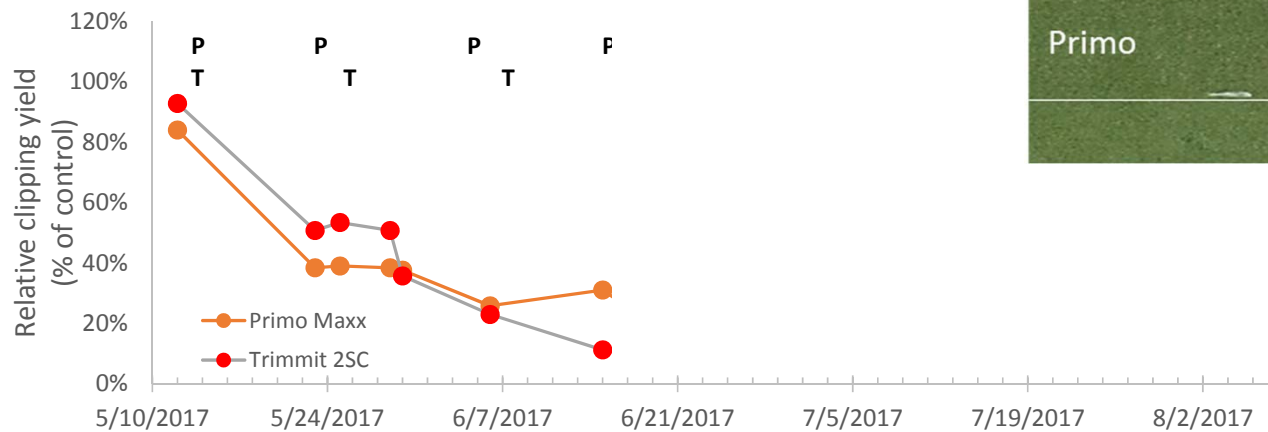
These intervals typically suppression bent greens by **20 and 35%**, respectively.



Picture Date:		6/5/17
Primo Maxx		Trimmit 2SC
5/10		5/10
5/22		5/26

One week later,  
phytotoxicity is becoming  
more apparent

Suppression 70-90%

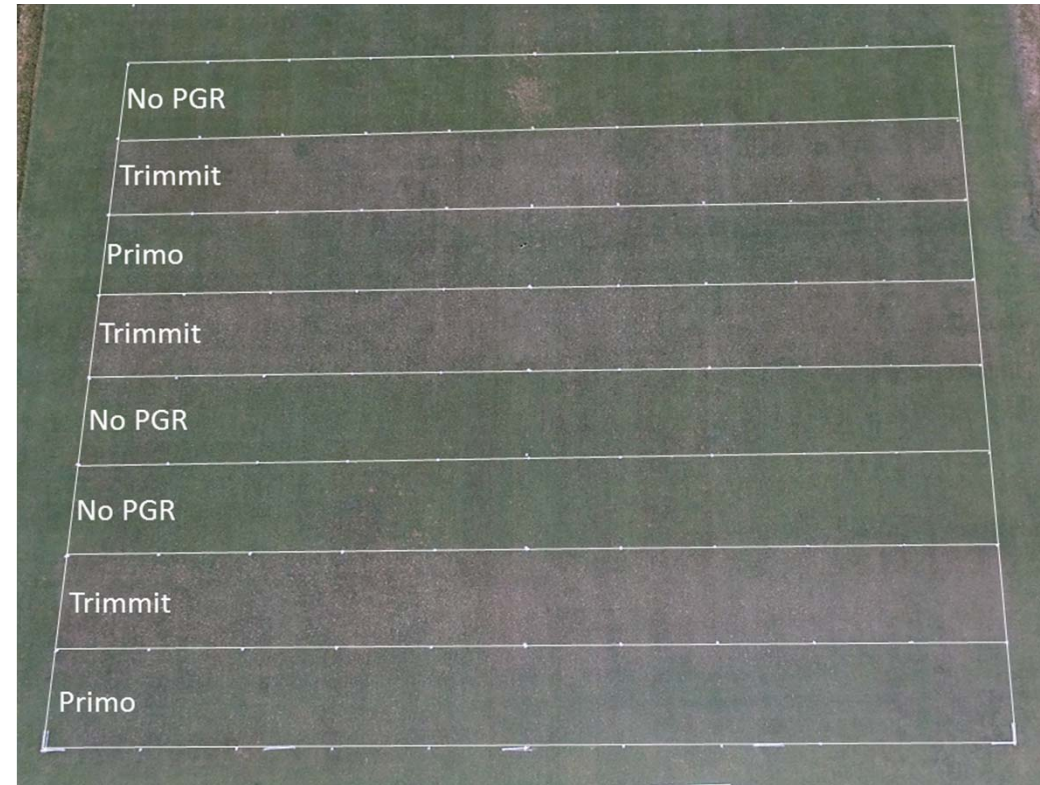
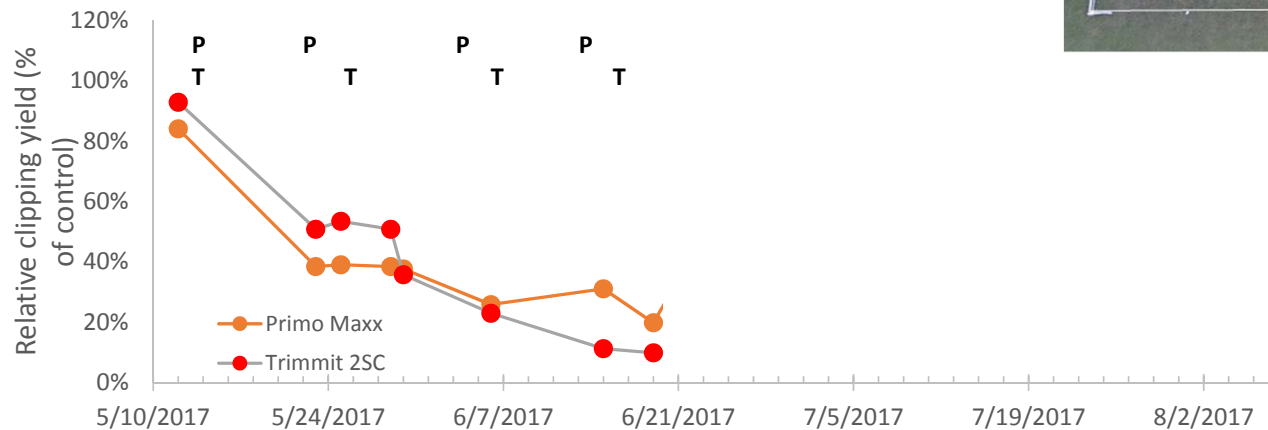


<b>Picture Date:</b>	<b>6/14/17</b>
<u>Primo Maxx</u>	<u>Trimmit 2SC</u>
5/10	5/10
5/22	5/26
6/5	6/7



Six weeks of greens PGR rates  
and intervals causes severe  
phytotoxicity on collars

Suppression 80-95%



Picture Date:	6/21/17
Primo Maxx	Trimmit 2SC
5/10	5/10
5/22	5/26
6/5	6/7
6/14	6/16

# Recovery from PGR over-regulation

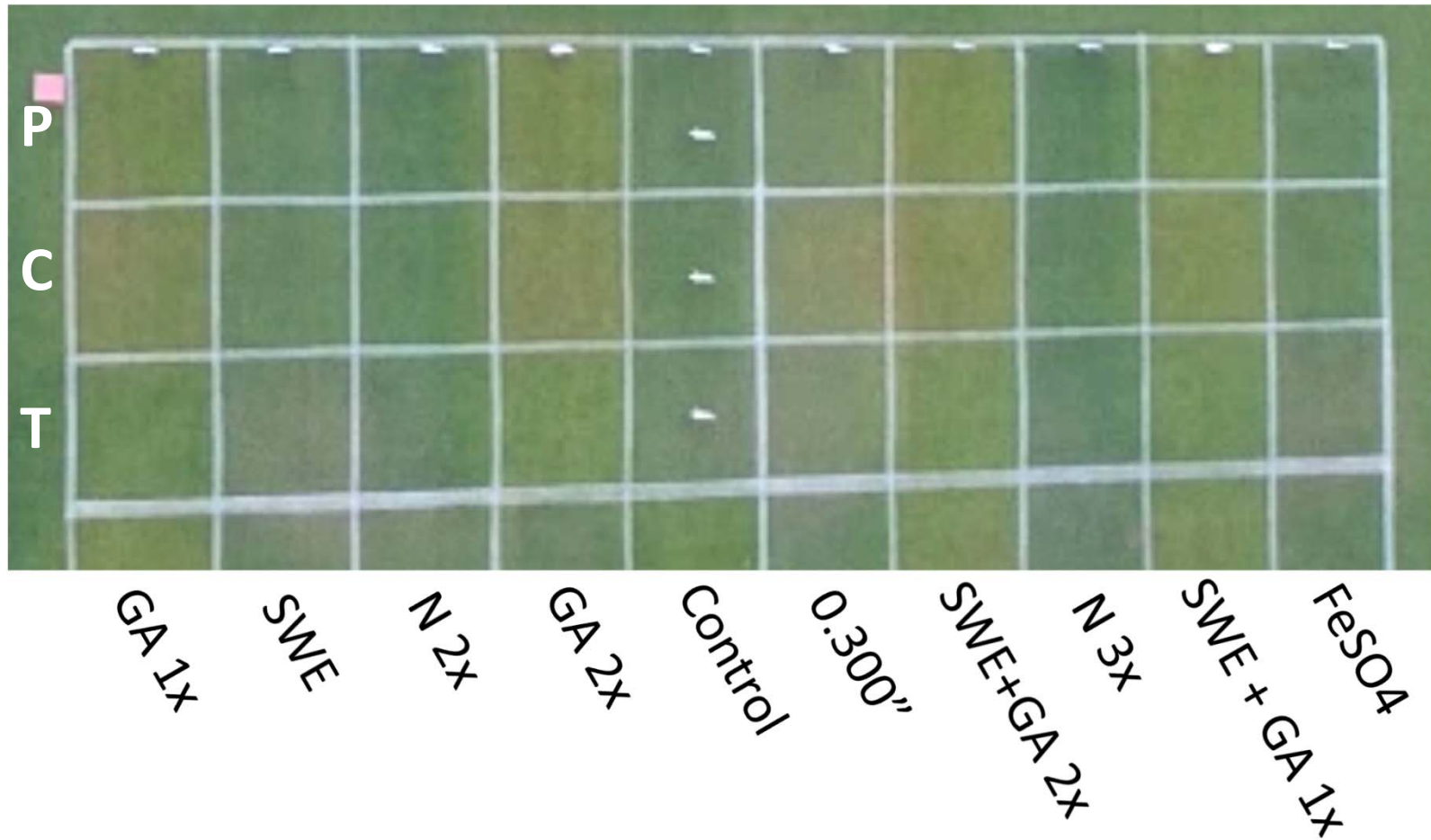
2 Days After Recovery Treatments





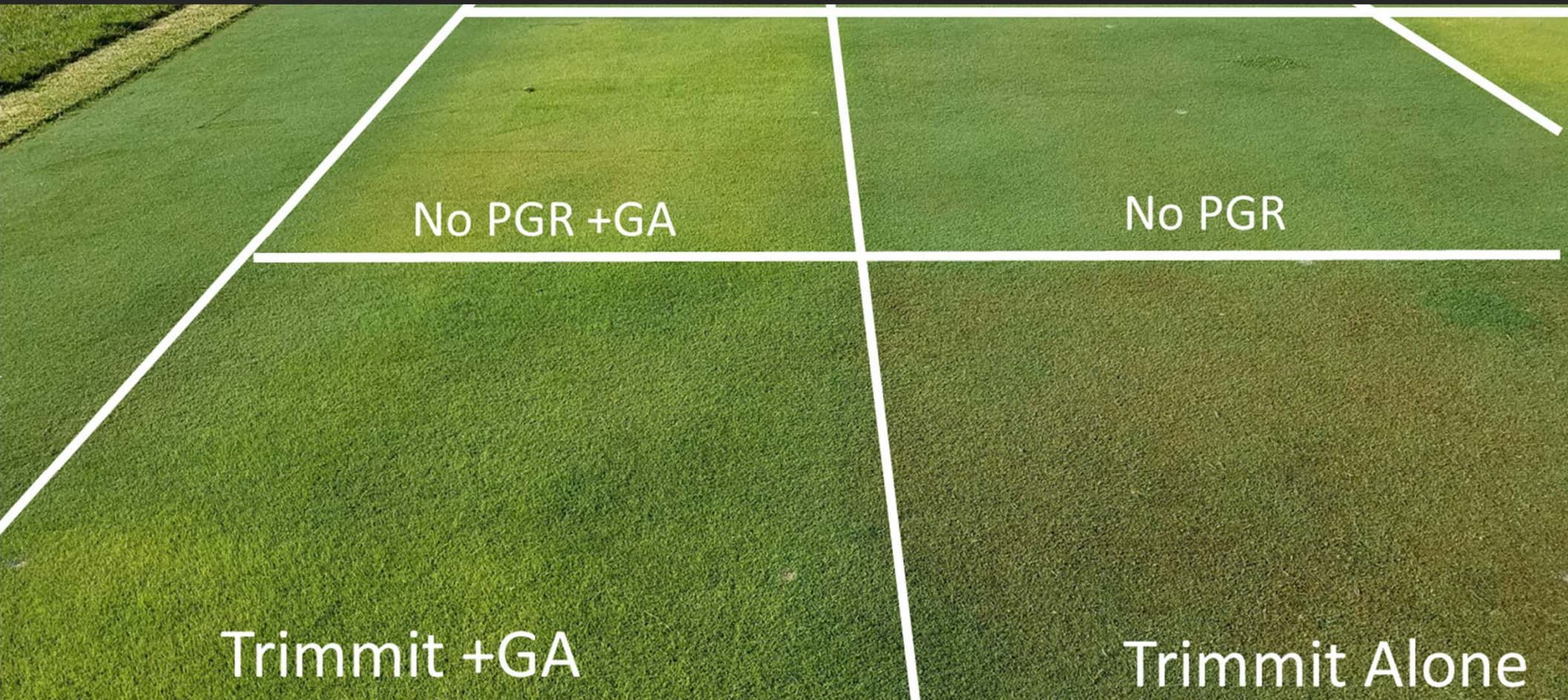


## 2 Week After First Application





Gibberellin helps over-regulation but caused severe etiolation on non-treated

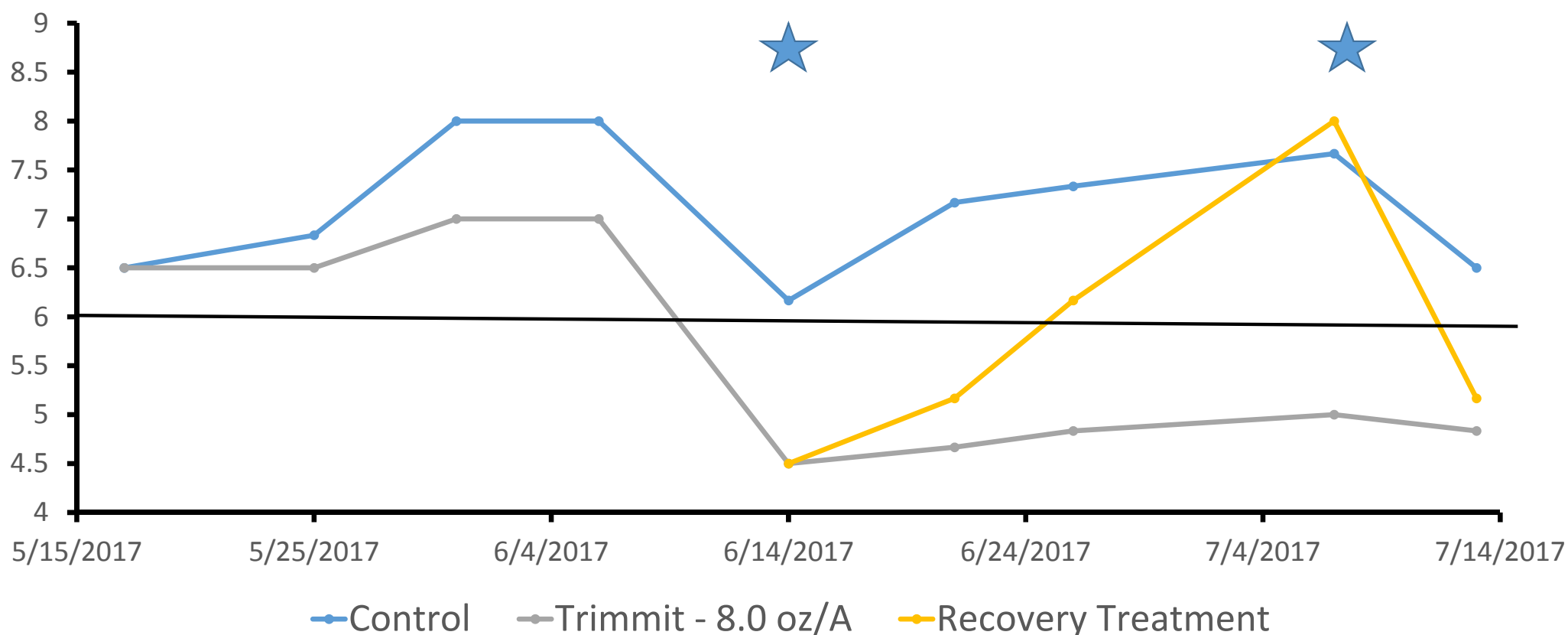




Second application led to collapse of control and  
Primo treated; Trimmit OK



# Gibberellin helped after one application but quality collapsed after a second GA application

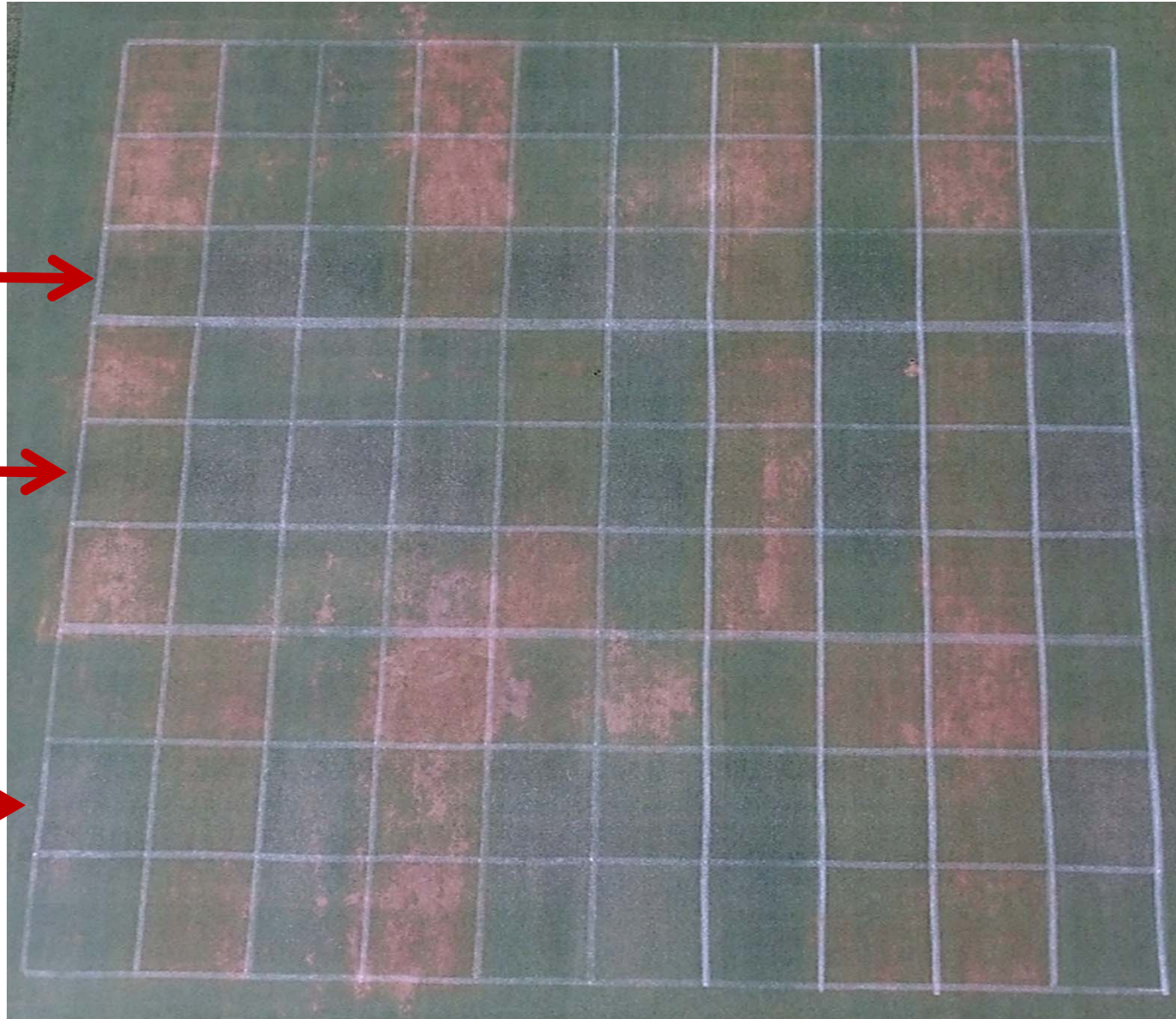




Recovery from  
PGR Over-  
regulation

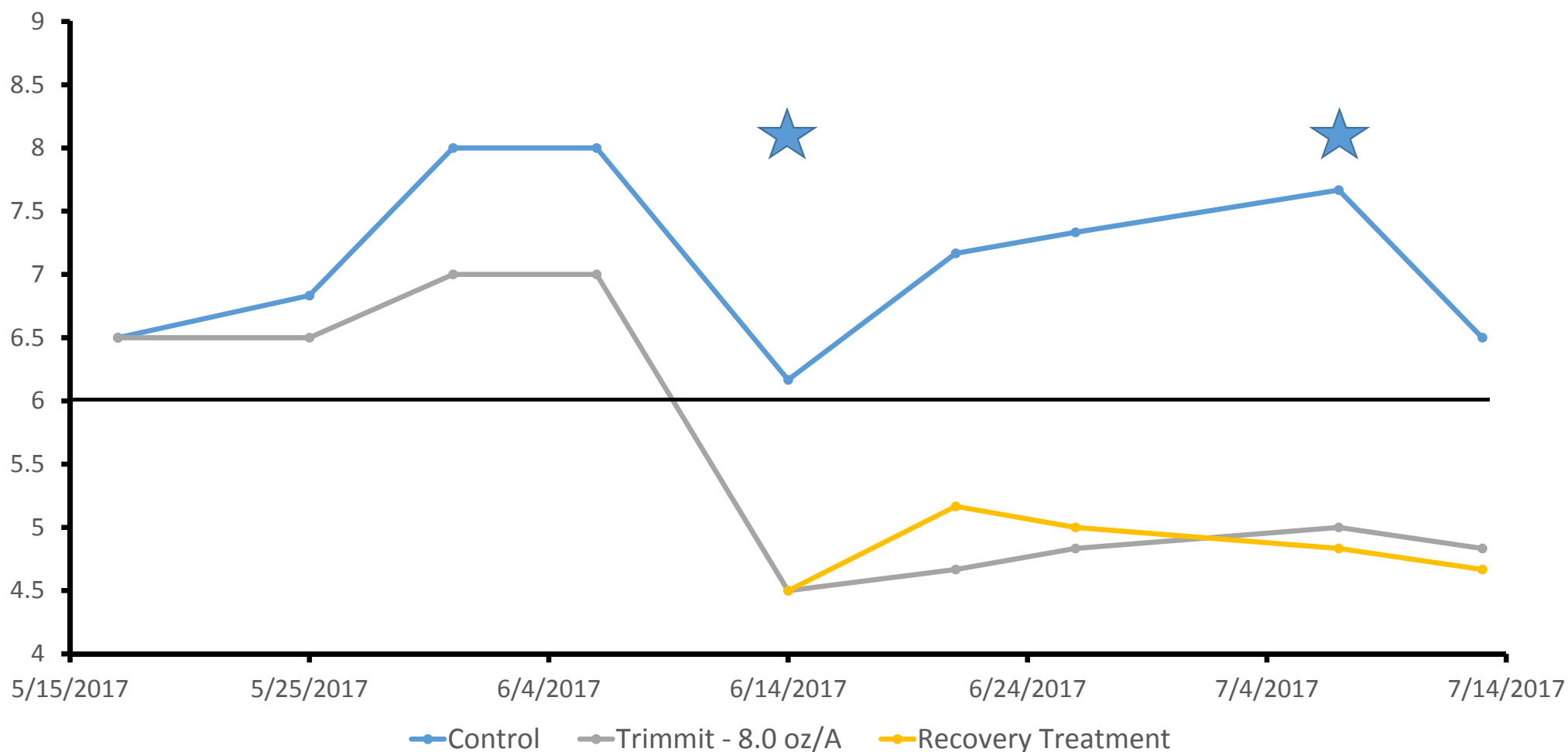
Too Much of a  
Good Thing  
Possible

Trimmit strips  
had no scalping

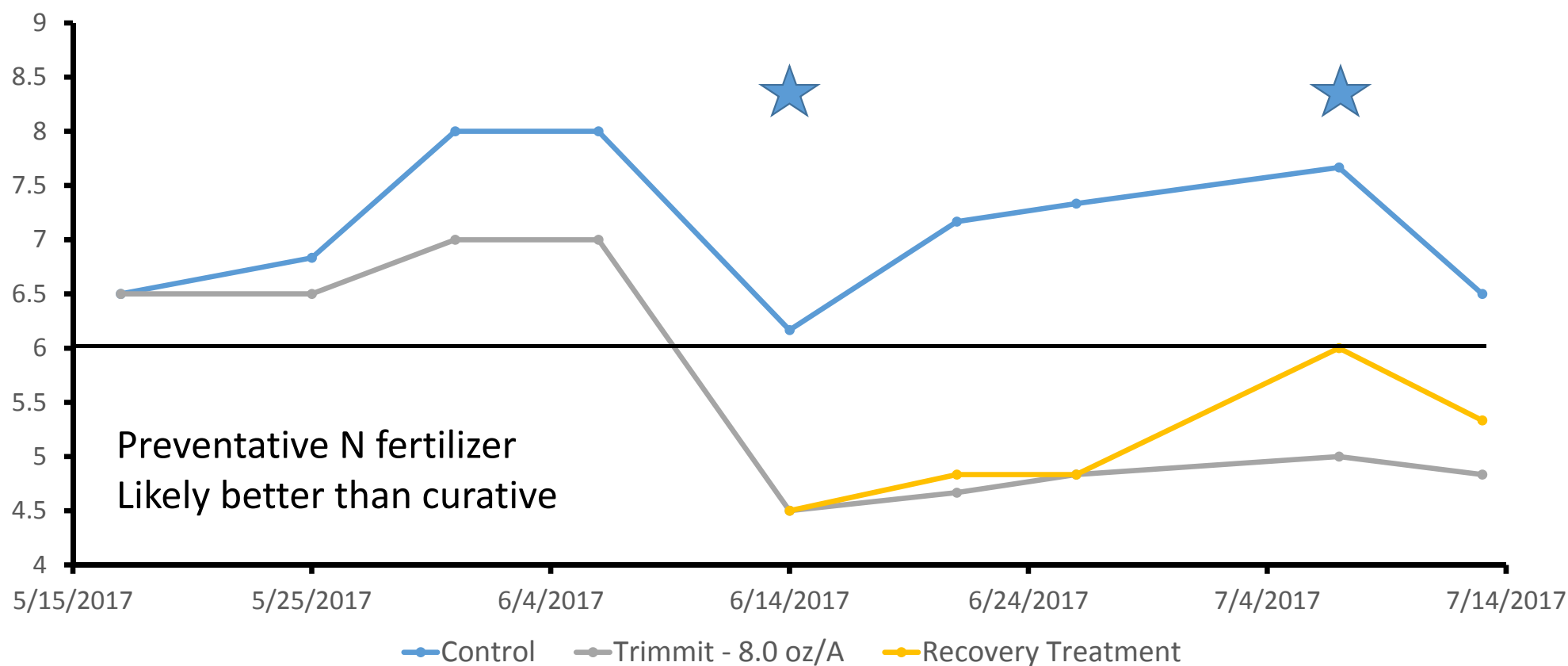




# Iron fertilizer didn't help phytotoxicity



# Increased nitrogen fertilization and lowered mowing heights are preventative – not curative



Research still on-going. Washing off Class A PGRs?





# Matthew Wharton at Carolina Golf Club washes Primo off his bermudagrass collars



Struggling Collars



Immediately Washed Off



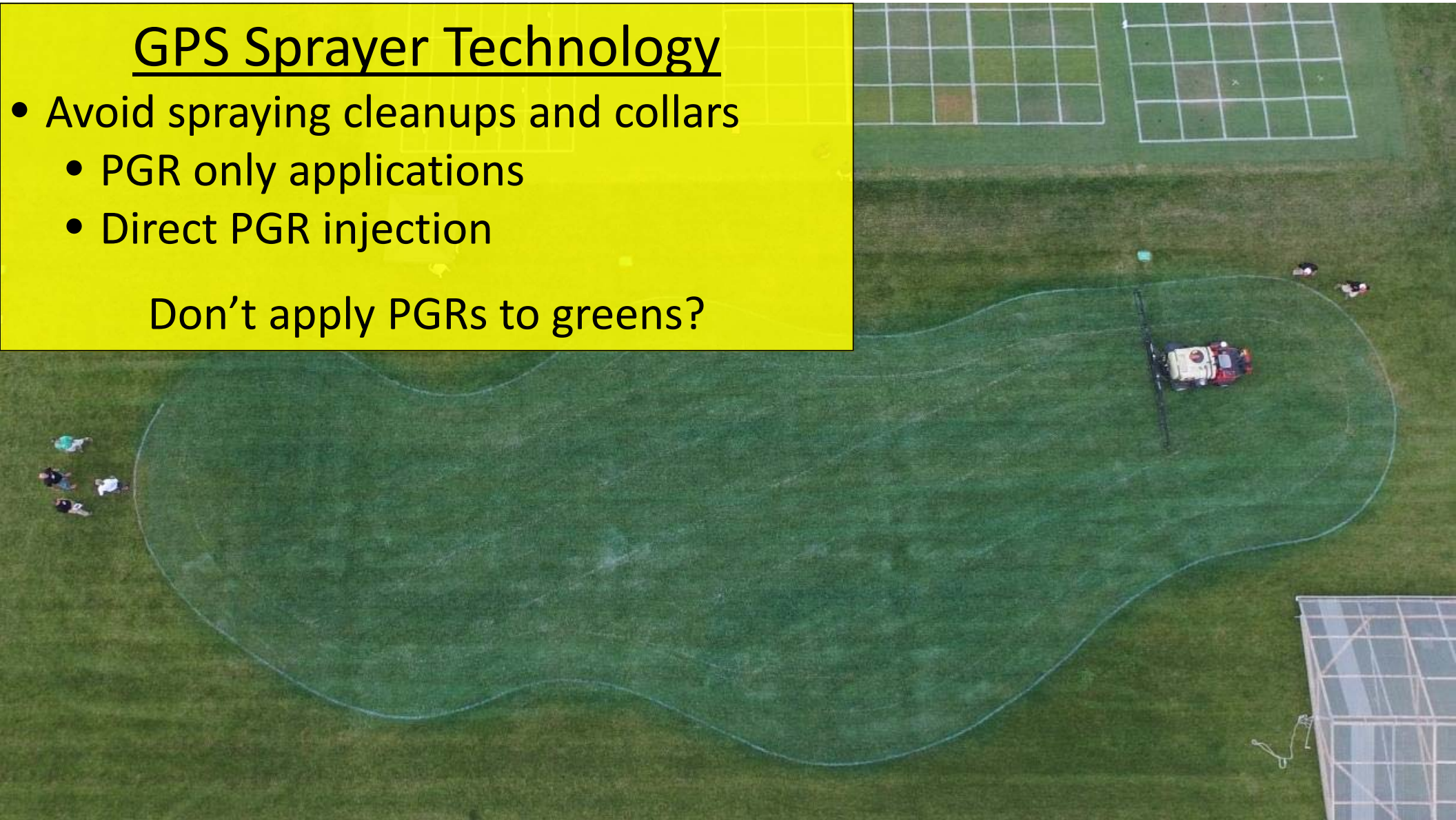
Improved Collars



## GPS Sprayer Technology

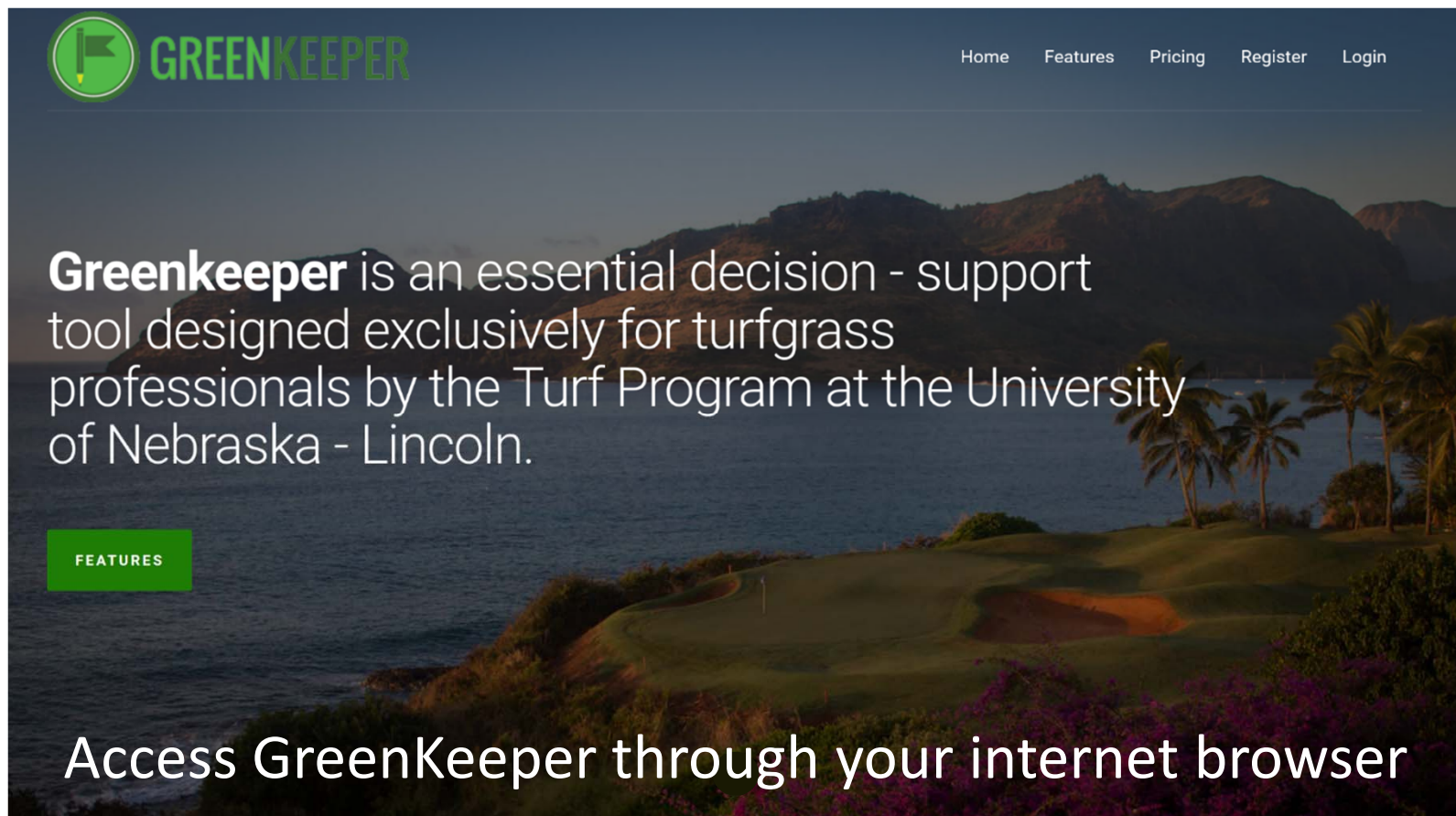
- Avoid spraying cleanups and collars
  - PGR only applications
  - Direct PGR injection

Don't apply PGRs to greens?



# GreenKeeperApp.com

Decision-support tool to guide turf agronomics

A screenshot of the GreenKeeperApp.com website. The background is a scenic image of a golf course with a green, a sand trap, and palm trees, set against a backdrop of mountains and a body of water. The website's header is dark blue with the GreenKeeper logo (a green circle with a white flag) and the text 'GREENKEEPER' in green. To the right of the logo are navigation links: 'Home', 'Features', 'Pricing', 'Register', and 'Login'. The main content area has white text on the left that reads: 'Greenkeeper is an essential decision - support tool designed exclusively for turfgrass professionals by the Turf Program at the University of Nebraska - Lincoln.' Below this text is a green button with the word 'FEATURES' in white. At the bottom of the page, there is a white text overlay that says 'Access GreenKeeper through your internet browser'.



## REMINDERS:

### Reapplication Reminder

Control of Heritage 50 WG has expired on Greens

## PRODUCT EXPIRATION LIFETIME:

### Greens

**Heritage 50 WG** (Ingredients: Azoxystrobin Target Pests: Take-all Patch - Preventative)

107%

Lifespan: 10/16/17 - 11/13/17

Days Control: 30/28

**Trimmit 2SC** (Ingredients: Paclobutrazol Target Pests: PGRs - Preventative)

94%

Lifespan: 10/16/17 - 11/17/17

GDD: 234/250

Relative Clipping Yield: 35% Suppression

**Velista** (Ingredients: Penthiopyrad Target Pests: Snow Mold - Preventative)

57%

Lifespan: 11/07/17 - 11/21/17

Days Control: 8/14

### Front Nine Tees

**Primo Maxx** (Ingredients: Trinexapac-ethyl)

## ACTIONS

My Course

Products

Report Pests

New Application

Past Applications

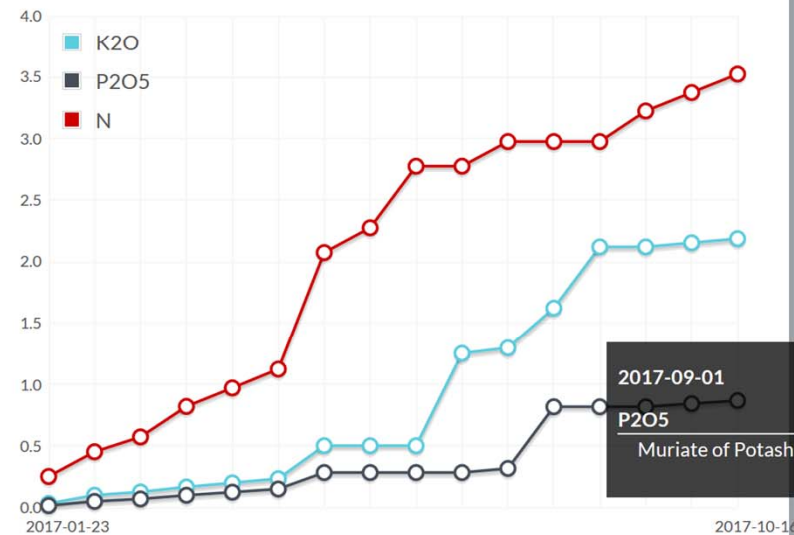
## CUMULATIVE FERTILIZER APPLIED (LBS / 1000 SQ FT)

Download

01/01/2017

12/31/2017

Greens



N x

P2O5 x

K2O x

0.82  
lbs / 1000<sup>2</sup> ft  
+0

2017-09-01  
P2O5  
Muriate of Potash-Granular  
(0-0-60)

0



# Example of PGR GDD Tracking

PRODUCT EXPIRATION LIFETIME:

Greens

Trimmit 2SC (Ingredients: Paclobutrazol Target Pests: PGRs - Preventative) ×

129%

Lifespan: 10/05/17 - 10/25/17  
GDD: 322/250  
Relative Clipping Yield: 10% Rebound

Front Nine Tees

Primo Maxx (Ingredients: Trinexapac-ethyl ) ×

38%

Lifespan: 10/20/17 - 11/18/17  
GDD: 114/298  
Relative Clipping Yield: 34% Suppression



# Questions and Comments



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