



# Advances in Disease and Weed Control in Warm-Season Grasses

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# What has changed in turf pest management?



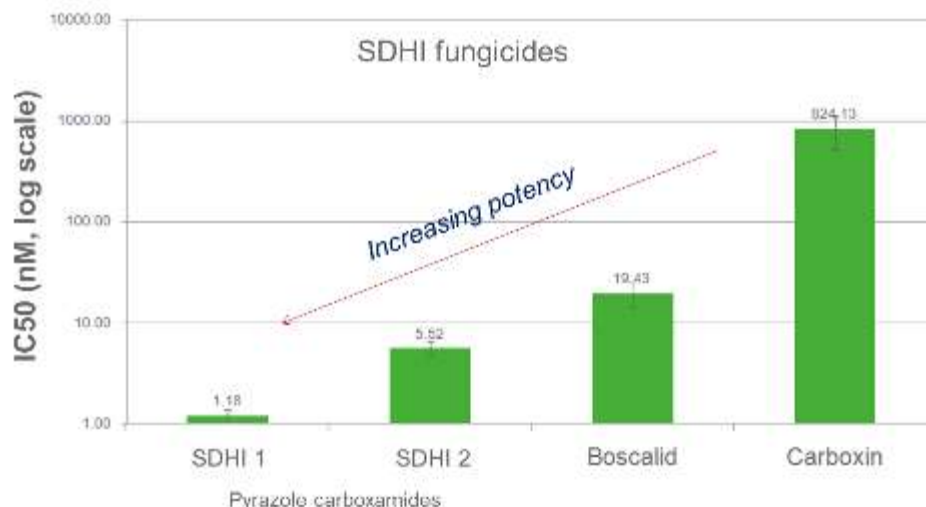
From *Bulletin US Golf Association Green Section*, Vol. 12, 1932



Photo by L.P. Tredway, 2018

# Optimized Target Site Activity Enables Reduced Rates

**IC<sub>50</sub> values of different SDHI fungicides on succinate dehydrogenase activity of *Septoria tritici* (in vitro).**



Pest	1998 Standard	Grams AI/acre	2018 Standard	Grams AI/acre
White Grubs	Merit® insecticide	180	Acelepryn® insecticide	48
Dallisgrass	MSMA	930	Monument® herbicide	10
Dollar Spot	Banner MAXX® II fungicide	400	Posterity® fungicide	40
Nematodes	Nemacur® nematicide	4,500	Indemnify® nematicide	200

# Increasing Regulatory Scrutiny on Crop Protection Chemicals

## Current Areas of Emphasis

- Risks to humans and domestic animals
- Risks to non-target organisms
- Applicator/user exposure
- Post-application exposure
- Spray drift potential
- Environmental fate
- Residue chemistry

- Applies to new registrations and re-registrations
- Increasing development and product support costs
  - New product registration
    - 8-10 years, ~\$300 million
  - Registration review every 15 yrs
    - 6-7 years, \$2-5 million

# Creating Multiple Streams of New AI Discovery



Random synthesis



Natural products and derivatives



Targeted development



Re-invention of older chemistries



3<sup>rd</sup> party partnerships



Biologicals

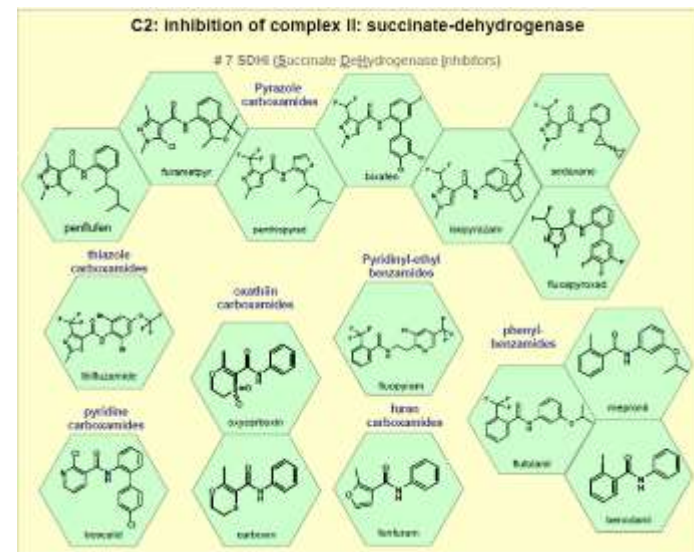
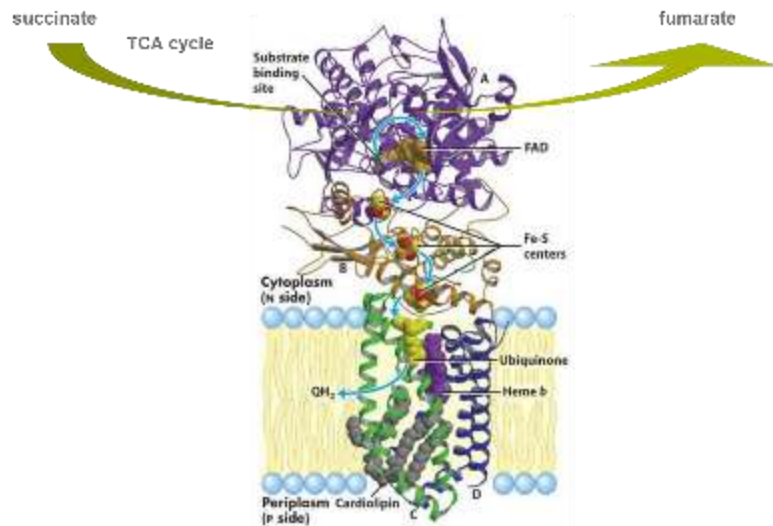


Emerging technologies

## Turfgrass Fungicides: Few New Chemistries, Many New Products

Category	2008	2018
Modes of Action	14	16
Active Ingredients	29	40
Unique AI Combinations	45	71

Source: Pest Control for Professional Turfgrass Managers, NC State University, 2008 and 2018







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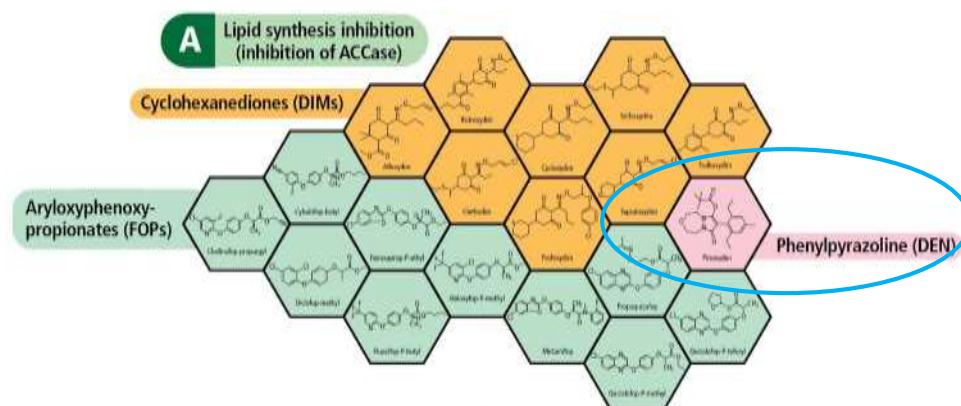
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# Group 1 Herbicides - ACCase Mode of Action

- Absorbed through green leaf tissue and translocated to growing point
- Inhibit fatty acid biosynthesis and prevent formation of cell membranes needed for growth
- Depolarize cell membranes in leaf tissue, disrupting cell function and survival
- Halt new growth and eventually lead to weed death
- Turf use has been historically limited by narrow control spectrum and/or lack of turf safety
- Pinoxaden brings a new class of chemistry to the turf market – phenylpyrazoline or ‘DEN’

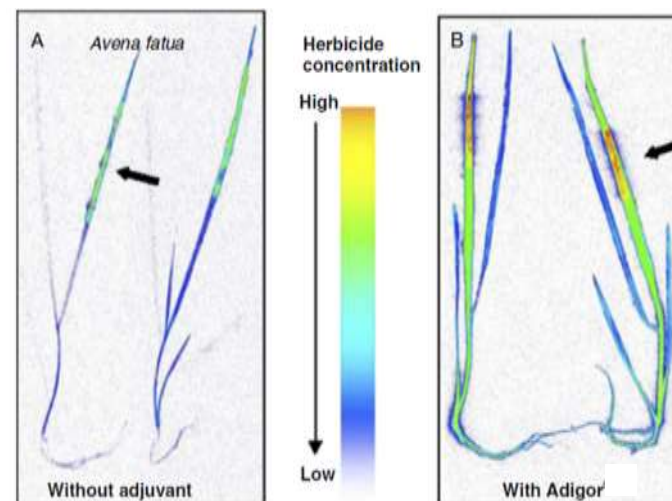
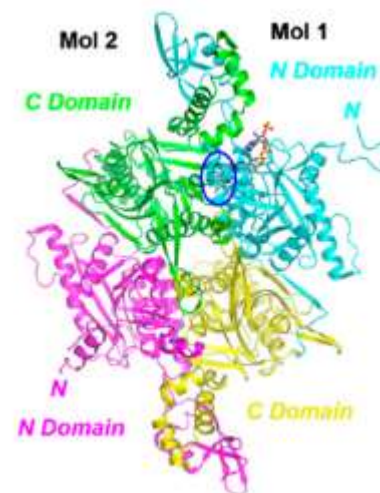
Chemistry	Common Name	Brand Name
aryloxyphenoxy-propionates “FOPs”	fenoxaprop-P-ethyl	Acclaim® Extra
	fluazifop-P-butyl	Fusilade® II
cyclohexanediones “DIMs”	clethodim	Envoy Plus™
	sethoxydim	Segment®
phenylpyrazoline “DEN”	pinoxaden	Manuscript®





# Optimized Components

- Pinoxaden represents a **new class of chemistry** to the turf market – phenylpyrazoline or '**DEN**'
- Advanced form of ACCase mode of action, specifically engineered for
  - Improved crop safety
  - Potent activity on tough grassy weeds
- A **proprietary safener**, cloquintocet-mexyl, speeds metabolism in desirable turf without affecting control of target weeds
- Includes **Adigor™™ surfactant**, custom-built to maximize Manuscript® performance



# Bermudagrass and Zoysiagrass Safety: Manuscript + Adigor™

- Manuscript® demonstrates excellent safety to bermudagrass and zoysiagrass turf, even at spot treatment rates
  - Similar to Monument®
  - Minor discoloration or phytotoxicity (10% or less) occasionally observed 7-10 days after the first application
  - Recovery typically occurs by 14 days after first application
  - Second application typically less injurious



Untreated

Manuscript  
9.6 fl oz/10,000 ft<sup>2</sup>

Performance assessments are based upon results or analysis of public information, field observations and/or internal Syngenta evaluations. Trial reflects treatment rates commonly recommended in the marketplace.

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# Tropical Signalgrass Control with Spot Treatments: Indian Creek Country Club, Hole #6



Manuscript® (9.6 fl oz/10,000 ft<sup>2</sup>) + Adigor™ (0.5 % v/v) applied twice on 21-day interval.

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# Smooth Crabgrass Control in 'Patriot' Bermudagrass Askew, VA Tech University, Blacksburg VA



Untreated

Manuscript® (9.6 fl oz/10,000 ft<sup>2</sup>)  
5-7 tiller crabgrass

Drive® XLR8 (64 fl oz/acre)  
5-7 tiller crabgrass

Manuscript applied on July 5 and July 20 at 9.6 fl oz/10,000 ft<sup>2</sup> and mixed with Adigor™ at 0.5% v/v. Drive applied on July 5 and July 20 at 64 fl oz/acre and mixed with MSO at 0.5% v/v.

Performance assessments are based upon results or analysis of public information, field observations and/or internal Syngenta evaluations. Trial reflects treatment rates commonly recommended in the marketplace.

## Manuscript Herbicide – Key Features and Benefits

- Active Ingredient: pinoxaden (Group 1 or ACCase inhibitor)
- Includes safener technology cloquintocet-mexyl
- Packaged with proprietary surfactant – Adigor
- Labeled for all turfgrass sites, except golf course putting greens
  - Safe to bermudagrass and zoysiagrass turf
  - St. Augustinegrass – sod only
- Key weeds – tropical signalgrass, crabgrasses, dallisgrass
  - Requires spot treatment application for control of mature weeds (9.6 fl oz/10,000 ft<sup>2</sup>)



# **Introducing Posterity<sup>®</sup> Fungicide**

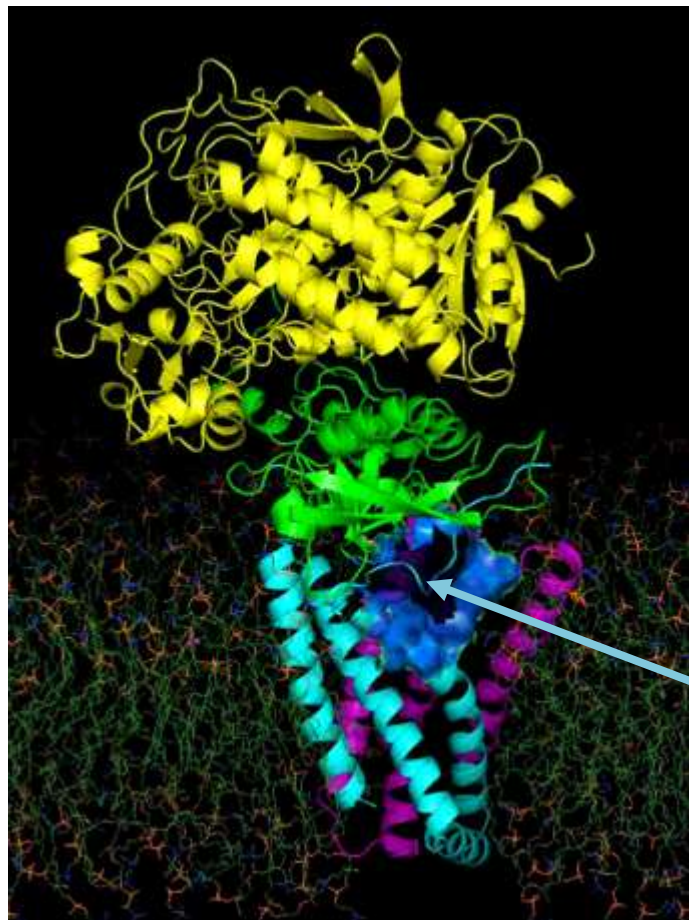
## **Holds Strong for Many Moons**



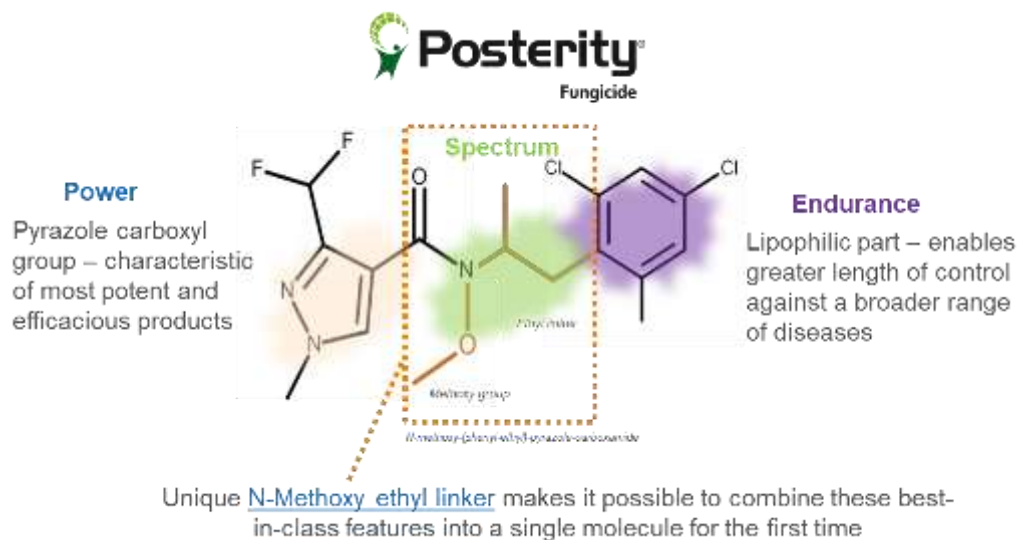
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# The chemistry of the SDHI fungicides is critically important to the potency of the compound



Complex II (succinate dehydrogenase)  
in mitochondrial membrane



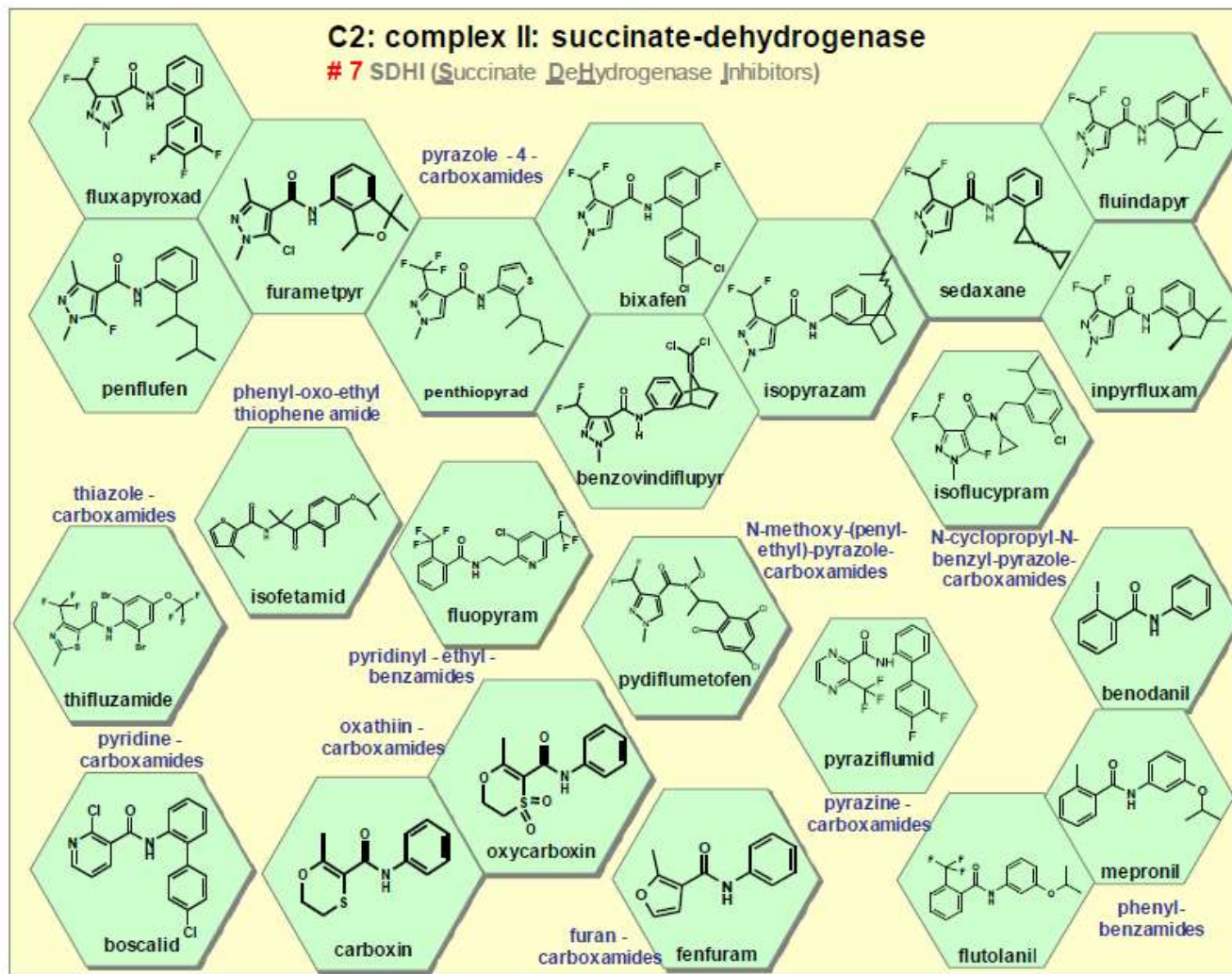
SDHIs displace ubiquinone,  
inhibiting conversion  
succinate to fumarate

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**The SDHI class of chemistry has expanded rapidly – more are still in development.**

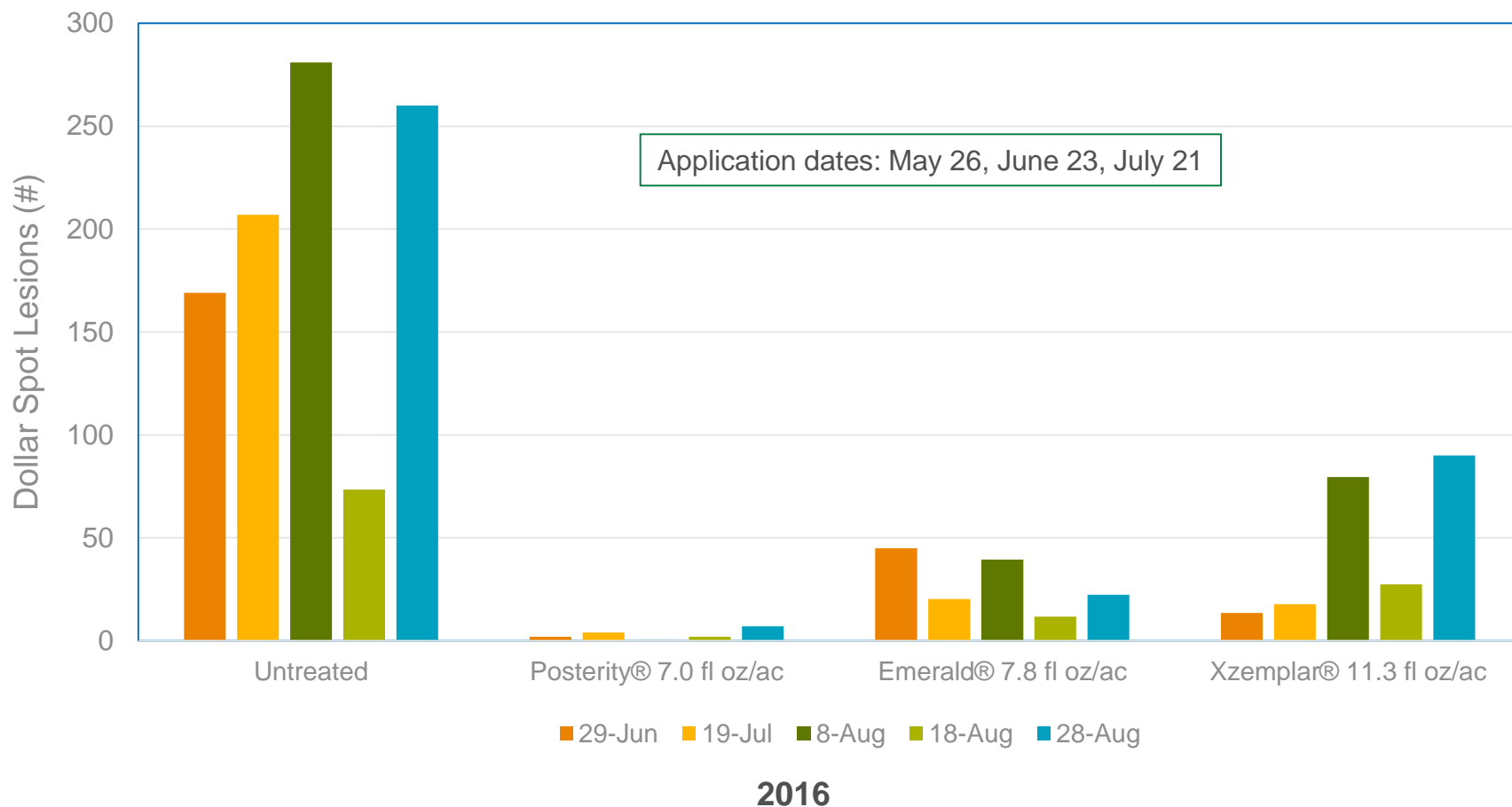


# SDHI Label Spectrums of Key Diseases

Diseases Controlled	Emerald® (boscalid)	Prostar® (flutalonil)	Xzemplar® (fluxapyroxad)	Kabuto® (isofetamid)	Exteris™ Stressgard® (fluopyram) (trifloxystrobin)	Velista® (penthiopyrad)	Posterity® (pydiflumetofen)
Dollar Spot	✓		✓	✓	✓*	✓	✓
Fairy Ring		✓	✓			✓	✓
Microdochium Patch			✓		✓*	✓	✓
Rhizoctonia diseases		✓	✓		✓*	✓	
Spring Dead Spot				✓	✓*	✓	✓
Anthracnose						✓	
Summer Patch			✓			✓	

\*fluopyram as a fungicide was launched as a pre-mix

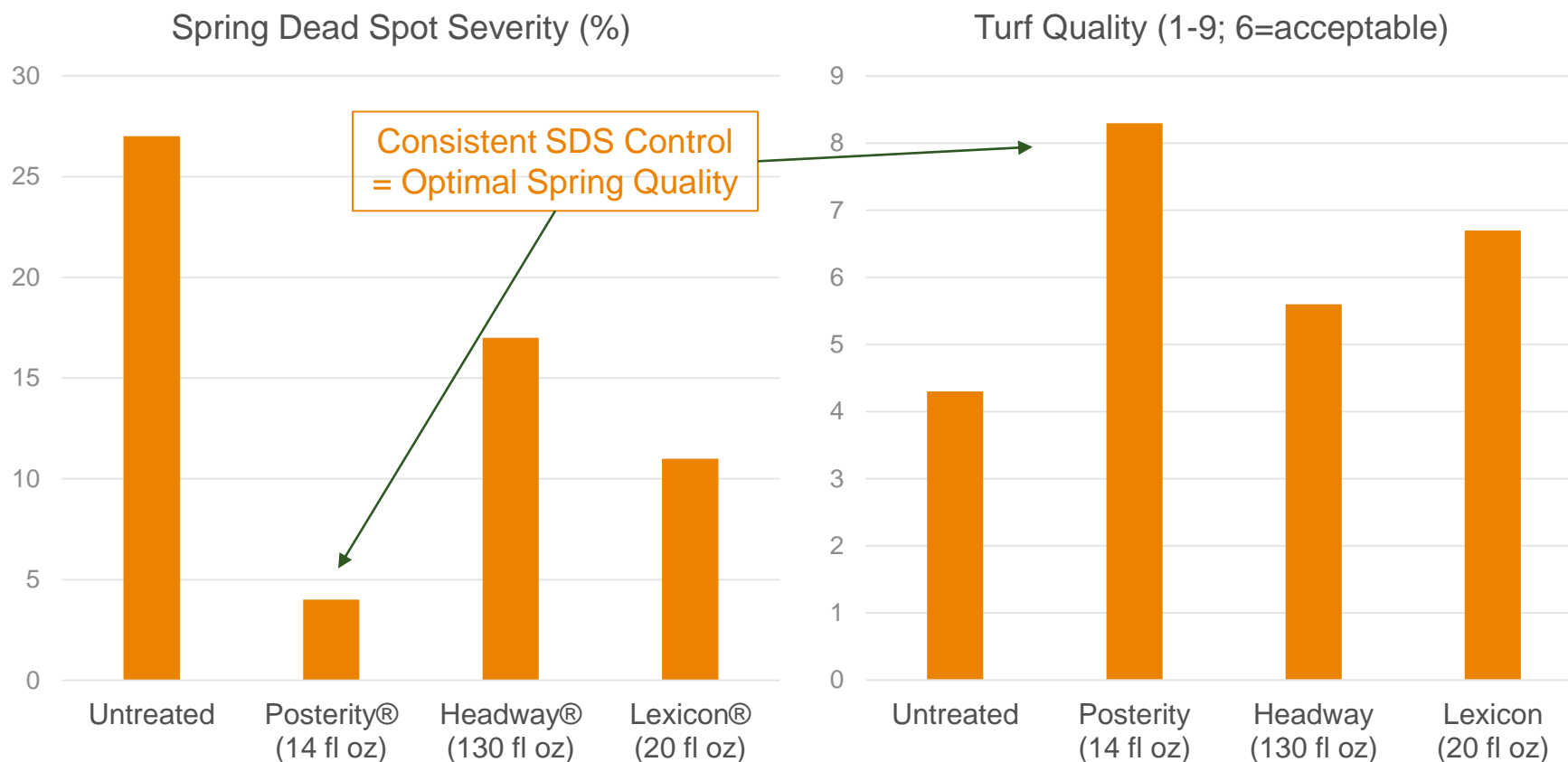
# Dollar Spot Control: 28-day Spray Intervals



Research Conducted by Bruce Clarke, Rutgers University

Fungicides applied in 1.89 gallons H<sub>2</sub>O/1000 ft<sup>2</sup>

# Consistent Spring Dead Spot Control



in Champion Bermudagrass  
Bruce Martin, Clemson University, Florence SC, 2016-2017

All rates are per acre. Treatments applied Sept 22 and Oct 20, 2016. Data collected April 28, 2017.



# Spring Dead Spot Control in Hybrid Bermudagrass Roughs

Syngenta Internal Trial, Greenville SC, 2016-2017



Untreated Control



Posterity® 14 fl oz/acre



Lexicon® 20 fl oz/acre



Xzemplar® 11.3 fl oz/acre

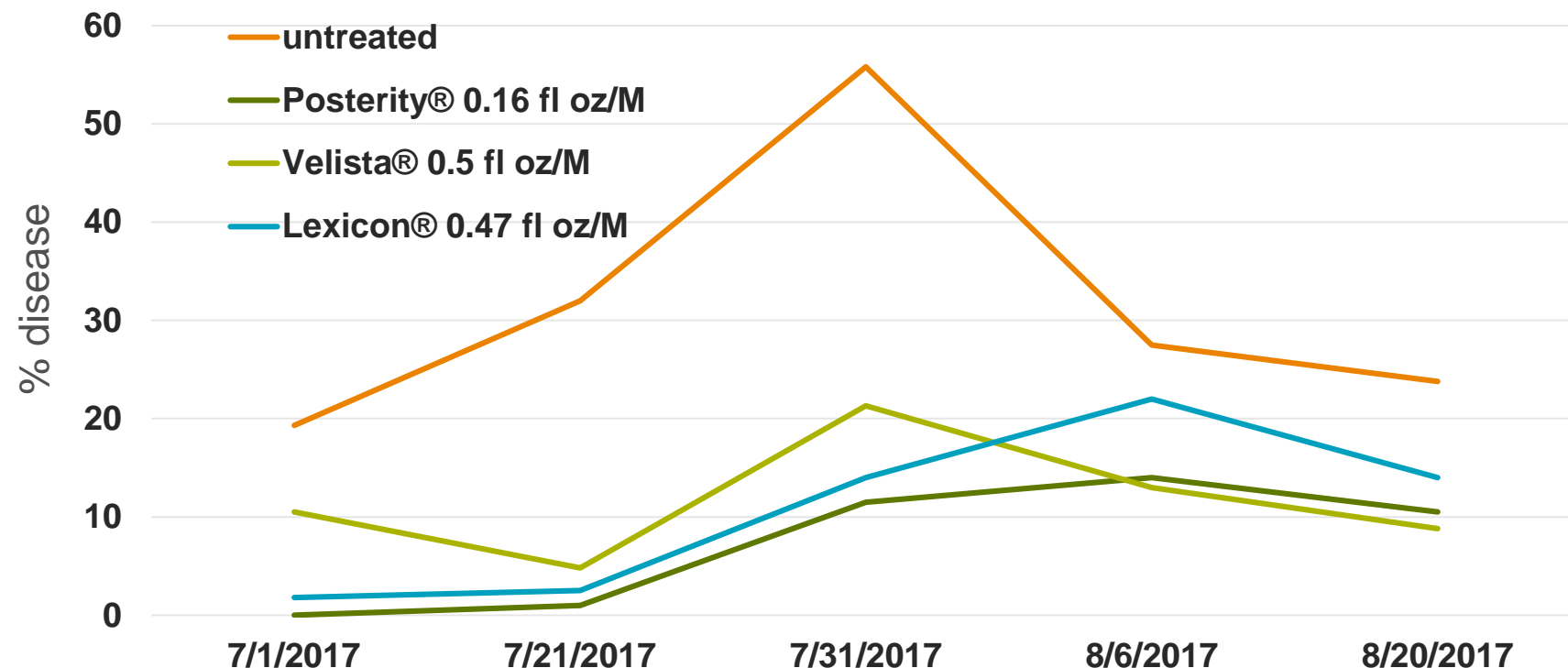
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# Preventative Fairy Ring Control

Bruce Clark, Rutgers University, 2017



Trial was conducted in an area with severe fairy ring in 2016

4 applications on a 28 day schedule - May 2, May 30, June 27, July 25.

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## Posterity Fungicide – Key Features and Benefits

- Active Ingredient: pydiflumetofin (Group 7 or SDHI)
- Labeled for golf course turf only
- Key diseases – spring dead spot, fairy ring, and dollar spot
  - Spring Dead Spot
    - 2 applications on 28-day interval prior to dormancy
    - 14 fl oz/acre for greens; 7 fl oz/acre on higher heights
  - Fairy Ring
    - 7 to 14 fl oz/acre on 28-day interval
  - Dollar Spot
    - 7 fl oz/acre on 21-day interval; 9.1 fl oz/acre on 28-day interval

## Summary and Conclusions

- The future for crop protection chemistry is very bright, thanks to modern discovery processes and formulation methods
- Although new chemistries are rare, multiple streams of discovery can still yield new tools to meet industry needs
- Today's crop protection compounds are increasingly active against target pests with improved specificity to minimize non-target effects
- As crop protection tools become more specific, accurate pest diagnosis becomes more essential
- Need an improved understanding of pesticide resistance management programs