

Pecan Fungicides – Past, Present and Future

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We're getting better equipment,
but what do we have in the tank?
(Recent budgets list \$150-250/A for fungicides)



Fungicide Classes

(Welcome to Intro Plant Pathology!)

1. Inorganics
2. Organometallics
3. Organic Protectants
4. Organic Systemics

I. Inorganics – ex. Sulfur

Known by Greeks, rediscovered by French in 1850 for vineyards w/ powdery mildew

Common even today, usually low cost, but often not real effective (dusting peanuts)

Phytotoxicity an issue, especially at high temperatures and/or with oils

Sulfur on Pecans



- Primary use has been for powdery mildew
- DMI's and QoI's are much better (Absolute, Quilt, etc. superb)
- Recent work showing S + DMI better results than DMI alone on peanut leaf spot

Sulfur enhances pecan nut weight

(HortScience - Wells, Brock and Brenneman, 2014)

- Foliar S had no effect on scab and no effect on the percent kernel
- S increased both leaf chlorophyll and nut size 2/3 years (size matters!)

I. Inorganics – ex. Copper

Strict protectant, effective on some fungi and bacteria, must be reapplied 5-10 days

Bordeaux Mixture; 1st effective foliar fungicide (copper sulfate + lime) found by accident to control downy mildew of grapes (**Alexis Millardet** in 1885), and still used today (reduced phytotoxicity)

Various coppers labeled on pecans, but to date they have provided only modest scab control

II. Organic Protectants

Dithiocarbamates found in 1930's

Easier to use, more effective, and less phytotoxic than Bordeaux. Ziram is still used today as a multi-site TPTH replacement when dealing with tin-resistant populations (6 lb/A was better than tin last year in “problem” orchards, but cost is an issue).

II. Organic Protectants

Dodine (Elast) developed in the 1950's

It's a cationic surfactant toxic to fungi and bacteria. Adsorbs strongly to cuticle so it resists washoff, and can be an antisporeulant. Can be phytotoxic to some older cultivars, and can have resistance issues (more so in other crops). Not good on several minor diseases, but vital to our nut scab programs.

III. Organometallics

Organotins (1960's)

Triphenyl tin hydroxide (TPTH) used on sugar beets and pecans (at times exclusively). Worker exposure and environmental issues, phytotoxic on some crops such as peanuts, and has antifeeding traits for insects.

RESISTANCE?????

Tin and Elast have been the “Twin Towers” of our pecan spray programs, especially for nut scab.

2014 fungicide sensitivity survey of orchards in Georgia

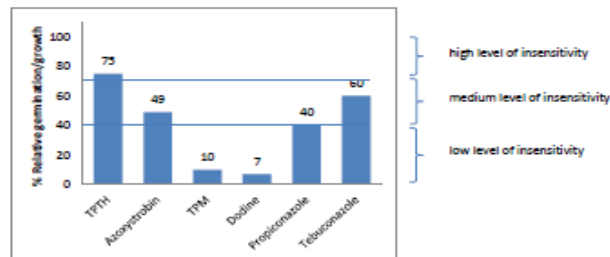
2014 UGA PECAN SCAB FUNGICIDE SENSITIVITY MONITORING PROGRAM

Name: Joe Sample
 Email: jsample@gmail.com
 Farm: Nuts Galore
 County: Dougherty

Sample #: 14000
 Sampling date: 6/8/14
 Cultivar: Desirable

Mean % relative germination or growth (RG) on medium containing discriminatory fungicide concentrations ($\mu\text{g/ml}$) compared to non-amended controls
 Bulk spore method, 3 groups of 15 lesions from each sample
 Spore germination (48h): TPTH, azoxystrobin, thiophanate-methyl (TPM), dodine
 Fungal growth (72h): propiconazole, tebuconazole

Fungicide Concentration	TPTH	Azoxystrobin	TPM	Dodine	Propiconazole	Tebuconazole
% RG	75	49	10	7	40	60



Key to interpretation of assay results:

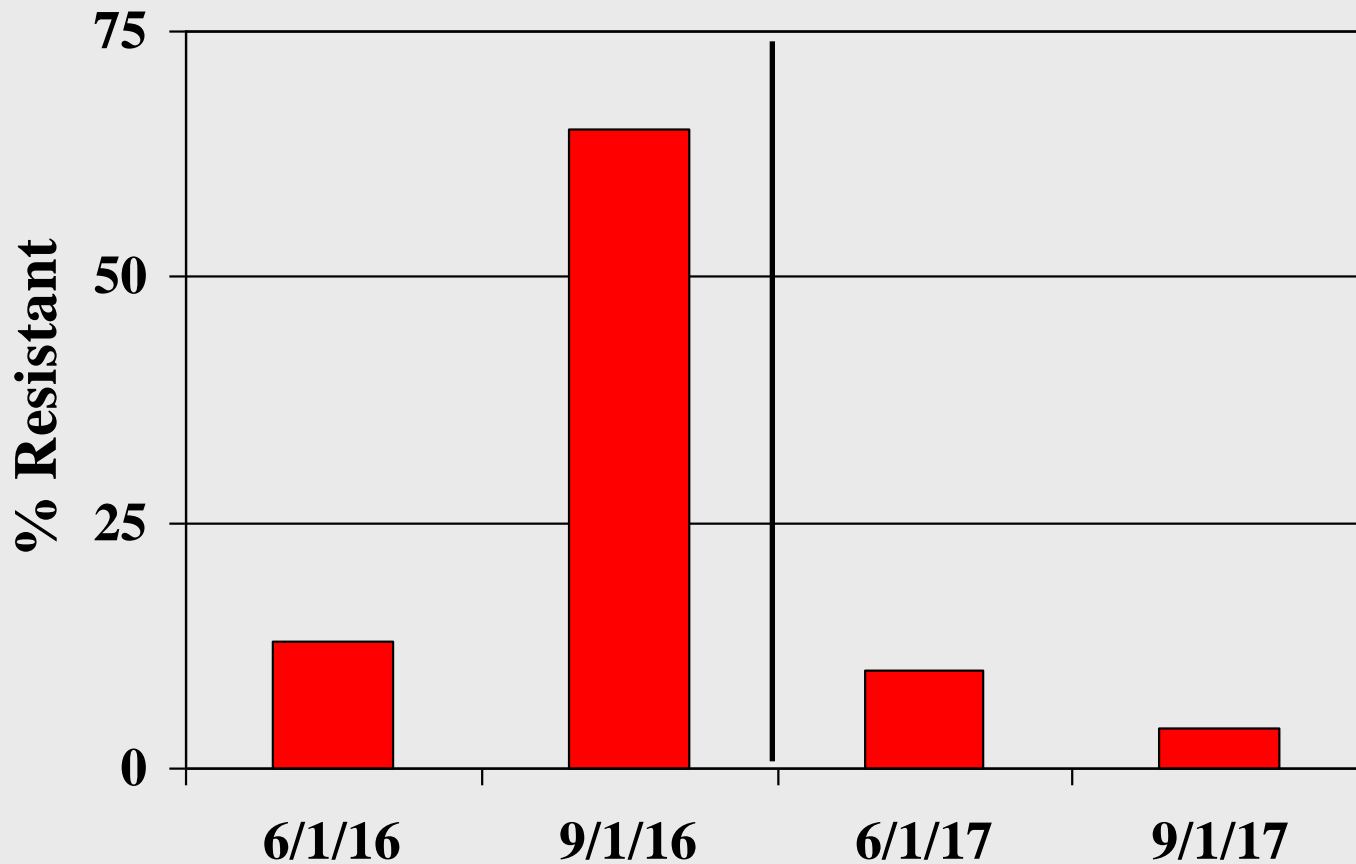
% RG	Level of insensitivity
0	none (sensitive)
1 - 39	low
40-69	medium
70 or more	high

Summary:

Based on the assay results, there is a high level of insensitivity to TPTH and a medium level of insensitivity to propiconazole and tebuconazole at this sampling location. There is a low level of insensitivity to thiophanate-methyl (TPM) and no insensitivity to dodine. There may be a medium level of insensitivity to azoxystrobin; however, further tests will be required to verify insensitivity to azoxystrobin.

For additional interpretation of results or for recommendations on fungicide selection, please contact Jason Brock, UGA Department of Plant Pathology, at jbrock@uga.edu or 229-386-7495.

“Fitness Cost” of tin resistance with 10 sprays of TPTH per year (Standish, Stevenson and Brenneman, 2017)



2017 On Farm Trials

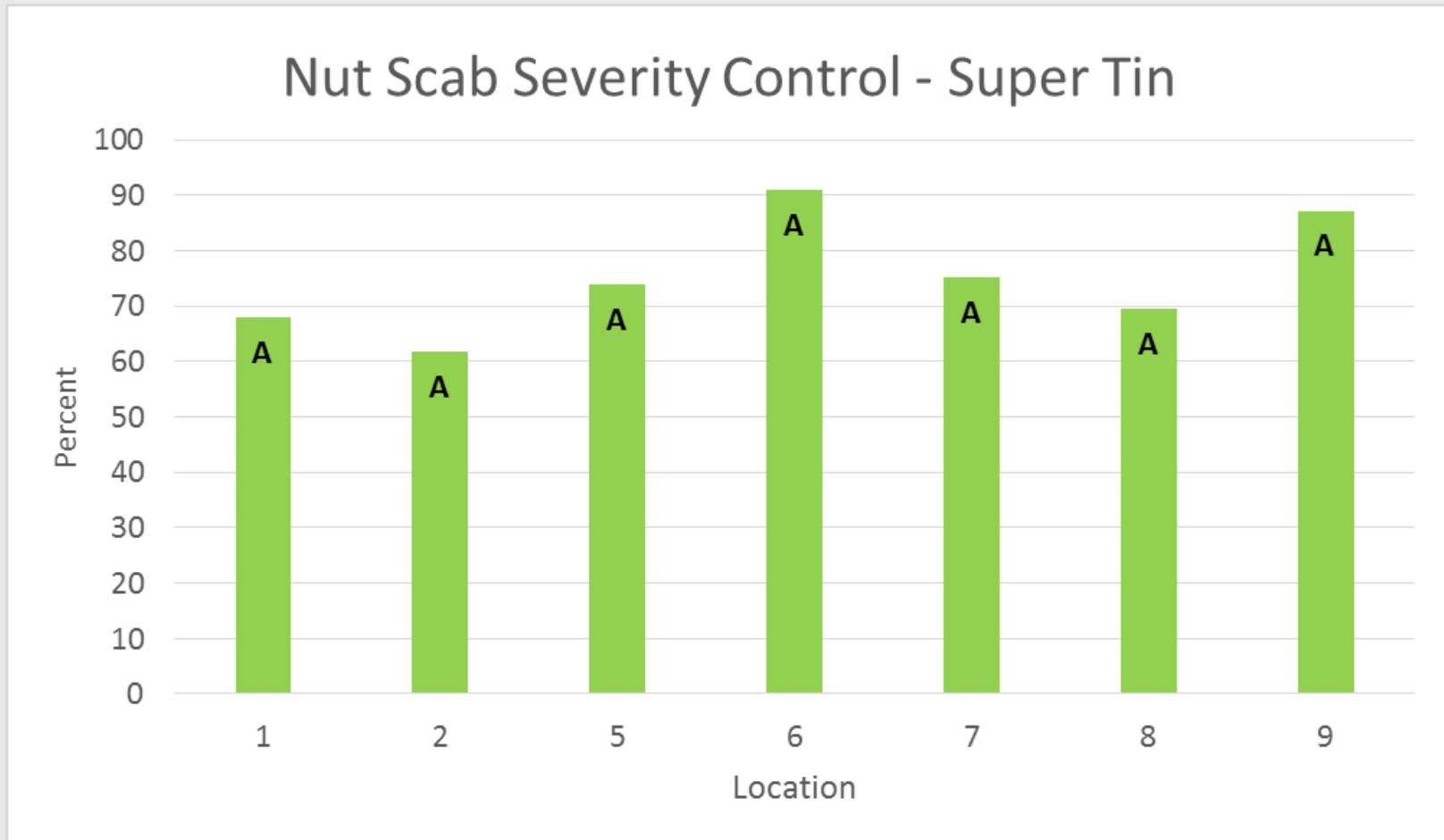
(Kory Herrington, UGA MS student)

- 9 “high risk” commercial orchards in South Georgia
- Treated Individual Terminals on non-sprayed trees
- Hand sprayed each terminal
 - Fungicide @ full rate diluted to 100 GPA
 - 10 applications @ 2 week intervals



“On Farm” Scab Trials, 2017

(Super Tin, 12 oz/A, 10 sprays)



“The rumors of my demise have
been greatly exaggerated!”

Mark Twain

The same appears to be true of TPTH on
pecans (thankfully!)

IV. Organic Systemics

First found in 1966 and revolutionized disease control with reduced wash-off, post-infection activity, lower rates, etc.

1. **benzimidazoles**; highly effective, but “poster child” for fungicide resistance, which occurred in as little as 2 years due to a single gene mutation (**ex. Benlate or Topsin**)

Use only 1-2 app's per year in a tank mix

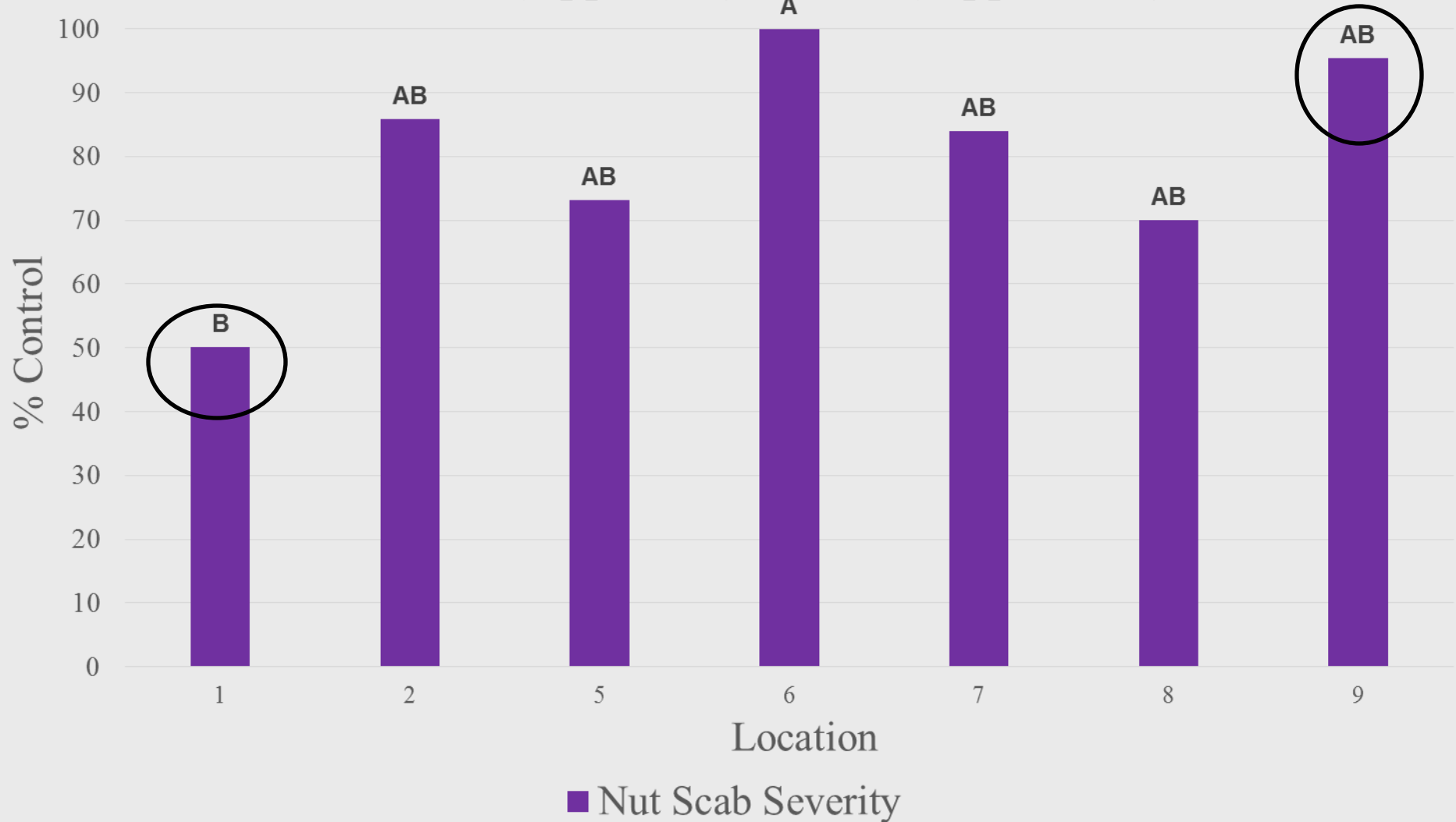
IV. Organic Systemics

2. Sterol Demethylation Inhibitors (DMI's)

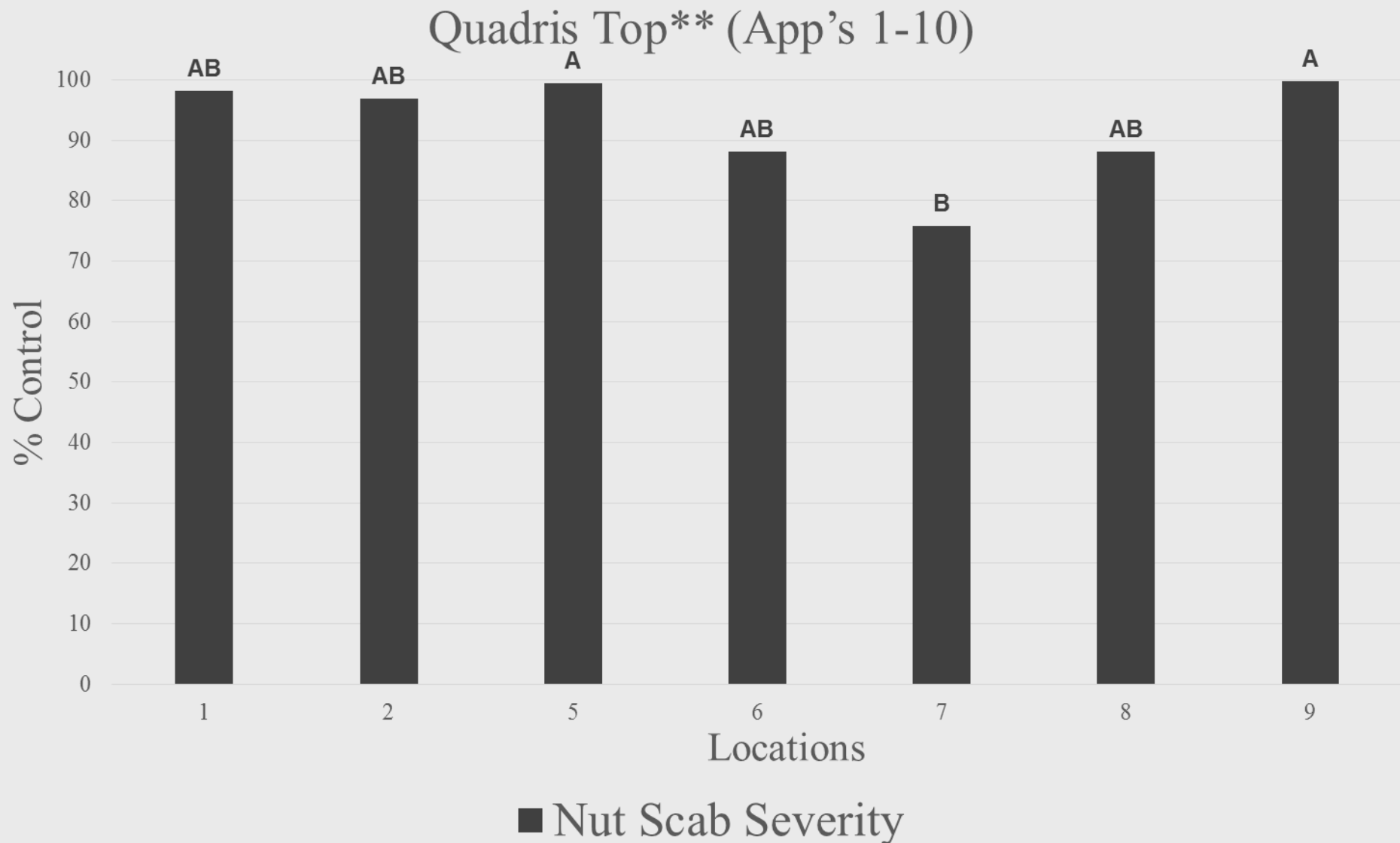
- prevent ergosterol formation which fungi need for membrane integrity
 - widely used (and abused), especially since Folicur (tebuconazole) went generic
- Better on leaf scab (Enable good on nuts), but both are compromised by resistance
- Difenconazole (Quadris Top) w/ excellent activity, even on DMI-resistant isolates

Nut Scab Control w/ DMI's + Organotin

Orius 3.6F (App's 1-4), TPTH (App's 5-10)



Nut Scab Control w/ Quadris Top (QoI + DMI)



IV. Organic Systemics

- 3. Strobilurins** were discovered from metabolites produced in nature by wood-rotting fungi (*Strobilurus tenacellus*).
 - widely used on many diseases since 1990's (ex. Sovran, Headline, Abound, etc.)
 - some resistance issues, but not as severe in pecans as in many other crops (need to know more, but must look at genes for resistance!)

QoI/Strobiluruns

Abound (App's 1-10)



IV. Organic Systemics

4. **Carboximides/SDHI** (Group 7)- disrupts fungal respiration (succinate dehydrogenase inhibitors)
- older chemistry, early ones were very effective but narrow spectrum (ex. Vitavax & Convoy) or not good on scab (ex. Fontellis)
 - latest ones are more broadly active and NOT cross-resistant to triazoles or strobilurins, and some are very active on scab
 - the new, “gee whiz” products are SDHI’s showing outstanding disease control on a variety of crops, and some are even nematicides (fluopyram)

What about the “Phites”?

(Phosphorous acid)

- Different mode of action, highly systemmic, relatively cheap, mixes with other chemistry, and active on a multiple pecan diseases, including scab (on leaves)
- Issue has been residues on exports to EU
- GREAT NEWS – The European Food Safety Authority is expected to approve an MRL of 500 ppm (vs 2) in near future!!!!

**We have a great arsenal of fungicides
– lets use them wisely!**



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**The Georgia Agricultural
Commodity Commission for Pecans**