Systemic Fungicides – the Good, the Bad and the Ugly!

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Pecan Fungicides – An Essential Input for SE Growers

• Requires big sprayers and slow speeds (100 GPA)
• Early April – late August on a 10-21 day schedule so can have 15-20 sprays in wet years
• MAJOR cost of production
Types of Fungicides

1. Contacts (Protectants)
   - remain on the plant surface, so no post-infection activity
   - multi-site mode of action, may even be toxic to plant cells if get inside
   - repeated applications for new growth
   - subject to wash off, UV degradation, etc. that decreases efficacy
   - ex. Super Tin, Ziram, Elast, etc.
Types of Fungicides

2. Systemics
   - absorb into the plant tissue
   - may provide post-infection control of some diseases (up to 72 hours)
   - different degrees of movement
     1. Local (within a leaf, ex. translaminar)
     2. Xylem-mobile (move up in plant)
     3. Phloem-mobile (move up and down)
Factors Affecting Systemic Movement

1. Host tissue. (ex. Orbit in leaves vs shucks)
2. Formulation and surfactants (why we use surfactants w/ systemics)
3. Different fungicides in a class can vary widely
   ex. Azoxystrobin (Abound) is xylem mobile, whereas pyraclostrobin (Headline) and trifloxyystrobin (Absolute) are local
Systemics – The Good

- may provide post-infection control of some diseases
- usually require less product
- often provide longer periods of control since not subject to weathering
- compensates for poor coverage (ie. Pecans)
- can hit targets that are difficult to spray (ex. roots, interior foliage, etc.)
Systemics – The Bad

- single-site mode of action so prone to resistance
- movement may also increase exposure to low rates that select for resistant isolates when mixed with a protectant – need good coverage
- usually less broad spectrum (do not control as many different diseases)
- often more expensive
## Systemicity of Pecan Scab Fungicides

*(Phosphite’s are xylem/phloem mobile - rare)*

<table>
<thead>
<tr>
<th>Fungicide Class</th>
<th>Trade names</th>
<th>Systemic?*</th>
<th>Relative use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzimidazoles</td>
<td>Topsin</td>
<td>Xylem</td>
<td>Low</td>
</tr>
<tr>
<td>DMIs*</td>
<td>Orbit, Enable, Folicur-tebuconazole</td>
<td>Xylem</td>
<td>Intense</td>
</tr>
<tr>
<td>Qols*</td>
<td>Abound Sovran Headline</td>
<td>Xylem</td>
<td>Moderate</td>
</tr>
<tr>
<td>Guanidines</td>
<td>Elast</td>
<td>Protectant*</td>
<td>Intense</td>
</tr>
<tr>
<td>Organotins</td>
<td>Super Tin</td>
<td>Protectant</td>
<td>Intense</td>
</tr>
</tbody>
</table>

* Big differences between individual products within a group
Is systemic movement important in pecan disease management?
(up to 90% of foliage in first 30 days!)
Proving Systemic Movement

Usually demonstrated on plant tissues with radioactive-labeled material

Ever see one of a pecan leaf?
Are there differences between a soybean (or wheat) plant and a pecan tree?
Do pecan fungicides* move

1) Upward from 1 leaf to another on the same shoot?
2) Downward from 1 leaf to another on the same shoot?
3) Into newly formed, unsprayed leaves?
4) Into the tops of trees in the xylem?

*azoxystrobin (Abound), tebuconazole & phosphite
Mapping Fungicide Movement w/ a Bioassay Technique

(Kyle Brown, M.S. 2015)
Fungicide Movement Upward From Treated to Nontreated Leaves

![Graph showing fungicide movement](image-url)
Fungicide Movement into New* Leaves
(* Emerged After Application)

![Bar chart showing lesion (cm²) for different treatments and new leaves.]

- Trt Leaf
- New 1
- New 2

Treatments:
- Abound
- Teb
- Tin
- Rampart
- Nontrt
Fungicide Movement Down into Lower Leaves on the Same Stem

<table>
<thead>
<tr>
<th>Lesion (cm²)</th>
<th>Trt Leaf</th>
<th>1 below</th>
<th>2 below</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rampart</td>
<td>Tin</td>
<td>Check</td>
</tr>
<tr>
<td>0</td>
<td>2.5</td>
<td>7.5</td>
<td>10</td>
</tr>
</tbody>
</table>
Systemic Fungicide Movement in Pecans

- Abound, tebuconazole and phosphites show some movement **up** into existing foliage, and **excellent** movement into new leaves not present when sprayed.
- Phosphites also move **down** (at least 2 leaves) into existing foliage.
- Can a highly mobile fungicide (ie. Phosphite) move into the tops of trees from the lower treated foliage?
From trunk sprays on a young tree with thin bark? Yes
Single-sided w/ & w/out Volute
# “Whole Tree” Systemicity Test

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rampart (apps. 2,4,6,8,10)</td>
<td>96 fl oz.</td>
</tr>
<tr>
<td>Super Tin 4L + Elast (apps. 1,3,5,7,9)</td>
<td>6 fl oz. + 25 fl oz.</td>
</tr>
<tr>
<td>2. Super Tin 4L (apps. 1-10)</td>
<td>6 fl oz.</td>
</tr>
<tr>
<td>+ Elast</td>
<td>25 fl oz.</td>
</tr>
<tr>
<td>3. Nontreated</td>
<td></td>
</tr>
</tbody>
</table>
Materials and Methods

• Treatments applied with a small PTO-driven air-blast sprayer to 25 year-old Desirable trees hedged to 25 ft the year prior to the study

• 4 replications per treatment

- poor coverage in tops of trees, and lots of regrowth (metabolic sink)
Protectant vs Systemic Scab Control in the Upper vs Lower Canopy (Nut Scab)

![Graph showing the comparison of Protectant vs Systemic Scab Control in the Upper vs Lower Canopy (Nut Scab)]
Effects on Embedded Scab Lesions

• Growing shoots very susceptible to scab
• Extended growing period in tree tops gives more chance for infection, particularly after hedging
• Less fungicide coverage
• Inoculum well placed to cause disease
Protectant vs Systemic Scab Control of Stem Lesions in the Upper Canopy, 2015

Lesions / 3 in.

- Phosphite
- Tin-Elast
- Check
No Evidence for “Whole tree” movement of phosphites to terminals
Systemics – The Good and the Bad, what about the Ugly?

1. Residues

- Move into plant tissue, so higher chance of pesticide residues in those plants
- We have an elaborate (and expensive), science-based registration process to insure safety of the crops we grow.
- Public policy is becoming less reliant on science – case in point, phosphites!
What are Phosphites?
(ProPhyt, Phostrol, Kphite, Rampart, Reliant, Fungi-phite, Nutri-phite, etc.)

• Phosphorous acid salts; NOT phosphate (fertilizer)
• Have very good activity on pecan scab, anthracnose, and other diseases; stronger on leaves than nuts
• Highly systemic in the tree, up and down
• Cheap and have a different mode of action (both direct on pathogen and increased plant defenses)
• Have been used A LOT in Georgia the last couple years, especially to combat fungicide resistance
So what is the problem?

- EPA regulates phosphites like fertilizers, i.e. no residue data are even required
- The EU considers them a pesticide, and have started testing for residues in other crops
- There has never been formal residue testing on pecans, so MRL set very low (2 ppm)
- Virtually any use will exceed this level
What do we do?

• Big gray area – risk of illegal residues in nuts (only in EU for now)
• Some other crops have discontinued use, even though phosphites fully labeled in the US
• Definite need for residue data on pecans. Working with IR-4 but will take time
• Be aware . . . . . will be an issue for multiple commodities in the years ahead (ex. peanuts)
The Ugly – Part 2

Nontarget affects

- ex. Phosphites. Plants cannot get P from phosphite, so it is NOT a fertilizer.
- Phosphite can mimic P, “fooling” a P deficient plant and make deficiency worse
  • seen even at 80-90% sufficiency level, and increasingly worse at low levels of P
  • Perhaps call this an “unfertilizer”?

-
N:P Imbalance
(made worse by phosphite???)
Systemic Fungicides

- Incredibly valuable tools for managing pecan diseases
- Know their strengths and weaknesses and use them accordingly!
Thanks to the Georgia Pecan Commission for funding this research
Hope this years crop exceeds all your expectations!