Efficacy and Timing of New Fungicides for Disease Management

Alan R. Biggs, Professor of Plant Pathology
West Virginia University TFREC, Kearneysville

Western Maryland Regional Fruit Meeting - February 24, 2011
Today’s Objectives:

- Spray Bulletin update – pathology
- Are there new fungicides? Let’s talk about that…
- How do we position the chemical activities against the *early-season* apple diseases?
- Fungicide resistance management with examples.
Summary of Disease Control Changes for 2011 Spray Bulletin

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West Virginia University TFREC, Kearneysville

Topguard 1.04SC

scab, mildew, rusts

- Pome Fruit: Apple only
- Scab: Topguard + protectant
- Use rate: 13 oz. for scab; 8 to 12 oz. for mildew and rust
- 4 applications max.
- 52 oz. max. per season
- PHI – 14 days
- REI – 12 hr
Topguard 1.04SC

- Flutriafol (an SI fungicide group, 3).
- Flutriafol is a “second generation” SI fungicide; has greater activity against scab than Rally, Rubigan, Procure.
- Label restricts use to 1 application per 14-day period.
- Is a good option for orchards where SI’s are still working.
- Do not add adjuvants to the spray solution

- Topguard 1.04SC + Captan 50W 3.2 fl oz + 1 lb
  - G E E for scab, powdery mildew and rust, dashes for the other diseases.

- Topguard 1.04SC + Mancozeb 75DF 3.2 fl oz + 1 lb
  - G E E for scab, powdery mildew and rust, dashes for the other diseases.
Apple Scab Fungicides - What’s on the Horizon?

- Bayer – Luna series (late 2011, 2012?)
  - Luna Sensation – fluopyram + Flint
  - Luna Experience – fluopyram + Elite
  - Luna Tranquility – fluopyram + Scala
    - Will still need to tank-mix with an EBDC

- Dupont – Fontelis (2013)
  - Similar class as boscalid (an ingredient in Pristine)
## Scab control by experimental fungicides
**Virginia Tech AREC, Winchester, 2008**

<table>
<thead>
<tr>
<th>Treatment and rate/A</th>
<th>Timing</th>
<th>Golden Del. leaves</th>
<th>fruit</th>
<th>Idared leaves</th>
<th>fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fungicide</td>
<td>---</td>
<td>7c</td>
<td>31g</td>
<td>4g</td>
<td>75g</td>
</tr>
<tr>
<td>Rally 40WSP 5 oz + Dithane 3 lb</td>
<td>TC-3C</td>
<td>3b</td>
<td>4ab</td>
<td>1b-f</td>
<td>23c-f</td>
</tr>
<tr>
<td><strong>A16001</strong> 12 fl oz + Dithane 3 lb</td>
<td>TC-3C</td>
<td>&lt;1a</td>
<td>1ab</td>
<td>&lt;1ab</td>
<td>28ef</td>
</tr>
<tr>
<td><strong>A16001</strong> 336SE 12 fl oz (Inspire)</td>
<td>TC-3C</td>
<td>&lt;1a</td>
<td>2a-e</td>
<td>&lt;1a-d</td>
<td>31f</td>
</tr>
<tr>
<td>Topguard 7 fl oz + Dithane 3 lb</td>
<td>TC-3C</td>
<td>4b</td>
<td>1ab</td>
<td>1b-f</td>
<td>21b-f</td>
</tr>
<tr>
<td>USF 2016A 4 fl oz</td>
<td>TC-6C</td>
<td>0a</td>
<td>0a</td>
<td>&lt;1a</td>
<td>7a</td>
</tr>
<tr>
<td>GWN-4616 10 fl oz + Dithane 3 lb</td>
<td>TC-3C</td>
<td>2b</td>
<td>6d-f</td>
<td>2d-g</td>
<td>13a-c</td>
</tr>
</tbody>
</table>

Mean separation at 95% confidence level. Four reps.
Applied 4/16 (TC); 4/24 (Pk-PF); 5/14 (late PF); 1C-3C: 5/28, 5/11, 6/25.
### Mildew control on Idared apples, 2008-09.

<table>
<thead>
<tr>
<th>Experimental treatment &amp; rate/A</th>
<th>Primary effect* (% inf., ’08 leaves If area)</th>
<th>Mildew infection ’09 primary shoots/tree</th>
<th>’09% infection leaves area</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fungicide</td>
<td>3.2 g 52 h 36 j</td>
<td>20.5 f</td>
<td>63 j 21 e</td>
</tr>
<tr>
<td>Rally 5 oz + Penncozeb 3 lb</td>
<td>5.2 de 39 d-f 10 c-f</td>
<td>10.0 c-e</td>
<td>27 h 4 cd</td>
</tr>
<tr>
<td>Luna Sensation 500SC 4 oz</td>
<td>8.0 a 10 a 2 a</td>
<td>2.8 a</td>
<td>2 a 1 a</td>
</tr>
<tr>
<td>Topguard 125SC 13 fl oz</td>
<td>6.5 bc 17 b 3 ab</td>
<td>5.5 a-c</td>
<td>12 b-e 2 bc</td>
</tr>
<tr>
<td>Topguard 13 fl oz + Dithane 3 lb</td>
<td>7.1 ab 19 b 3 ab</td>
<td>3.5 ab</td>
<td>16 d-g 3 bc</td>
</tr>
</tbody>
</table>

Mean separation by W-D K-ratio t-test (p=0.05). Four reps; 10 shoots/tree rated 22 Jun.

Test rows non-treated border rows in 2008 to stabilize mildew inoculum pressure for 2009.

* Apparent suppressive effect on 6 mildew shoots / tree 26 Jun: scale 1-10 (1= no effect).
Treatment effect on primary mildew

- Non-treated primary shoot (below)

- Topguard-treated primary shoot (13 fl oz above)
- Similar effect by USF2016A (Luna Sensation)
## Mildew control on Idared apples, 2009.

<table>
<thead>
<tr>
<th>Experimental treatment and rate/A</th>
<th>App #</th>
<th>primary effect*</th>
<th>% infection, Idared leaves</th>
<th>if area</th>
<th>fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fungicide</td>
<td>---</td>
<td>1.9 j</td>
<td>63 j</td>
<td>21 e</td>
<td>43 f</td>
</tr>
<tr>
<td>Rally 40WSP 5 oz + Penncozeb 3 lb</td>
<td>#1-7</td>
<td>5.0 fg</td>
<td>27 h</td>
<td>4 cd</td>
<td>7 a</td>
</tr>
<tr>
<td>Flint 50WG 2 oz</td>
<td>#1-7</td>
<td>5.0 fg</td>
<td>17 d-g</td>
<td>3 bc</td>
<td>13 ab</td>
</tr>
<tr>
<td>Luna Sensation 500SC 4 oz (USF2016A)</td>
<td>#1-7</td>
<td>8.9 a</td>
<td>2 a</td>
<td>1 a</td>
<td>9 ab</td>
</tr>
<tr>
<td>Adament 50WG 4 oz</td>
<td>#1-7</td>
<td>6.6 cd</td>
<td>7 b</td>
<td>2 b</td>
<td>14 a-c</td>
</tr>
<tr>
<td>Flint 50WG 2 oz + Rally 2 oz</td>
<td>#1-7</td>
<td>6.3 de</td>
<td>10 b-d</td>
<td>2 bc</td>
<td>21 b-d</td>
</tr>
<tr>
<td>Sovran 50WG 4 oz + Rally 2 oz</td>
<td>#1-7</td>
<td>6.6 cd</td>
<td>8 bc</td>
<td>2 b</td>
<td>15 a-c</td>
</tr>
<tr>
<td>Topguard 125SC 13 fl oz</td>
<td>#1-3C</td>
<td>7.4 bc</td>
<td>12 b-e</td>
<td>2 bc</td>
<td>25 c-e</td>
</tr>
<tr>
<td>Topguard 13 fl oz + Dithane 3 lb</td>
<td>#1-3C</td>
<td>7.7 b</td>
<td>16 d-g</td>
<td>3 bc</td>
<td>18 a-d</td>
</tr>
</tbody>
</table>

Mean separation by Waller-Duncan K-ratio t-test (p=0.05). 4 reps; rated 6/22.

* Suppressive effect on 6 primary shoots/tree 26 Jun: scale 1-10 (1= no effect). Fungicide app. dates: 2 Apr, 16 Apr, 24 Apr (Pk-bl); 5 May (PF); 1C-7C: 19 May, 2 Jun, 15 Jul, 1 Jul, 16 Jul, 30 Jul, 20 Aug.
<table>
<thead>
<tr>
<th>Experimental treatment and rate/A</th>
<th>App # leaves</th>
<th>% infection, Rome</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fungicide</td>
<td>---</td>
<td>46 a</td>
</tr>
<tr>
<td>Rally 40WSP 5 oz + Penncozeb 3 lb</td>
<td>#2-5</td>
<td>0 d</td>
</tr>
<tr>
<td>Flint 50WG 2 oz</td>
<td>#2-3</td>
<td>0 d</td>
</tr>
<tr>
<td>Inspire Super 2.82EW 12 fl oz</td>
<td>#4-5</td>
<td>1 bc</td>
</tr>
<tr>
<td>Manzate 75DF 6 lb</td>
<td>#1-5</td>
<td>10 b</td>
</tr>
<tr>
<td>Fontelis 200 SC 20 fl oz + oil 1%</td>
<td>#1-5</td>
<td>3 b-d</td>
</tr>
<tr>
<td>Topguard 125SC 13 fl oz + Captan 80 3 lb</td>
<td>#2-5</td>
<td>0 d</td>
</tr>
<tr>
<td>Topguard 125SC 13 fl oz + Dithane 3 lb</td>
<td>#2-5</td>
<td>0 d</td>
</tr>
</tbody>
</table>

Mean separation by Waller-Duncan K-ratio t-test (p=0.05). 4 reps; rated 6/22.

Application timings: HG = 31 Mar, P = 7 Apr, B = 15 Apr, PF = 28 Apr, 1C = 10 May, 2C = 25 May, 3C = 11 Jun, 4C = 23 Jun, 5C = 7 Jul, 6C = 23 Jul, and 7C = 11 Aug.
Fungicide Resistance – warning upgraded

- **CAUTION:**

- **1 RESISTANCE WARNING:** These ratings assume that the target fungus has not developed resistance to listed fungicides...

- SI resistance is currently suspected in the powdery mildew fungus in some locations. Resistance to the strobilurin (QoI) fungicides is likely to occur in the scab fungus and possibly in powdery mildew.

- If resistance is suspected, use of the suspect “at-risk” fungicide should be discontinued and replaced by full rates of other effective fungicides. The use of mixtures of materials, rotations among classes of materials (Table 2, p. 33), or both, is strongly advised.
What is Fungicide Resistance?

- Stable, inherited adjustment by a fungus to a fungicide -- resulting in reduced sensitivity of the fungus to the fungicide

- Particularly important for site-specific fungicides
Characteristics of Fungicide Resistance

- Stable, inherited adjustment by a fungus to a fungicide -- resulting in reduced sensitivity of the fungus to the fungicide

- Particularly important for site-specific fungicides

- Resistance typically arises from a low rate of natural mutation

- Since the fungicide effectively controls sensitive isolates, resistant isolates may become dominant under continued fungicide use -- leading to control failures

- Fitness of resistant strain defines the persistence of the trait in the absence of fungicide use
Major Fungicide Resistance Issues in Tree Fruit Crops

- **Apple**
  - Apple scab (SI’s, QoI’s)
  - Powdery mildew (SI’s)
  - Alternaria leaf blotch (QoI’s)

- **Stone fruits**
  - Brown rot (SI’s; QoI’s – populations starting to shift from baseline)
  - Cherry leaf spot (SI’s)
Strobilurin (QoI) resistance is widespread, and at a high level in most areas of Michigan.

- These fungicides (Flint, Sovran) should not be used for primary scab control.
- Few orchards remain with QoI sensitivity.
- SI resistance is also prevalent, and at higher levels than those observed 10-15 yrs. ago.

Comments from Dr. George Sundin - Michigan State University
Fungicide Resistance Summary
- Other Locations

- **New York**
  - Cornell University (WVU partner) – Dr. Kerik Cox
    - Apple scab (SI’s, QoI’s)
    - Brown rot of stone fruits (SI’s)

- **Pennsylvania**
  - Penn State – Dr. Henry Ngugi
    - Apple scab (SI’s, QoI’s)

- **Virginia**
  - Virginia Tech – Dr. Keith Yoder
    - Apple scab (SI’s, QoI’s)

- **South Carolina**
  - Clemson University – Dr. Guido Schnabel
    - Brown rot of stone fruits (SI’s, QoI’s)
## Classes of apple fungicides at risk for development of resistance

<table>
<thead>
<tr>
<th>Chemical class</th>
<th>Compound</th>
<th>Trade name(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterol inhibitors</td>
<td>fenarimol</td>
<td>Rubigan</td>
</tr>
<tr>
<td><strong>(Group 3)</strong></td>
<td>myclobutanil</td>
<td>Rally (Nova)</td>
</tr>
<tr>
<td></td>
<td>triflumizole</td>
<td>Procure</td>
</tr>
<tr>
<td></td>
<td>fenbuconazole</td>
<td>Indar</td>
</tr>
<tr>
<td></td>
<td>Difenoconazole + cyprodinil</td>
<td>Inspire (Super)</td>
</tr>
<tr>
<td></td>
<td>Tebuconazole + trifloxystrobin</td>
<td>Adament</td>
</tr>
<tr>
<td></td>
<td>flutriafol</td>
<td>Topguard</td>
</tr>
<tr>
<td>Strobilurin (QoI)</td>
<td>kresoxim-methyl</td>
<td>Sovran</td>
</tr>
<tr>
<td><strong>(Group 11)</strong></td>
<td>trifloxystrobin</td>
<td>Flint</td>
</tr>
<tr>
<td></td>
<td>pyraclostrobin + boscalid (not a strobilurin)</td>
<td>Pristine</td>
</tr>
<tr>
<td></td>
<td>Trifloxystrobin + tebuconazole</td>
<td>Adament</td>
</tr>
<tr>
<td>Carboximide (anilide)</td>
<td>boscalid + pyraclostrobin</td>
<td>Pristine</td>
</tr>
<tr>
<td><strong>(Group 7)</strong></td>
<td>fluopyram + trifloxystrobin</td>
<td>Luna Sensation</td>
</tr>
<tr>
<td></td>
<td>ponthiopyrad</td>
<td>Fontelis (LEM-17)</td>
</tr>
<tr>
<td>Benzimidazole</td>
<td>thiophanate-methyl</td>
<td>Topsin-M</td>
</tr>
<tr>
<td><strong>(Group 1)</strong></td>
<td>thiabendazole</td>
<td>Mertect</td>
</tr>
<tr>
<td>Guanidine</td>
<td>dodine</td>
<td>Syllit, Cyprex</td>
</tr>
<tr>
<td>Anilinopyrimidine</td>
<td>cyprodinil</td>
<td>Vangard</td>
</tr>
<tr>
<td><strong>(Group 9)</strong></td>
<td>pyrimethanil</td>
<td>Scala, Penbotec</td>
</tr>
</tbody>
</table>
Orchard history; effect of number of applications on appearance of resistance in scab fungus - Dr. W. Koeller, Cornell University

- **Dodine (Syllit, Cyprex)**
  - 60 applications

- **Benzimidazoles (Topsin M, T-Methyl, Benlate)**
  - 20 applications

- **SIs (Nova, Procure, Rubigan)**
  - 10 - 30 applications at low rates
  - 60 + applications at high rates

- **APs (Vangard, Scala)**
  - poor performance in SI-resistant orchards

- **Strobilurins (Flint, Sovran)**
  - 25 applications, maybe more at high rates
Fungicide Classes *Not* Prone to Resistance Development

- Carbamates
  - Ziram
- Ethylene-bis-dithiocarbamates (EBDC’s)
  - Mancozeb, metiram
- Captan
- Sulfur
- Copper (bacteria, though!)
# West Virginia apple scab resistance 2005 - 2010

## Fungicide Resistance

<table>
<thead>
<tr>
<th>Orchard</th>
<th>Dodine</th>
<th>Myclobutanil</th>
<th>Pyrimethanil</th>
<th>Trifloxystrobin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-R-M '05</td>
<td>Shift</td>
<td>Resistant</td>
<td>Shift</td>
<td>Shift</td>
</tr>
<tr>
<td>1-R-M '06</td>
<td>Shift</td>
<td>Resistant</td>
<td>Shift</td>
<td>Sensitive</td>
</tr>
<tr>
<td>2-TR '05</td>
<td>Shift</td>
<td>Resistant</td>
<td>Shift</td>
<td>Shift</td>
</tr>
<tr>
<td>2-TR '06</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
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<tr>
<td>2-TR '10</td>
<td>Sensitive</td>
<td>Shifted</td>
<td>No data</td>
<td><strong>Resistant</strong></td>
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<tr>
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<td>Shift</td>
<td>Sensitive</td>
</tr>
<tr>
<td>3-RF '06</td>
<td>Resistant</td>
<td>Resistant</td>
<td>Shift</td>
<td>Sensitive</td>
</tr>
<tr>
<td>4-UF '05</td>
<td>Sensitive</td>
<td>Resistant</td>
<td>Shift</td>
<td>Shift</td>
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<tr>
<td>5-NHF '05</td>
<td>Shift</td>
<td>Resistant</td>
<td>Shift</td>
<td>Sensitive</td>
</tr>
<tr>
<td>6-JO '06</td>
<td>Shift</td>
<td>Resistant</td>
<td>Shift</td>
<td>Sensitive</td>
</tr>
<tr>
<td>6-JO '08</td>
<td>Shift</td>
<td>Resistant</td>
<td>Shift</td>
<td><strong>Resistant</strong></td>
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<tr>
<td>6-JO '10</td>
<td>Sensitive</td>
<td>Resistant</td>
<td>No data</td>
<td>Shifted</td>
</tr>
<tr>
<td>7-KTFREC '06</td>
<td>Shift</td>
<td>Resistant</td>
<td>Shift</td>
<td>Sensitive</td>
</tr>
<tr>
<td>7-KTFREC '07</td>
<td>Shift</td>
<td>Resistant</td>
<td>Shift</td>
<td>Sensitive</td>
</tr>
<tr>
<td>8-GOS '06</td>
<td>Sensitive</td>
<td>Resistant</td>
<td>Sensitive</td>
<td>Shift</td>
</tr>
<tr>
<td>9-MLO</td>
<td>Sensitive</td>
<td>Shift</td>
<td>Sensitive</td>
<td>Shift</td>
</tr>
</tbody>
</table>
Apple Scab

- Usually the earliest disease
- Ascospores trapped in March
- First infection often at GT
- Early infection on sepals often drives an epidemic with losses
Apple scab

- Overwinters on leaves on the ground.

- Spores discharged by early spring rains.

- Spores usually mature by green-tip stage (mostly over by petal fall).
Apple scab

- Early infection may cause fruit and leaf drop.
- Results in sepal infection of remaining fruit and poor ‘return bloom’
- Many crabapples also susceptible but infected by a different race of the fungus.
- Scab-resistant cultivars (SRC’s) available.
Apple scab

- Length of wetting required for spores to germinate and infect at a given temperature is well known (consult tables).

- Optimum is nine hours at 65 F; drops off sharply at above 80, but can infect if wet two days at 33-36 F. (Spray bulletin, p. 87)
Scab - Be aware of your local weather and bud conditions!!
16-yr history of foliar scab control with SI+EBDC
Stayman apple, Winchester, VA. (VARP support)

- Generally poorer and variable control since 2004
- Credit control in 2006-07 to EBDCs (dry years)
Scab fungus test against SI (myclobutanil) - sensitive

- Isolate ViB09 sensitive to all 3 levels of fungicide.
- This isolate was from a check (untreated) tree.
Scab fungus test against SI (myclobutanil) - resistant

- Isolate ViC23 demonstrated resistance to all 3 levels of fungicide.
- Growth on all plates was approximately the same.
Effect of less SI usage on other diseases (mildew, rusts, etc.)

- How to cover those diseases if SIs aren't used
- Retention of effectiveness of other "at-risk" fungicide classes, especially strobilurins
Early season apple diseases:

- Scab
- Powdery Mildew
- Rusts - quince rust, cedar-apple rust
- Frogeye leaf spot
- Moldy core
- Fire blight
Powdery mildew

- Dry weather disease
- Recurrent problem affects yields

- Fruit infection at pink stage
- Secondary infection during bloom and later
- Protect new growth / buds
Mildew development and control

Spores (conidia) typically available on opening lateral buds at tight cluster stage
Powdery Mildew -

- Less use of SI's = more mildew likely
- Mildew has chronic effects on yield
- Focus on tight cluster - 2nd cover
- Strobilurins ok while in schedule
- Sulfur, inexpensive, suppressive, ok
  - (need tighter spray interval)
- Topsin-M (for SB/FS) ok later in season
- Ineffective - EBDC's, ziram, captan, Vangard, Scala
- Confusing symptom - potato leafhopper injury
Control of % leaves infected with mildew by SI+EBDC as related to number of "mildew days" in test year
Stayman and Idared apples, 1994-2009, Winchester, VA

- Check (% lvs inf.)
- SI+EBDC (% control)

Number of "mildew days" in test yr/rate

% leaves infected/% control

- 38
- 32
- 24
- 44
- 29
- 49
- 32
- 28
- 31
- 31
- 38
- 5oz
- 40
- 43
- 33
- 34-5oz
- 7.5oz
Early season apple diseases:

- Scab
- Powdery Mildew
- Rusts - quince rust, cedar-apple rust
- Frogeye leaf spot
- Moldy core
- Fire blight
Rust Diseases

- Local disease pressure
- Can affect tree vigor.
- Alternate host: Eastern Red Cedar.
- Inoculum level related to two years earlier.
- Control with SI’s, EBDC’s, ziram.
Cedar-apple rust spore types:
Control of Rusts

- Appearance of dormant galls - green tip
- Spores released with warm spring rains
- Remove cedar trees if possible
- SI's most effective fungicides before or after infection has occurred
- EBDCs, ziram ok as protectants
- Captan, sulfur, Vangard/Scala not effective
- Strobies may be weak under high disease pressure

Local rust observations:
- Our worst rust infection periods typically occur at mid-50s and higher
- Some long wetting periods at 50F have given little or no rust infection
- Not much difference between length of wetting required for light or severe
Apple Disease Development

Seasonal timing:

- Scab
- Mildew
- C-a rust inoculum related to two years before
- Fireblight!
- Summer diseases
  - Sooty blotch / fly speck (but depends on CWH)
  - Rots
- Minor diseases? Local problems.
Compensating for fungicide-resistance problems

1. Inoculum reduction —
   A. Apply urea to fallen leaves in spring or fall.
      Rate: 40 lb urea in 100 gal water applied to one acre

Results of trials in NH:
   -- Sprayed leaves on trees 12 Oct: 97% spore reduction
   -- Fall ground spray, early Nov.: 42-58% reduction.
   -- Spring ground spray: 70% avg. reduction; range 44-86%.

Conclusions:
   -- Spring application may provide most consistent results?

Compensating for fungicide-resistance problems

1. Inoculum reduction —
   B. Chop leaf litter with a flail mower

Results of trials in NH:
- Fall shredding: 72% mean reduction in ascospore production over 4 yrs; range 34-91%
- Spring shredding: 78% mean reduction in ascospore production over 4 yrs; range 57-89%
- On 10 farms, it always reduced scab in unsprayed control trees that were part of the experiment.
- Very late fall shredding (Dec 16) was less effective

Compensating for fungicide-resistance problems

Probability of economic loss from scab control failures in commercial orchards

Risk of primary scab infection

2. Start fungicides at or before green tip - Cu for fire blight reduction should provide 7 days of protection.
2. Protect first green tissue: start fungicide programs at green tip and before the first infection period. Vangard, Scala, Syllit...

Scab spore load in high-inoculum orchards
Compensating for fungicide-resistance problems

1. Inoculum reduction via urea or leaf chopping.
2. Start fungicides at or before green tip.
3. Consider using a mancozeb-captan tank mix in critical pre-bloom sprays.
Compensating for fungicide-resistance problems

1. Inoculum reduction via urea or leaf chopping.
2. Start fungicides at or before green tip.
3. Use mancozeb-captan tank mixes.
4. Use higher rates of contact fungicides:
   • Mancozeb at 5-6 lb/A (ending at PF)
   • Mancozeb 3 lb/A + captan-80 2 lb/A
     or + captan-80 3 lb/A
   • Higher rates ahead of predicted heavy rains?
   • Higher rates base on tree growth stage?
Compensating for fungicide-resistance problems

1. Inoculum reduction via urea or leaf chopping.
2. Start fungicides at or before green tip.
3. Use mancozeb-captan tank mixes.
4. Use higher rates of contact fungicides.
5. Use stronger fungicides for enhanced protection at TC & Pk or at Pk & Bl.
Compensating for fungicide-resistance problems

5. Flint/mancozeb or Sovran/mancozeb for enhanced protection at TC & Pk or at Pk & Bl.
   - Mixed with mancozeb to work around oil sprays.
   - Provides early mildew and rust control.

Cautions:
- Sovran is phytotoxic to some sweet cherries!
- May not work were resistance is present.
- Label restrictions: *Do not apply more than 4 applications of Flint fungicide or any other Group 11 fungicide per season.*
  Thus, growers are limited to a total of 4 sprays/year for any combination of Flint, Sovran, Pristine,
Compensating for fungicide-resistance problems

5. Inspire Super plus mancozeb for enhanced protection at TC & Pk or at Pk & Bl or at PF & 1C:
   - Provides mildew and rust control.
   - May suppress scab even where Rally and Rubigan have failed.
   - Even if difenoconazole is compromised by resistance, this mixture will be as good as any protectant program.
   - At 1st C, it will suppress early summer disease infections.
   - Do not apply more than 3-4 sprays/season.
1. Inoculum reduction via urea or leaf chopping.
2. Start fungicides at or before green tip.
3. Use mancozeb-captan tank mixes.
4. Use higher rates of contact fungicides.
5. Use stronger fungicides for enhanced protection at TC & Pk or at Pk & Bl.
6. Be cautious with Inspire Super or Indar in orchards where other DMIs have failed.
Strategies for reducing pressure on “at-risk” fungicides

• Utilize copper spray on fire blight susceptible cultivars (no later than 1/4” green on fresh market fruit)
• Vangard (or Scala), dodine?, or other protectant at ½” green-tight cluster
• Choice of general protectant based on rust pressure, cost, use and compatibility with oil (EBDC’s, ziram vs. captan)
• Avoid use of SI’s alone. Use mixtures or protectants where applicable
• Consider mixtures and/or alternating schedules of strobilurins
• Consider practices that reduce disease pressure (urea)
Resistance management - brown rot of stone fruits
DMI and QoI sensitivity

- Examined 186 isolates across 6 NY counties
- Fungicide sensitivity: mycelial relative growth assays
  - DMI: 10 x and 100 x historical baseline EC(50) values for fenbuconazole and propiconazole
  - QoI: EC$_{50}$ dose response curves for components of Pristine fungicide (pyraclostrobin, boscalid, pyraclostrobin + boscalid at formulated ratio)
    - w/ and w/o salicylhydroxamic acid (SHAM)
- PCR-RFLP analysis to detect DMI resistant determinant ‘Mona’
  - 65 bp insert in cyp51 promoter region
  - Strongly associated with high level of resistance towards DMI’s

(Luo et al. 2008 Plant Dis. 92(7) 1099)
Brown rot resistance to SI’s in W.Va.

- ~40 isolates analyzed for “mona” fragment
  - All isolates possessed this indicator of potential resistance
- Isolates tested in the lab for growth on fenbuconazole (Indar)
  - EC50 values ranged from 0.004 to 0.129 showing many resistant elements in the population.
Choice of fungicides?

- Plan fungicide schedule with long-term use in mind
- Tight cluster- 2nd cover
  - Keep something in schedule for mildew, if needed
  - Keep something in schedule for rusts, if needed
- Plan for season-long options - 1st choice; 2nd choice
- Use mixtures whenever possible
  - reduce likelihood of resistance
  - reduce damage in year resistance appears
  - slows rate of epidemic
Other items

- Thiram and Triadimefon removed from Bulletin
- Added Captan 80WDG formulation to schedules
- DODINE (SYLLIT) is formulated as a 3.4F flowable and is used from 1.5 to 3.0 pints per acre at 7-day intervals to maintain scab control beginning at green tip in tank mix with a captan- or mancozeb-based formulation. (No more 65W).
- SCHOLAR 50W (SCHOLAR 50W or 1.92SC)
- All Ziram occurrences changed to 76DF
WVU KTFREC Current Conditions

Disease management information directed mostly to the eastern counties of West Virginia and the tree fruit industry there. The blog is updated as needed throughout the growing season by Alan R. Biggs, Professor of Plant Pathology and Extension Specialist, West Virginia University, Kearneysville Tree Fruit Research and Education Center, Kearneysville, WV.

Thursday, December 13, 2012
Welcome!

Welcome to the 2011 WVU KTFREC Current Conditions Blog. This format will provide a Current Conditions page with more features than before. We hope you like it. Let us know what you think.

Thursday, January 20, 2011
Fruit School Program

Winchester Area Commercial Fruit Production School
February 11, 2011
Lee Jackson Conference Center, Winchester
Current Conditions

- http://wvu-ktfrec.blogspot.com/

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**VA/WV Winchester Area Fruit School - Friday, February 11, 2011**

Make plans to attend the Winchester Area Commercial Fruit Production School, Lee Jackson Conference Center, Winchester, VA. 8:00 AM to 4:00 PM. This is the same location as last year. We'll distribute the program when it becomes available.

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*Posted by WVU KTFREC Current Conditions at 11:03 AM 0 comments [share]*