Controlling Summer Diseases in Apples

OMAFRA
Summer Disease Webinar
with Ontario Apple Growers
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Sooty Blotch & Flyspeck (SBFS)

Background
Sooty Blotch & Flyspeck (SBFS)

Background

A. SBFS are caused by fungi that live on cuticular waxes of many plant species: they are not host specific.

B. Recent work from Iowa (Dr. Mark Gleason’s Lab):
   1. Sooty blotch: More than 60 species.
   2. Flyspeck: Several species may be involved

C. Implications of Gleason’s work:
   1. Species causing SBFS may vary with geographic region.
   2. Fungicide susceptibility may vary with species.
   3. Research results with fungicides may vary by location.
Relationship between flyspeck and sooty blotch: (as observed in NY):

1. In the absence of fungicides, SB appears on apples before flyspeck does due to a shorter incubation period.

2. In sprayed orchards, flyspeck usually shows up first, presumably because it can tolerate slightly higher fungicide residues on fruit than sooty blotch can.

3. Thus, spray programs that control flyspeck always control sooty blotch, although Sovran and Flint are weak against some species within the complex.
Relationship between flyspeck and sooty blotch (as observed in NY):

4. If SB appears on fruit prior to harvest, it usually means that fungicide residues were totally depleted at least 14 to 21 days prior to harvest.

5. If only SB (with no flyspeck) appears on fruit prior to harvest:
   • probably all fungicide residues were removed in one heavy rain sometime after the last fungicide spray.
   • flyspeck will pop out after a few more hours of wetting (which may occur after harvest).
Note: Hours of wetting noted below are from string, not electronic devices. For electronic wetness sensors, use 185 hr, not 270 hr.

1. Flyspeck ascospores are released from wild hosts after PF.

2. Flyspeck incubation on wild hosts requires 270-hr leaf wetting.

3. Conidia blow into orchard and begin infections on apples.

4. Flyspeck incubates on apples for another 270-hr of leaf wetting.

5. Flyspeck begins appearing on fruit after 540-hr leaf wetting from petal fall.
Fungicides for SBFS

1. Mancozeb provides excellent early-summer control.

2. Topsin M (thiophanate-methyl) + Captan is an old standard for summer fungicide programs, but labels/buyers may limit its usefulness.
   • Controls sooty blotch, flyspeck, fruit rots, scab
   • Under moderate disease pressure, Topsin M at 12 oz/A plus Captan 80W 2 lb/A should last the shorter of either 21 days or through 2.0 inches of rain.

3. Pristine is the gold standard for late-summer sprays:
   • slightly better rain-fastness than Topsin M.

4. Inspire Super is an alternative, but slightly less effective than Pristine. However, do NOT use Inspire Super in orchards where scab is still active in late summer (resistance mgmt.) Use with Captan to control rots!
Inspire Super controls sooty blotch & flyspeck

- 2012 field trial showed Inspire Super was as good as Pristine for controlling SBFS.
- Pristine is better than Inspire-S for controlling summer rots.
- Therefore use Captan with Inspire-S when applied during summer.
- Skipping early sprays allowed SBFS to build up sooner: i.e., early infections were NOT eradicated!
- Pristine is still best as last spray preharvest.
Results from a Hudson Valley Fungicide Trial, 2010

Test fungicides were applied at 1st & 2nd cover and 30 and 15 days before harvest, with captan/Topsin applied to all plots for intervening summer sprays.

Between the last spray and harvest of Golden Delicious:
18 days and 2.1” rain
5. Phosphite fungicides: For flyspeck & sooty blotch, ProPhyt + Captan works as well as Topsin + Captan.

- ProPhyt at 1.5 to 3 pt/A "activates" Captan against SBFS.
- ProPhyt does not boost Captan’s activity against fruit rots.
- If used during summer, the phosphite-captan mix might work best during late June and early July when fruit rot control is less critical.
- ProPhyt also extends activity of Topsin M and Pristine against SBFS, but improvements with ProPhyt were relatively small.

- Read phosphite labels: they are all different!
Phosphite Fungicides

Royal Court with flyspeck at harvest on 18 Sept., 2007
Sprays were applied 7 Jun, 3 Jul, 23 Jul, and 14 Aug
Interval from last spray to harvest was 35 days with 3.0” rainfall.

<table>
<thead>
<tr>
<th>Fungicide and rate of product/A</th>
<th>Fruit with flyspeck (%)</th>
<th>Grand means for effects of fungicides</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fungicide alone</td>
<td>With ProPhyt 1.5 pt/A</td>
</tr>
<tr>
<td>No fungicide</td>
<td>88 d</td>
<td>48 d</td>
</tr>
<tr>
<td>Captan 80&lt;sub&gt;WDG&lt;/sub&gt; 30 oz</td>
<td>52 d</td>
<td>22 bc</td>
</tr>
<tr>
<td>Topsis M 70&lt;sub&gt;WDG&lt;/sub&gt; 12 oz</td>
<td>27 c</td>
<td>16 bc</td>
</tr>
<tr>
<td>Pristine 38&lt;sub&gt;WDG&lt;/sub&gt; 15 oz</td>
<td>11 ab</td>
<td>6 a</td>
</tr>
</tbody>
</table>

Grand means for effects of ProPhyt 42 B 23 A 22 A

Any of the 12 simple means followed by the same lower-case letter are not significantly different (\(P \leq 0.05\)) as determined by applying Fisher's Protected LSD to results from a 3x4 two-way analysis of fungicides and ProPhyt.
Bitter rot

*Colletotrichum* species: at least 18 different species can cause it.

- In dry weather, dark raised pustules in a light tan, slightly sunken lesion.
- V-shaped area of decay in flesh.
- Sometimes shows characteristic orange sporulation in damp weather.
- Favored by **hot, humid weather** in mid to late summer.
- Can spread rapidly if fruit are not protected with fungicides.
Bitter rot: Why is it an increasingly common problem?

1. Warmer summers

2. More susceptible cultivars, e.g. Honeycrisp

3. More late-maturing cultivars that need a Sept. fungicide cover.

4. Changing horticultural practices:
   a. Small twigs left beneath trees after pruning provide spores.
   b. Drops left on the orchard floor.
   c. Dwarf rootstocks = more drought stress?
Bitter Rot

Inoculum to initiate fruit infections may come from:

- **Rotted fruit left on the ground!**
- **Dead wood in trees, especially following fire blight.**
- Wild hosts in hedgerows, woodlots, and ground cover.
- Prunings left beneath trees?
In one case, inoculum came from horse-chestnut (*Aesculus hippocastanum*) trees next to the orchard.

Colletotricum infections on horse chestnut leaves (above), along with an apple from a nearby tree showing signs of bitter rot.
Bitter rot on hand-thinned fruit in New York’s Champlain Valley provided inoculum for infecting ripening fruit still on the tree.

Photographed 3 August 2006
Best fungicide options:

Captan: If fruit begin to show bitter rot, however, use full label rates applied at 10-14 day intervals, especially ahead of warm wet weather.

Flint, Sovran, Pristine, Merivon: moderately effective, with less visible residue than high-rate captan, but must be applied with mid-rates of Captan in problem blocks.

Cultural controls (sanitation for problem blocks):

• Prune out dead wood during winter.
• Remove rotted fruit from beneath trees after harvest.
• Remove dead twigs from beneath trees after pruning.
For all of the above, moving potential inoculum to sodded row middles and shredding with a flail mower should be OK.
Results from a field trial at the Hudson Valley Lab in 2011:

- Much more bitter rot on HC than on other cultivars.
- None of the fungicides were very effective. WHY??

**Bitter Rot Development on Three Cultivars**

Highland, NY—2011

<table>
<thead>
<tr>
<th>Control</th>
<th>Microthiol // lime-sulfur</th>
<th>Topsin 3 oz + Capt-80 1 lb</th>
<th>Merivon 1.83 + Sylgard-309</th>
<th>Pristine + Sylgard-309</th>
<th>Luna-S (4X)TC + Capt</th>
<th>Rally + Penn TC + Capt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent fruit affected</td>
<td></td>
<td>60</td>
<td>50</td>
<td>40</td>
<td>30</td>
<td>20</td>
</tr>
</tbody>
</table>

Royal Court
Honeycrisp
Cameo
However, trees were water-stressed in July.
Some fruit showed heat injury after the July heat wave. Heat injury is different from sunburn, although both may occur at the same time.
Tissue collapse on Honeycrisp as a result of heat injury
Heat injury on Honeycrisp (below) is sometimes followed by extensive development of bitter rot (right):

Initial decays produce inoculum that generates additional infections.
Bitter rot management

Cultural controls (sanitation for problem blocks):
- Prune out dead wood during winter.
- Remove rotted fruit from beneath trees after harvest.
- Remove dead twigs from beneath trees after pruning.
For all of the above, moving potential inoculum to sodded row middles and shredding with a flail mower should be OK.
- CONSIDER: Irrigating to soil saturation ahead of heat waves.
- CONSIDER: Applying fresh fungicide ahead of predicted heat?

Best fungicide options:
Captan: If fruit begin to show bitter rot, however, use full label rates applied at 10-14 day intervals, especially ahead of warm wet weather.

Flint, Sovran, Pristine, Merivon: moderately effective, with less visible residue than high-rate captan, but must be applied with mid-rates of Captan in problem blocks.
Other cautions for summer sprays:

Some sprays may cause lenticel damage:

• Spray materials may enter lenticels during preharvest sprays or postharvest treatment.
• Exposed cells are compromised and die during storage.
Other cautions for summer sprays:

Minimize the potential for lenticel cracking:

• Avoid drought stress with irrigation when possible.
• Be cautious with spray mixtures (e.g., captan, calcium, foliar nutrients), especially when heavy rains follow drought conditions, thereby allowing rapid fruit sizing that often results in ruptured lenticels and subsequent penetration of sprays that kill cells beneath lenticels.
Over the past decade, our understanding of the fungi causing bitter rot has also changed:

Species causing bitter rot in 2006:


Species causing bitter rot in 2016:

<table>
<thead>
<tr>
<th>C. gloeosporioides complex</th>
<th>C. acutatum complex</th>
<th>C. bioninense complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. gloeosporioides</td>
<td>C. paranaense: Clade 1</td>
<td></td>
</tr>
<tr>
<td>C. fructicola</td>
<td>C. melonis: Clade 1</td>
<td></td>
</tr>
<tr>
<td>C. alienum</td>
<td>C. nymphaeae: Clade 2</td>
<td></td>
</tr>
<tr>
<td>C. siamense</td>
<td>C. fioriniae: Clade 3</td>
<td></td>
</tr>
<tr>
<td>C. ainigma</td>
<td>C. acutatum: Clade 4</td>
<td></td>
</tr>
<tr>
<td>C. piri</td>
<td>C. acerbum: Clade 5</td>
<td></td>
</tr>
<tr>
<td>C. theobromicola</td>
<td>C. godetiae: Clade 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. pyricola: Clade 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. salicis: Clade 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C. rhombiforme Clade 5</td>
<td></td>
</tr>
</tbody>
</table>

(species shown in red are probably the most important)
Impression from my (incomplete) lit review

1. *C. acutatum* species seem to predominate in cooler climates, *C. gloeosporioides* species in warmer climates.

2. Glomerella leaf spot is caused primarily by species in the *C. gloeosporioides* group (*C. fructicola in Brazil*) and by *C. karstii* in the *C. bioninense* group; role of *C. acutatum* sp. in leaf spotting is questionable.

3. *C. fioriniae* predominates in the northeast.

4. *C. godetiae* may predominate in Europe.
Colletotrichum as entomopathogen, endophyte

At least three *C. acutatum* species infect insects:

* C. fioriniae attacks Hemlock scale (Marcelino et al., 2008).

* C. gloeosporioides f. sp. ortheziidae infects citrus scale (Cesnik et al., 1996), but this species may actually be *C. nymphaeae* (Damm et al., 2012a).

An unidentified species from the *C. acutatum* complex was recently shown to cause mortality in the Asian chestnut gall wasp (Graziosi and Rieske, 2015).

Another species grows as an endophyte in cacao and protects trees from *Phytophthora* infection.
Colletotrichum as entomopathogen, endophyte

C. fioriniae has been shown to grow as an endophyte in many broad-leaved plants, including many weed species found in orchards (Marcelino et al., 2009).

Colletotrichum species may have developed a commensal or mutualistic relationship with some plant hosts because of its ability to suppress insect pests and/or other pathogens.

So where is Colletotrichum lurking in orchards?