Apple IPM Intensive Workshop

IPM for Apple Scab and Fire Blight

Kerik D. Cox, Anna Wallis, David Strickland, and Katrin Ayer

Plant Pathology and Plant-Microbe Biology Section
• **Implement the best horticultural practices**: high-density plantings are better for color, yield per acre, agrichemical applications, drying time & air circulation for disease protection

Tall spindle semi-dwarf 300/A

Tall spindle HD dwarf 1200/A
IPM: General

• Implement the best horticultural practices:
  • Water management: select the best sites, tile orchards, manage drip irrigation
  • Prune dead plant material & manage weeds to increase air circulation
Apple scab

- Perennial problem in cool wet temperate production regions
- Susceptible cultivars: favored by consumer and producer
- High input system (10+ fungicide applications/year)
- Fungicide resistance is reported for nearly all single-site fungicides chemistries
Apple scab

• Overwinters: infected leaf litter

• Infection: ascospores from leaf litter

• Secondary spores produced on infected leaves spread infection to other fruit & leaves

• Spread is local & management is site-specific
Taipan: Apple scab

Apple Scab Incidence

- 100%
- 95%
- 80%
- 70%
- 33%
- 0%

Time

Sanitation + Silver Tip Copper
Silver Tip Copper
Sanitation, Urea
Nothing
Fall or Spring Urea
Harvest

Silver tip copper

Fall or Spring Urea

Cornell Cooperative Extension provides equal program and employment opportunity.
IPM: Apple scab

**Protectant fungicides GT to Bloom**

- Full season program with anti-sporulant fungicide applications $r = 0.40$
- Single site fungicides From Bloom to 2C $r = 0.55$
- Protectant fungicides from GT to Bloom $r = 0.75$

**Single-site fungicides Bloom to 2C**

- Lesions on mature fruit
- Terminal leaves with lesions fall with senescence
- Secondary infection of leaves and fruit by conidia
- Ascus with ascospores mature in pseudocystum in the spring and release with rainfall
- Pseudocystum
- Conidia
- Aeciospores with conidiophores

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IPM: Apple scab

- Implement the best horticultural practices: use resistance cultivars
  - Enterprise, Freedom, Goldrush, Jonafree, Liberty, Pristine, Redfree, Topaz, William’s Pride, Crimson Crisp, Prima, Ariane, Honeycrisp
  - Immunity to apple scab (*Rvi6* gene) NOT other diseases (e.g. Topaz & PRR)

IPM: Apple scab

- **Sanitation**: remove & destroy fruit drops, leaf litter, and prunings, or other dead plant material: Avoids accumulation of inoculum
  - Fall or spring Leaf Shredding (rake into middles, scalp the sod) or Urea application (40lbs/100) or Dolomitic lime (2.5 tons/Acre)
  - Delayed Dormant Copper application at silver tip (15% MCE)
• **Chemical management:**
  • Primary apple scab: Protectant fungicides 5-7 days from green tip to petal fall: captan, mancozeb, sulfur, dodine
  • Secondary apple scab: Single site fungicides 5-7 days bloom to 2-3rd cover: DMIs, QoIs, SDHIs
IPM: Apple scab

- Apple scab forecasting
  - Predicts ascospore maturity, ascospore release, conditions for 1’ infection
  - Helps track 1’ apple scab infection
  - 2” apple scab “technically” not predicted
- NEWA system for NY growers
IPM: Apple scab

• NEWA Disease forecasting for apple scab
  • Predicts ascospore maturity, ejection, & infection events
  • Provides warnings of possible infection events
• Local and satellite weather data: w/LW algorithms for satellite data
### Apple Scab Results for Peru

The Ascospore Maturity degree day model begins at 50% green tip on McIntosh flower buds. To recalculate ascospore maturity for your orchard, enter your green tip date.

**Green Tip Date:** 4/18/2015

<table>
<thead>
<tr>
<th>Ascospore Maturity Summary</th>
<th>Past</th>
<th>Past</th>
<th>Current</th>
<th>Past</th>
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<tbody>
<tr>
<td>Date</td>
<td>5/9</td>
<td>5/10</td>
<td>5/11</td>
<td>5/12</td>
<td>5/13</td>
<td>5/14</td>
<td>5/15</td>
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<tr>
<td>Ascospore Maturity</td>
<td>13.0%</td>
<td>18.0%</td>
<td>21.0%</td>
<td>27.0%</td>
<td>31.0%</td>
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<tr>
<td>Daily Ascospore Discharge</td>
<td>0.0%</td>
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<td>0.4%</td>
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<tr>
<td>Cumulative Ascospore Discharge</td>
<td>1.7%</td>
<td>1.7%</td>
<td>19.1%</td>
<td>19.3%</td>
<td>19.5%</td>
<td>19.5%</td>
<td>19.5%</td>
<td>21.0%</td>
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#### Infection Events Summary

<table>
<thead>
<tr>
<th>Date</th>
<th>Past</th>
<th>Past</th>
<th>Current</th>
<th>Ensuing 5 Days</th>
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<td>5/16</td>
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</table>

- **Days to Symptoms:** 12-13
- **Average Temp (F) for wet hours:** 64, 54, 60, 65, 59
- **Leaf Wetness (hours):** 0, 6, 9, 11, 0, 0, 1, 8
- **Rain Amount:** 0.00, 0.01, 0.62, 0.12, 0.00, 0.00, 0.00, 0.03
### Apple Scab Results for Peru

The Ascospore Maturity degree day model begins at 50% green tip on McIntosh flower buds. To recalculate ascospore maturity for your orchard, enter your green tip date.

**Green Tip Date:** 4/18/2015

### Ascospore Maturity Summary

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<tr>
<td>Ascospore Maturity</td>
<td>78.0%</td>
<td>82.0%</td>
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<td>93.0%</td>
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<td>97.0%</td>
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<tr>
<td>Daily Ascospore Discharge</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>3.6%</td>
<td>34.8%</td>
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<tr>
<td>Cumulative Ascospore Discharge</td>
<td>23.6%</td>
<td>23.6%</td>
<td>23.6%</td>
<td>23.6%</td>
<td>23.6%</td>
<td>27.2%</td>
<td>62.0%</td>
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</table>

### Infection Events Summary

The Ascospore Maturity model predicts that 95% of the ascospores have matured. At this point, essentially all ascospores will be released after a daytime rain of greater than 1/10 inch with temperature above 50°F.

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<tr>
<th>Date</th>
<th>Past</th>
<th>Past</th>
<th>Current</th>
<th>Current</th>
<th>Current</th>
<th>Current</th>
<th>Current</th>
<th>Current</th>
<th>Ensuing 5 Days</th>
<th>Ensuing 5 Days</th>
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<td>Infection Events</td>
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<td>No</td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Combined</td>
<td>Yes</td>
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<tr>
<td>Days to Symptoms</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9-10</td>
<td>-</td>
</tr>
<tr>
<td>Average Temp (F) for wet hours</td>
<td>64</td>
<td>64</td>
<td>74</td>
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<tr>
<td>Leaf Wetness (hours)</td>
<td>8</td>
<td>5</td>
<td>7</td>
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<tr>
<td>Rain Amount</td>
<td>0.05</td>
<td>0.01</td>
<td>0.04</td>
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Download Time: 5/28/2015 23:00
Considerations for apple scab models:

- Predictions on primary apple scab infection & ascospore dynamics
- NEWA cursory information on ascospore maturity and ejection
- NEWA uses forecast data conservatively > day 3-5 less weight than days 1&2
• Considerations for apple scab models:
  • Models predict favorable conditions: apply at the highest risk periods not every infection
  • Spraying in advance? Use common sense with any model
  • Avoid spraying only after an infection period > selection for resistance
IPM: Fire Blight

• Fire blight increasingly problematic
  • High-density tall/super spindle plantings (1000 – 1200/A) = $high-value acreage

• Young productive trees: protracted bloom & vigorous susceptible shoot tissue

• Resistant rootstocks not always helpful: once fire blight hits leader > tree gone

• New popular scion varieties susceptible
IPM: Fire Blight

- Blossom blight
  - Reduces current season’s crop
  - Managed forecasted antibiotic applications

- Shoot blight
  - Reduces bearing wood for following season
  - Managed by pruning and treatment with growth regulator prohexadione-calcium (Apogee)
IPM: Fire Blight

• Rootstock blight
  • Systemic infection of rootstock from suckers or blossom/shoot blight
  • Managed by resistant rootstocks

• Trauma blight
  • Results from wounds caused by hail, wind, & animals
  • Managed by antibiotics or copper
IPM: Fire Blight

Antibiotics & Biologicals at Bloom

Full season program with bloom protection
SARS, PGRs, and Pruning $r = 0.40$

SARS, PGRs, & Pruning from PF to Harvest $r = 0.55$

Antibiotics & Biologicals at Bloom $r = 0.75$

$60\%$, $75\%$, $95\%$

- Antibiotics & Biologicals at Bloom
- SARS, PGRs, and Sanitation (Pruning) from PF to Harvest

Cankers ooze in the spring as the weather warms and lands on open flowers

Primary Infection

Bacteria multiplying on the stigma infect through floral nectaries

Secondary Infection

Insects and wind may disperse bacteria to actively growing tissues

Bacterial invasion ends at terminal bud set, but entire shoots may blight

Bacteria overwinters in cankers formed on shoots and trunks in fall

Wet oozing canker filled with bacterial cells

Blossoms blight as bacteria invades
IPM: Fire Blight

• Implement the best horticultural practices: use less susceptible cultivars
  • No single-gene resistance in popular cultivars
  • Resistant rootstocks include the Geneva series & B.9 (2nd year)
  • Remove infected trees
IPM: Fire Blight

• Post-season: Clean up inoculum to reduce spread within and between trees: Prune out strikes & small cankers
IPM: Fire Blight

• Pre-season: Scout and prune out oozing cankers
  • Large - depressed discolored cracked bark: main scaffolds can’t prune
  • Small – blossom & shoot infections, summer pruning cuts: numerous & hard to see/find
IPM: Fire Blight

• Pre-season
  • Delayed Dormant Fixed Copper application at silver tip (15% MCE) (Warm weather causes cankers to ooze > fire flight inoculum increases greatly)

• Bloom (had or have history of fire blight)
  • Use: consultant, extension alerts, or disease model forecasts for fire blight infection periods (NEWA)
• Bloom
  • Models over predict infection risk: shouldn’t need more than 3 applications to get to petal fall
  • Need 1 well-timed application
  • Use Model + Common Sense/Consultant
IPM: Fire Blight

• Bloom
  • Since streptomycin resistance is rare in NY, use highest rate of strep (24 oz/A) for a forecast infection
  • Consider an application of Kasumin 2L at the labeled rate (64 fl oz/A) for the 2nd or 3rd forecast infection
• Bloom (Organic with susceptible varieties)
  • No antibiotics (Oct 20, 2014), Highest rate of Blossom Protect, Double Nickel with Cueva, Previsto, Regalia w/copper, or Serenade Opti
  • Use NEWA forecasts, apply materials for protection at EIP of 60-70 during wet weather at bloom—use local data
IPM: Fire Blight

• Post-Bloom & Summer: SARS & Prohexadione Ca
  • SARS: Actigard, Regalia, and LifeGard
  • PhCa: Retards vigorous shoot growth in young trees & is best protection against shoot blight

<table>
<thead>
<tr>
<th>Product</th>
<th>Application Details</th>
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<tbody>
<tr>
<td>PhCa 6-12 oz</td>
<td>@ PF and 14-21 days</td>
</tr>
<tr>
<td>PhCa 6 oz</td>
<td>@ Pink</td>
</tr>
<tr>
<td>PhCa 2 oz + Actigard 1 oz</td>
<td>@ Pink &amp; PF</td>
</tr>
</tbody>
</table>

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IPM: Fire Blight

• Post-Bloom & Summer: **Copper (protectant)**
  • Can cause fruit russet: not a concern in nursery or during establishment; Apply with adequate drying time
  • Protectant: reduces surface bacteria
  • Terminals can outgrow protective residues of copper
  • Low rate fixed copper program: 7-10 day schedule until terminal bud set
IPM: Fire Blight

• Post-Bloom & Summer: Pruning newly developed strikes
  • Remove as soon as noticed on a **cool dry day**
  • Cut into last season's growth - At least 12” into healthy tissue
  • Young trees: if 12” is into the main scaffold > remove/replant
  • “Rescue” program apply Apogee 6-12 oz/100 gal, wait 5 days, prune every two week till terminal bud set
IPM: Fire Blight

- Fire blight forecasting:
  - Predicts blossom blight infection risk periods
  - Helps track development of shoot blight only (not infection), why?
  - Best practice for avoiding antibiotic resistance
  - NEWA: both use heat units & presence of moisture
IPM: Fire Blight

- NEWA system:
  - CougarBlight logic (WSU)
  - Epiphytic infection potential (WV UMD)
- Integrated with NEWA/NRCC weather data
- Fully Automated: w/ limited user input
IPM: Fire Blight

EIP Thresholds & Bactericides selection

- EIP > 70: streptomycin or kasugamycin
- EIP 40-70: Oxytetracycline or a biological
• Considerations for models:
  • Tells: **When** and **How** favorable environmental conditions are for blossom blight infection
  • Doesn’t predict control failures or future disease
  • Less effective for shoot blight: 1) **internal** movement of bacteria to growing shoot tips or 2) **external** injury following, insect, animal, or warm windy storm
  • More cost-effective to spray for blossom blight when environment conditions are favorable
  • Applying antibiotics for blossom blight, use the models to guide application timing
Which of the following is not an IPM practice for apple scab

1. Pruning limbs with apple scab infected fruit
2. Applying urea to reduce inoculum
3. Applying fixed copper delayed dormant to reduce inoculum
4. Using disease resistant cultivars
The fire blight model forecasts risks on all of the following except

1. Degree hour accumulations during bloom
2. The presence of dew
3. Hours of accumulated leaf wetness from petal fall
4. First blossom open date
Which of the following is not an IPM practice for fire blight

1. Using less susceptible resistant cultivars
2. Applying defense inducers and plant growth regulators
3. Delayed-dormant application of copper to reduce inoculum
4. Apply urea to leaf litter to reduce inoculum