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Apple IPM Intensive Worshop

IPM for Apple Scab and Fire Blight

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Plant Pathology and Plant-Microbe Biology Section

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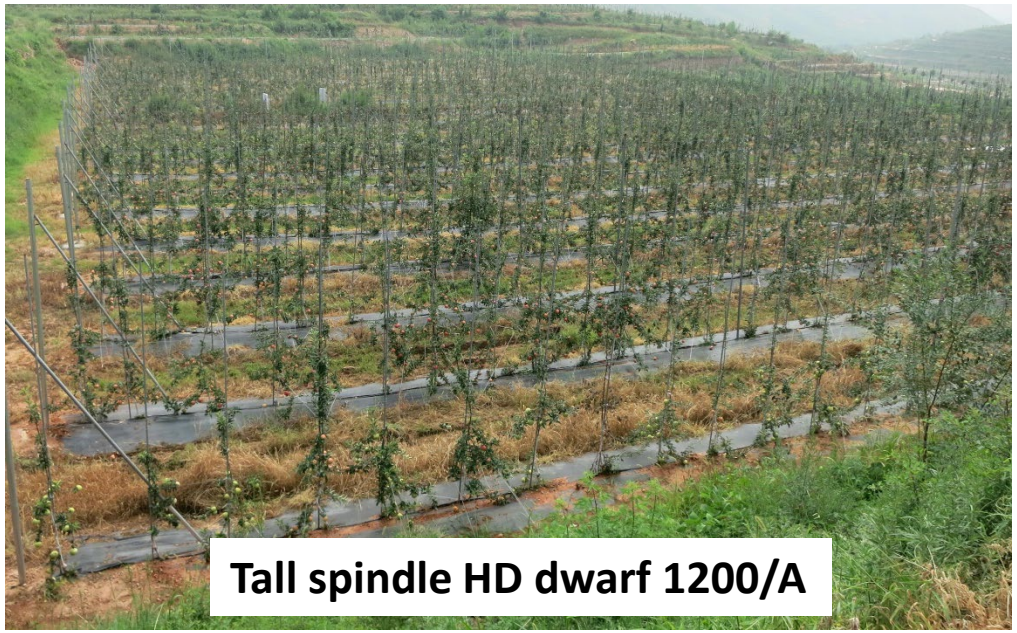
IPM: General

- **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

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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

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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

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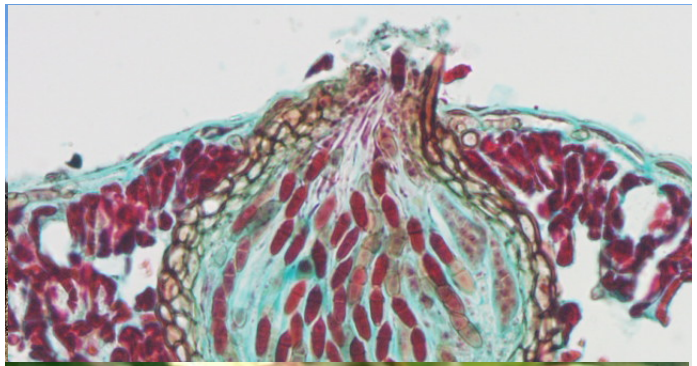
Apple scab

- 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



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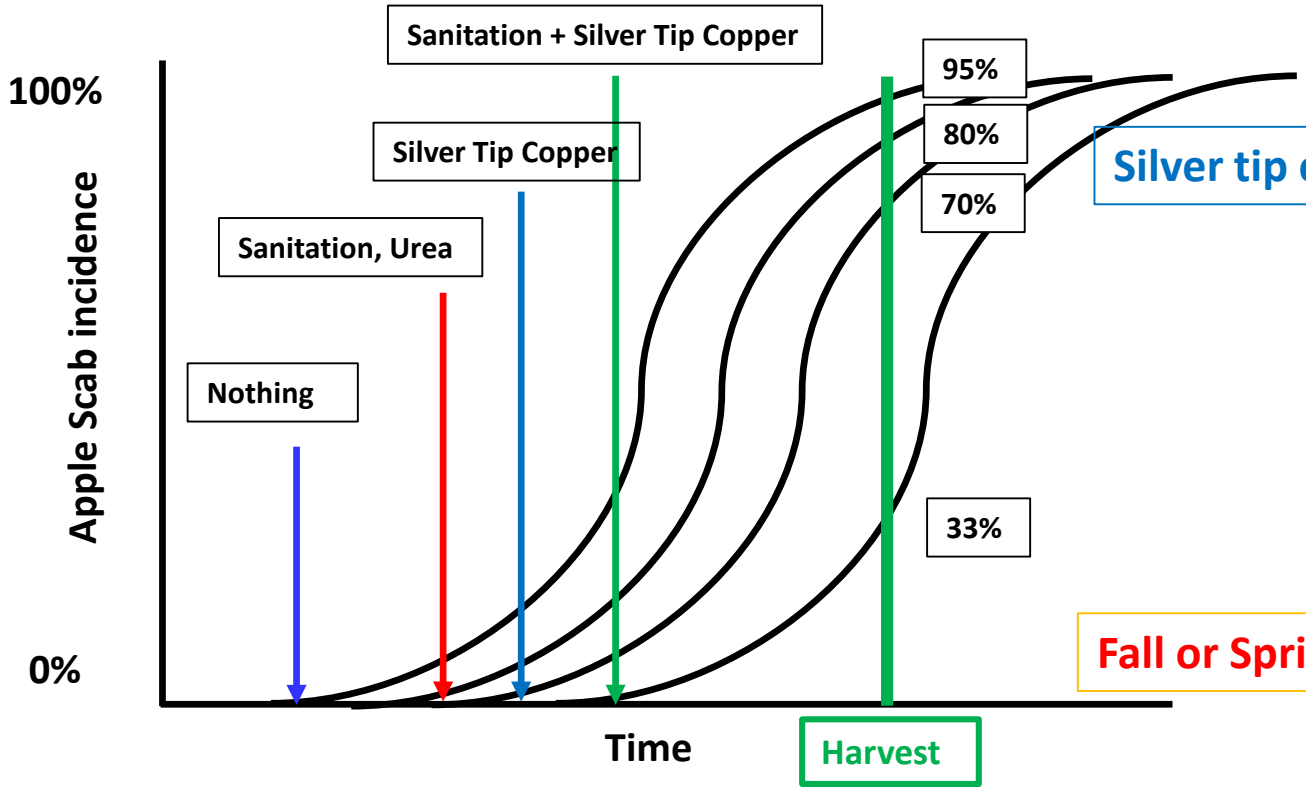
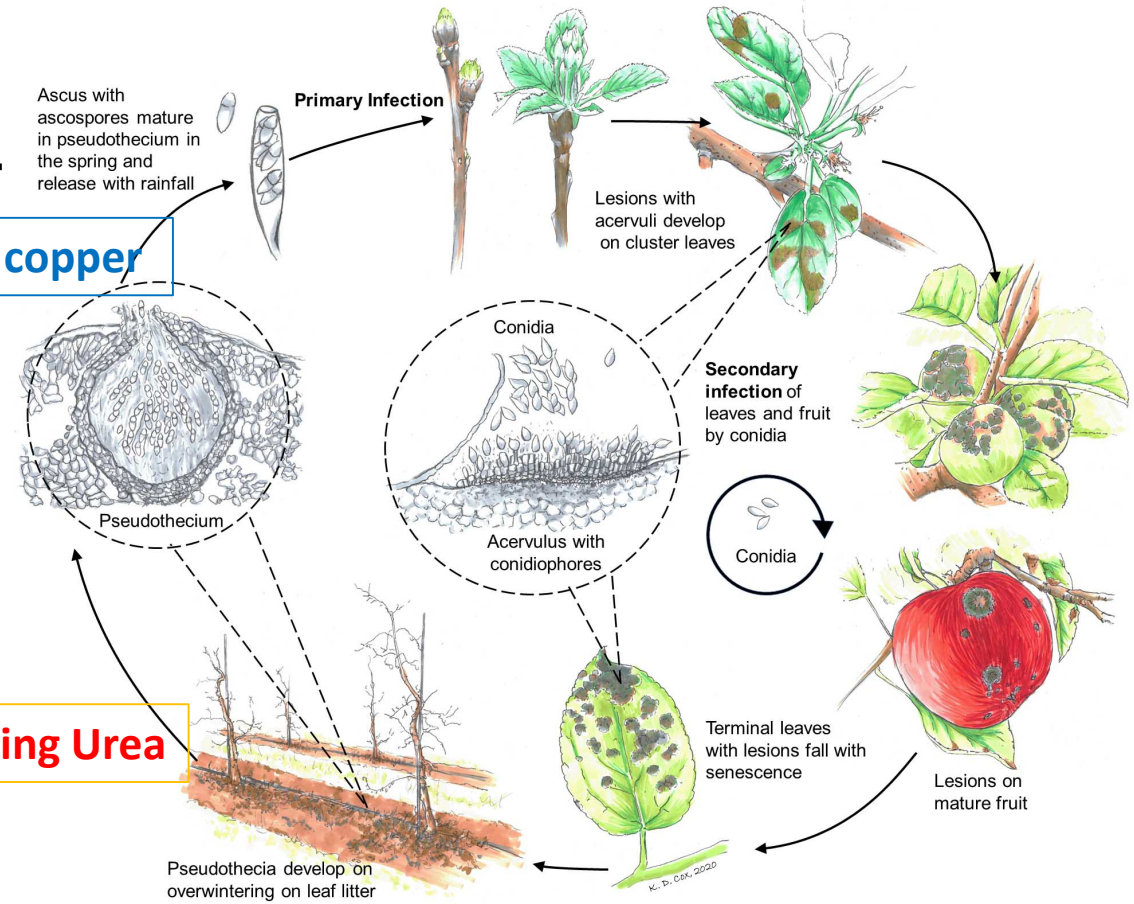
IPM: Apple scab



Silver tip copper

Fall or Spring Urea



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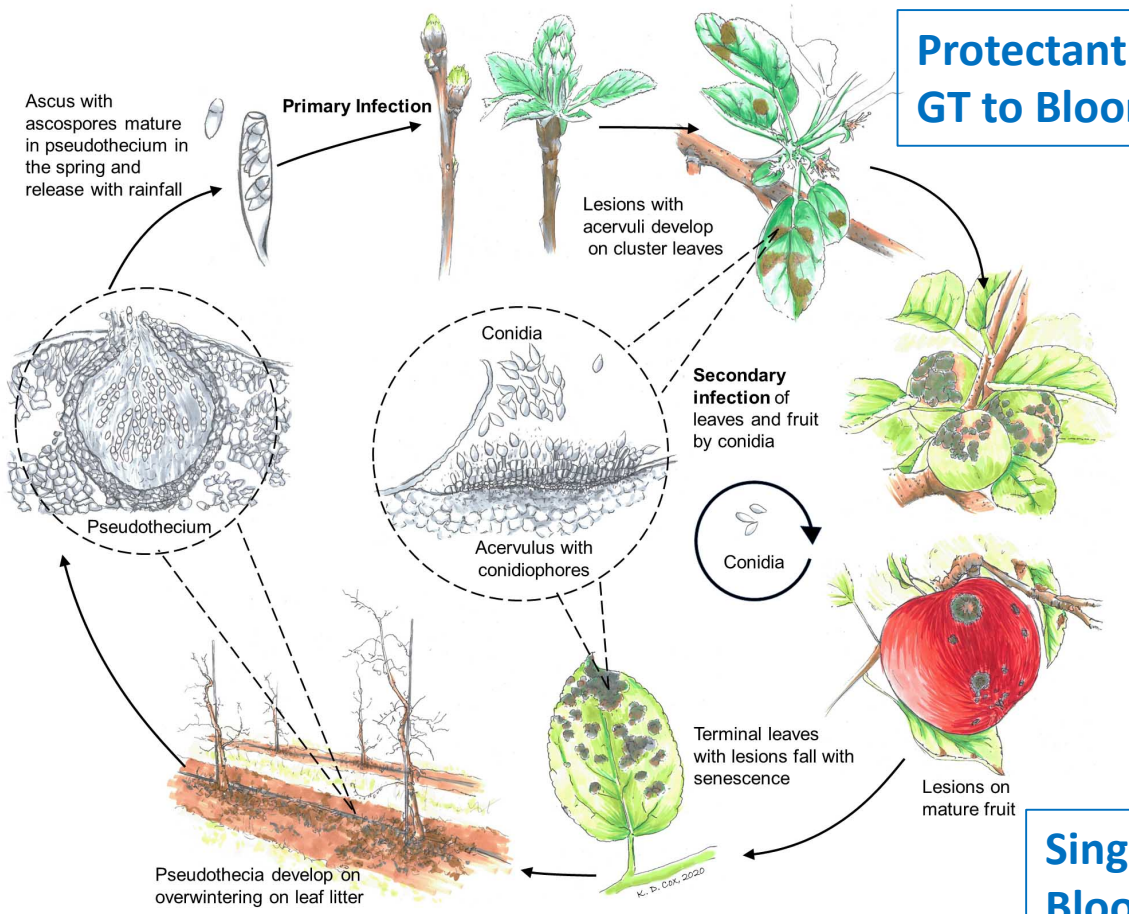
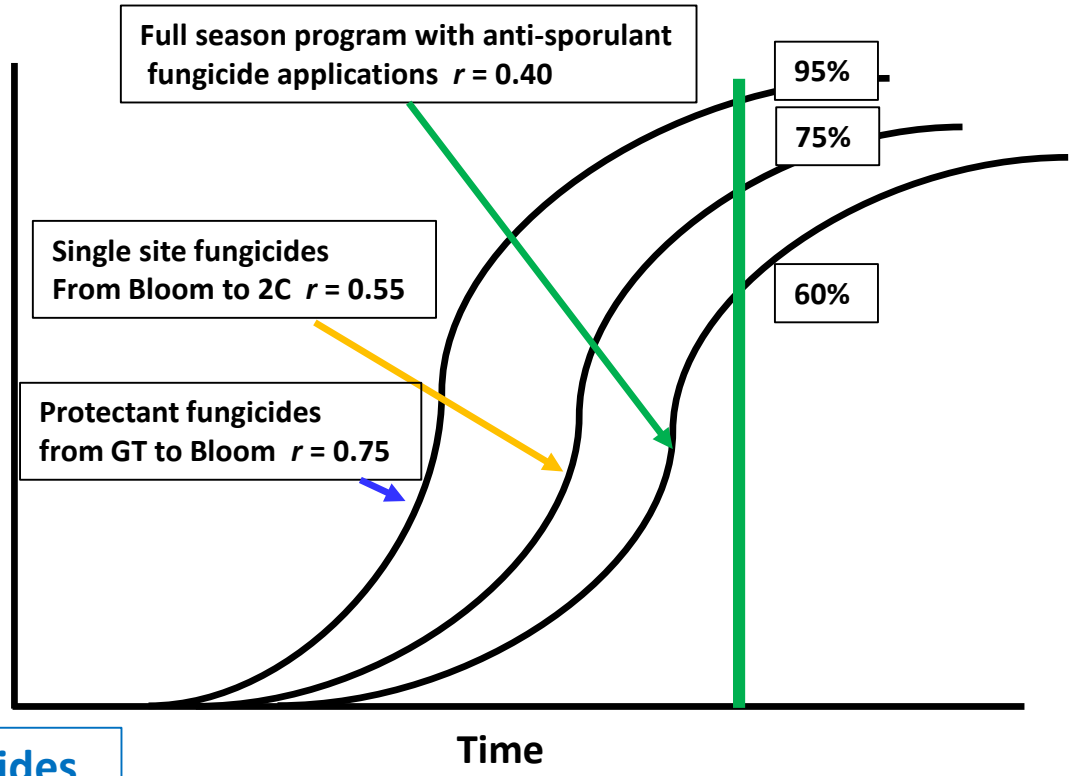
IPM: Apple scab



Protectant fungicides GT to Bloom

Single-site fungicides Bloom to 2C



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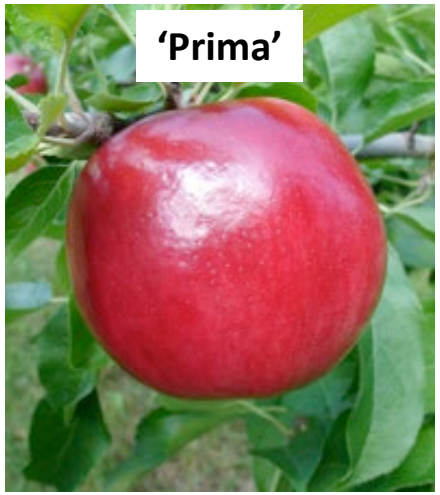
IPM: Apple scab

- **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)

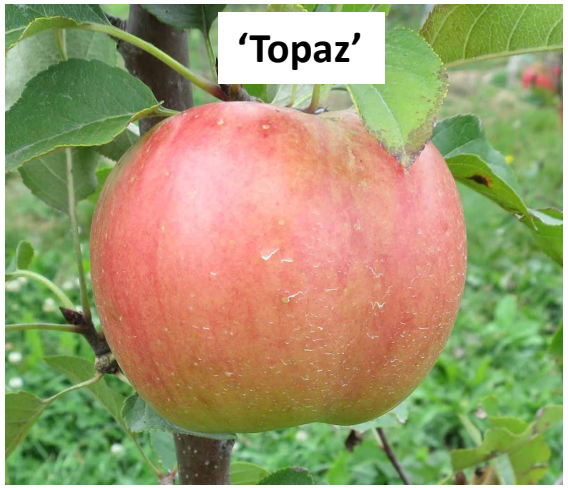
http://kuffelcreek.wordpress.com/



http://www.eatlikenoone.com/prima-apples.htm

http://www.plant.photos.net/index.php?title=File:Apple_williams_pride.jpg

http://www.plant.photos.net/index.php?title=File:Apple_libertye.jpg



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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)

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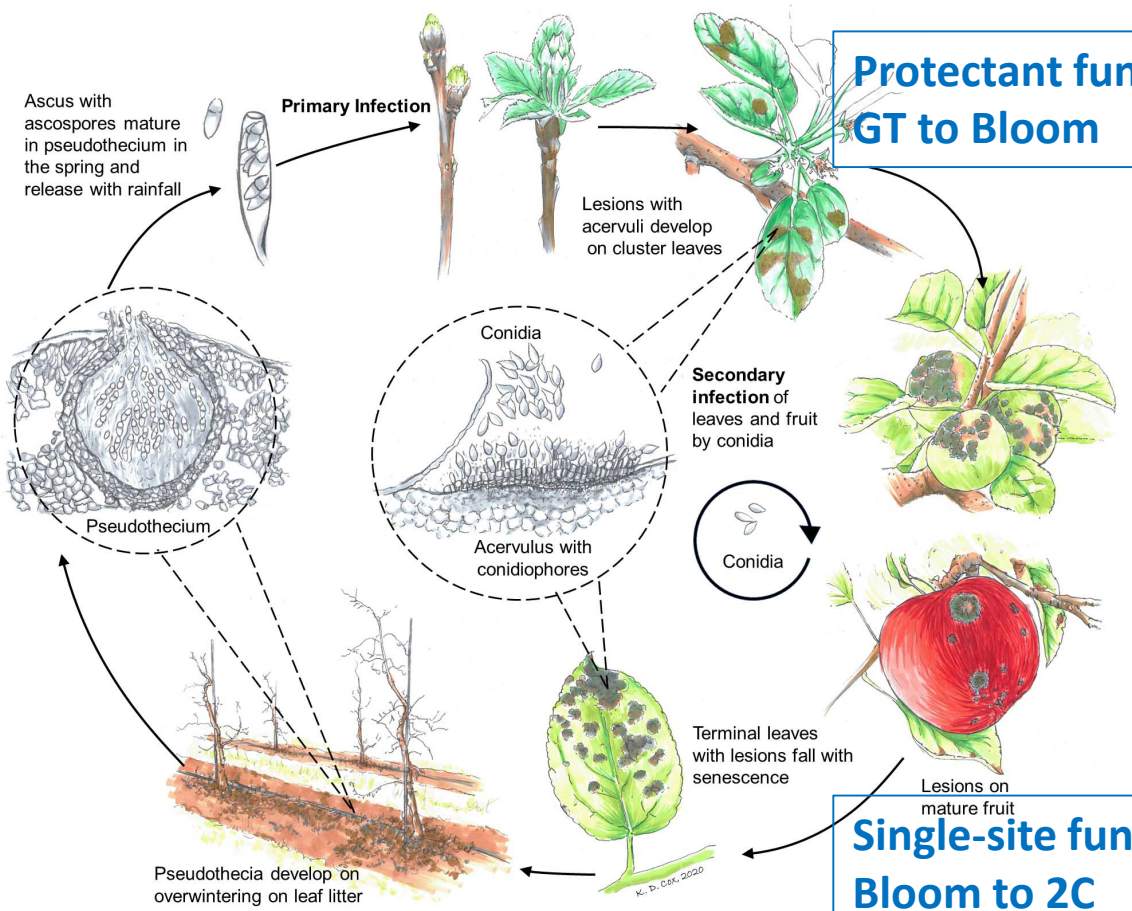
IPM: Apple scab

- **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



Protectant fungicides GT to Bloom

Single-site fungicides Bloom to 2C

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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

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IPM: Apple scab

- NEWA Disease forecasting for apple scab
- http://newa.cornell.edu/index.php?page=apple-diseases
- Predicts ascospore maturity, ejection, & infection events
- Provides warnings of possible infection events
- Local and satellite weather data: w/LW algorithms for satellite data

Map | Results | More info

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

	Past	Past	Current	Ensuing 5 Days				
Date	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
Ascospore Maturity	13.0%	18.0%	21.0%	27.0%	31.0%	36.0%	41.0%	49.0%
Daily Ascospore Discharge	0.0%	0.0%	17.4%	0.4%	0.0%	0.0%	0.0%	1.5%
Cumulative Ascospore Discharge	1.7%	1.7%	19.1%	19.5%	19.5%	19.5%	19.5%	21.0%

Ascospore Maturity Graphs

Infection Events Summary

	Past	Past	Current	Ensuing 5 Days				
Date	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
Infection Events	No	Combined	Combined	Yes	No	No	No	No
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

Download Time: 5/17/2015 23:00

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IPM: Apple scab

Map | Results | More info

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Ascospore Maturity Graphs

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Green Tip Date: 4/18/2015

Ascospore Maturity Summary

	Past	Past	Current	Ensuing 5 Days				
Date	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27
Ascospore Maturity	78.0%	82.0%	84.0%	86.0%	90.0%	93.0%	95.0%	97.0%
Daily Ascospore Discharge	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	34.8%
Cumulative Ascospore Discharge	23.6%	23.6%	23.6%	23.6%	23.6%	23.6%	27.2%	62.0%

Ascospore Maturity Graphs

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.

Infection Events Summary

	Past	Past	Current	Ensuing 5 Days				
Date	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27
Infection Events	No	No	No	No	No	Combined	Yes	Combined
Days to Symptoms	-	-	-	-	-	-	9-10	-
Average Temp (F) for wet hours						64	64	74
Leaf Wetness (hours)	0	0	0	0	0	8	5	7
Rain Amount	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.04

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IPM: Apple scab

- 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

Map | Results | More info

Apple Scab Results for Peru

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Ascospore Maturity Summary

	Past	Past	Current	Ensuing 5 Days				
Date	5/24	5/25	5/26	5/27	5/28	5/29	5/30	5/31
Ascospore Maturity	90.0%	93.0%	95.0%	97.0%	98.0%	98.0%	99.0%	99.0%
Daily Ascospore Discharge	0.0%	0.0%	3.6%	34.8%	17.9%	0.0%	0.0%	9.6%
Cumulative Ascospore Discharge	23.6%	23.6%	27.2%	62.0%	79.9%	79.9%	79.9%	89.5%

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Infection Events	No	Combined	Yes	Combined	Yes	No	Combined	Combined
Days to Symptoms	-	-	9-10	-	9-10	-	-	-
Average Temp (F) for wet hours		64	64	74	69		72	52
Leaf Wetness (hours)	0	8	5	7	6	0	6	24
Rain Amount	0.00	0.05	0.01	0.04	0.07	0.00	0.25	0.42

Download Time: 6/1/2015 23:00

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IPM: Apple scab

- 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

Map | Results | More info

Apple Scab Results for Peru

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Ascospore Maturity Graphs

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Infection Events	No	Combined	Yes	Combined	Yes	No	Combined	Combined
Days to Symptoms	-	-	9-10	-	9-10	-	-	-
Average Temp (F) for wet hours		64	64	74	69		72	52
Leaf Wetness (hours)	0	8	5	7	6	0	6	24
Rain Amount	0.00	0.05	0.01	0.04	0.07	0.00	0.25	0.42

Download Time: 6/1/2015 23:00

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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

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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)

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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

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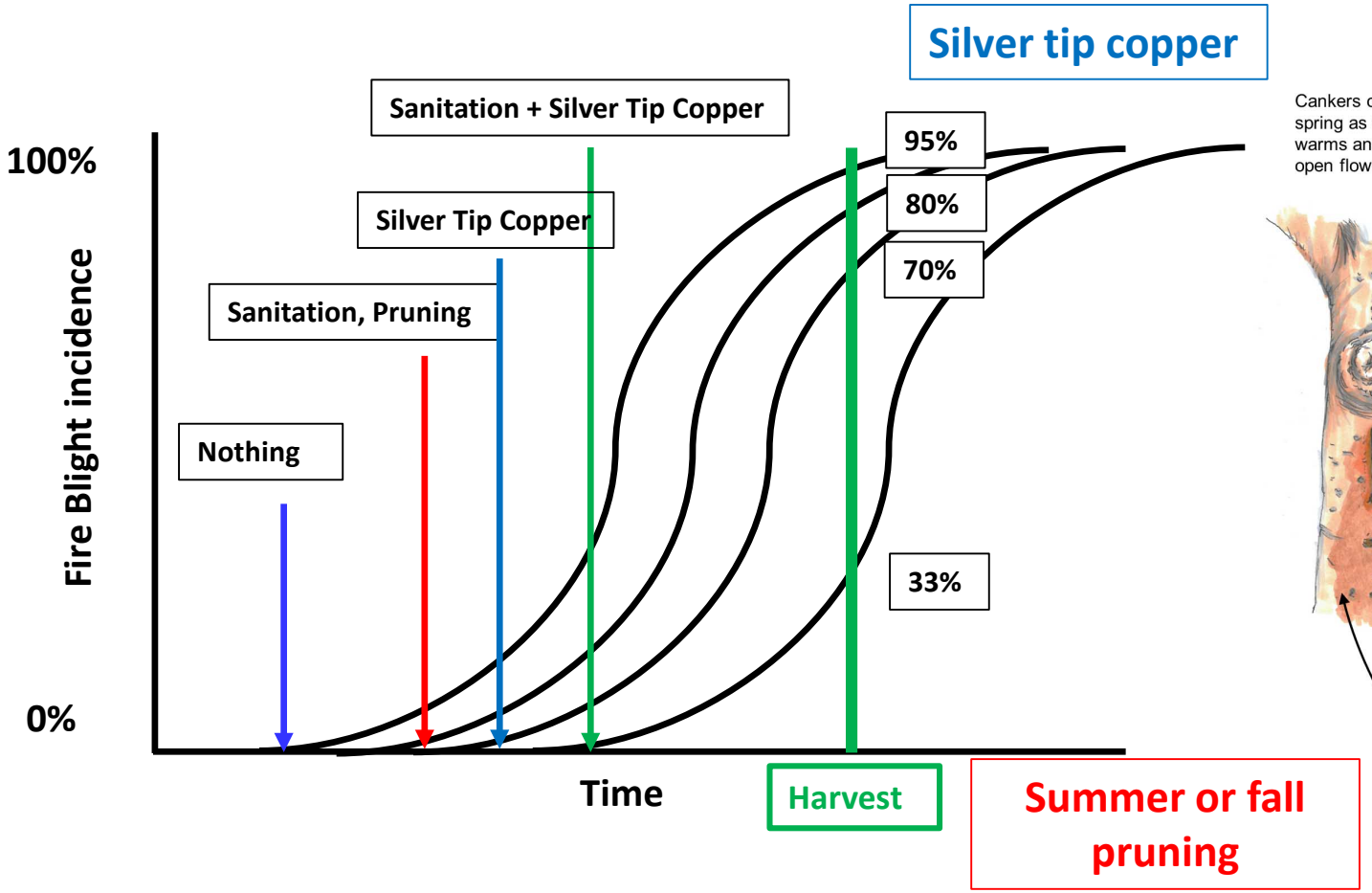
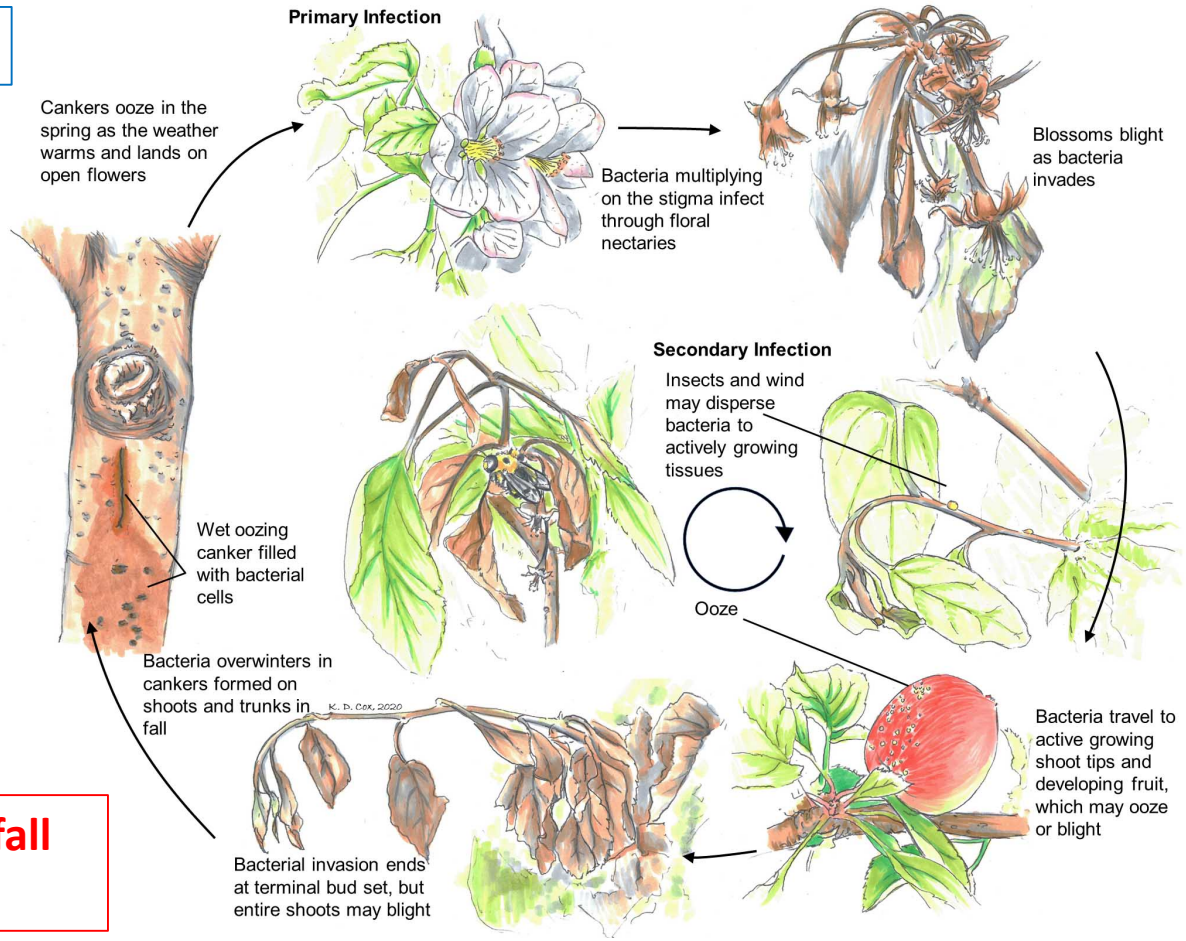
IPM: Fire Blight





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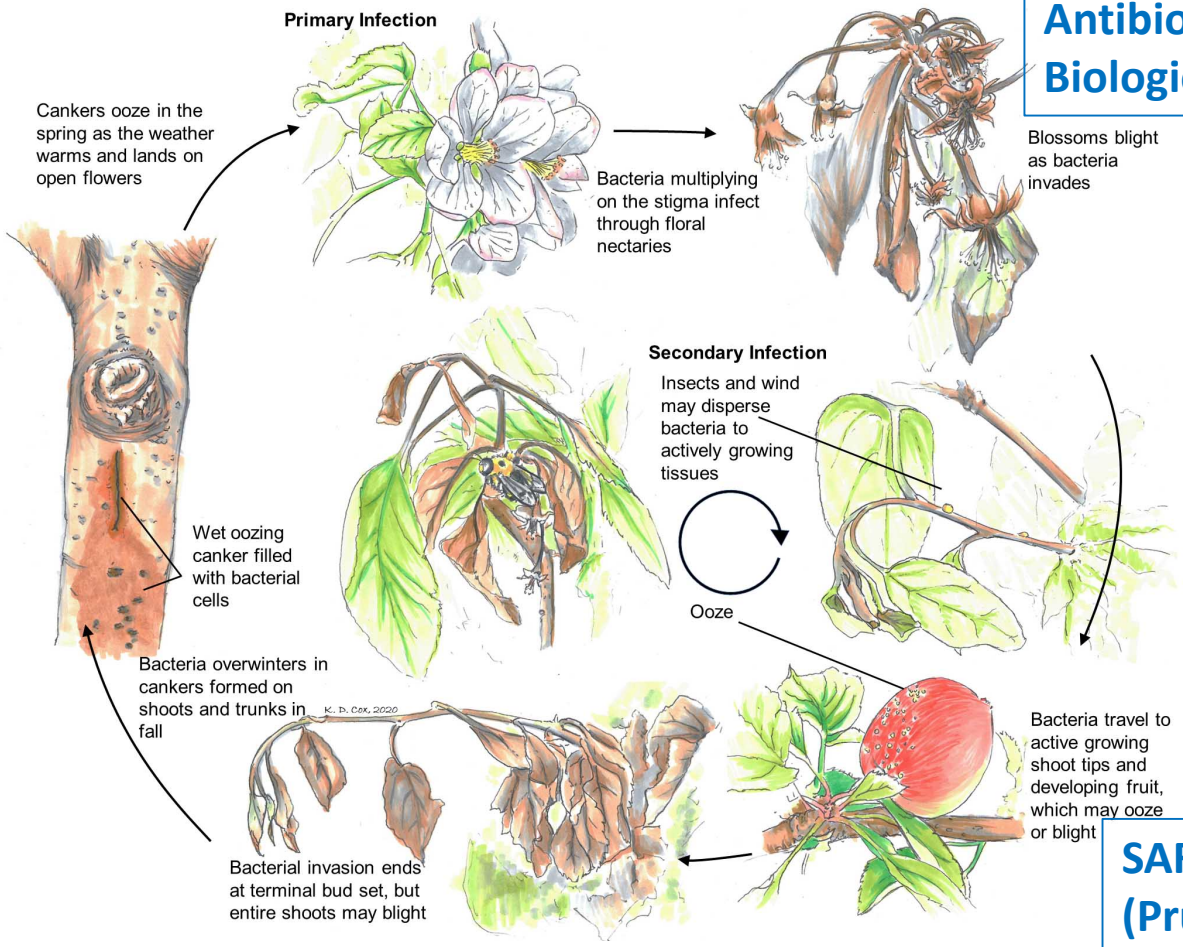
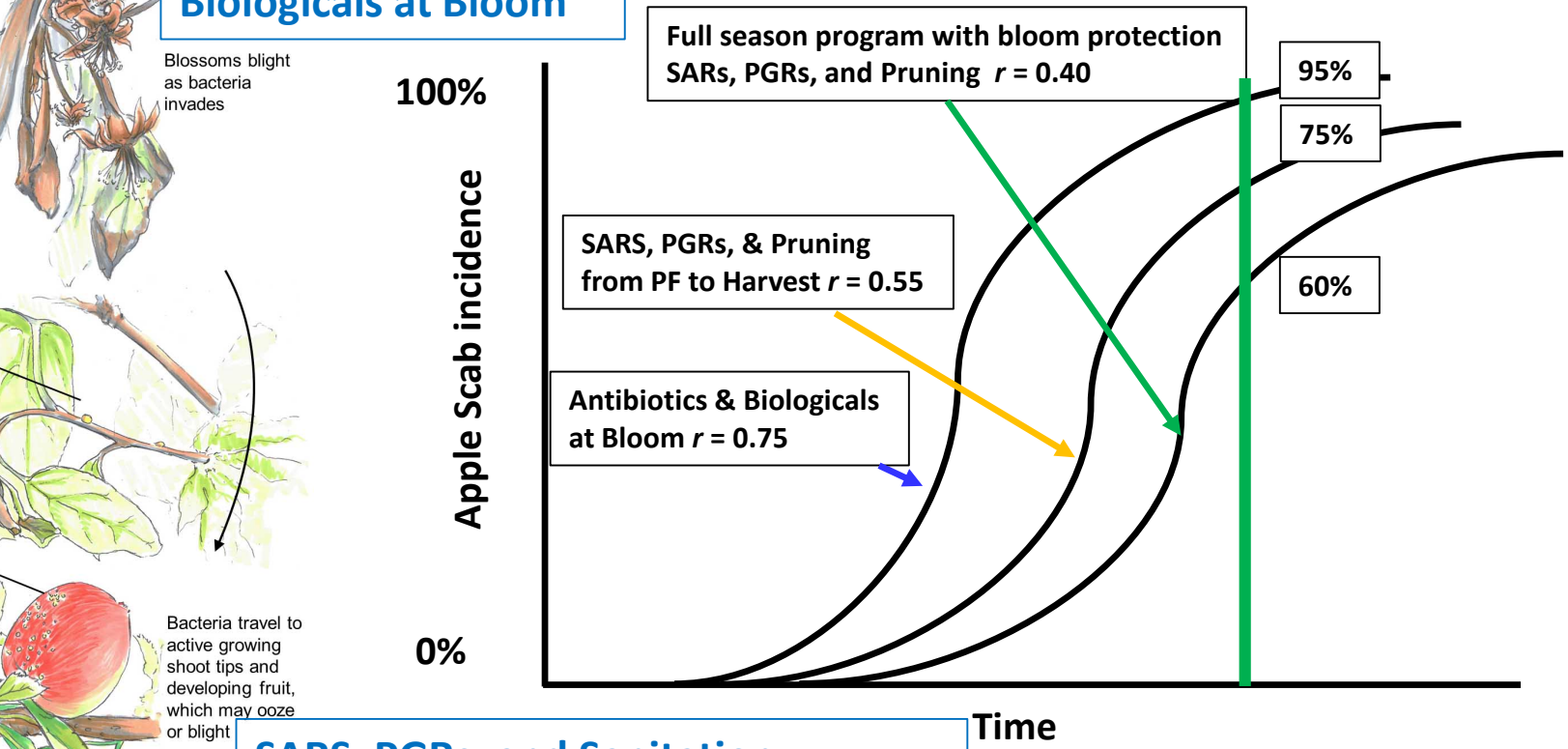
IPM: Fire Blight



Antibiotics & Biologicals at Bloom



SARS, PGRs, and Sanitation (Pruning) from PF to Harvest

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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

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IPM: Fire Blight

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

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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

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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)

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IPM: Fire Blight

- 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

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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

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IPM: Fire Blight

- 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

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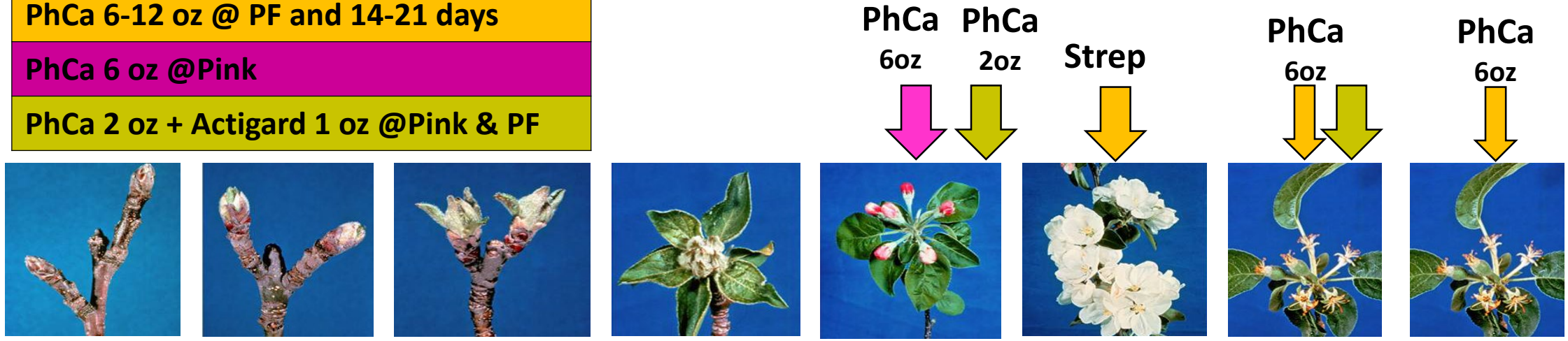
IPM: Fire Blight

- 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

PhCa 6-12 oz @ PF and 14-21 days
PhCa 6 oz @Pink
PhCa 2 oz + Actigard 1 oz @Pink & PF



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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

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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 budset

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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

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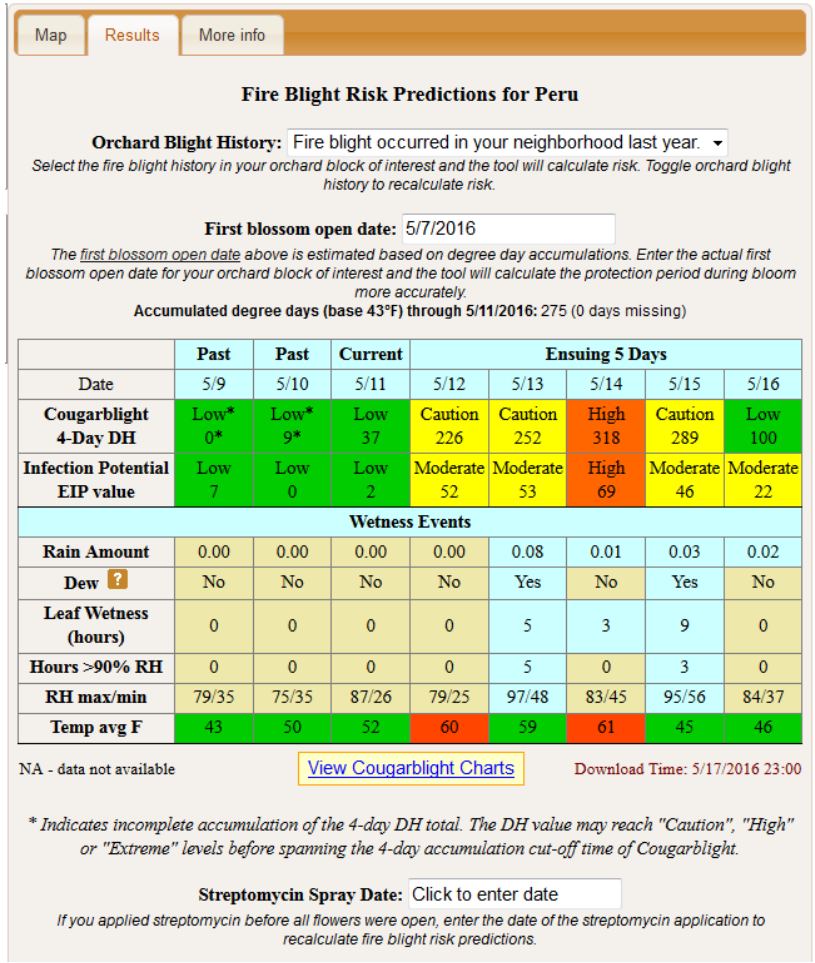
IPM: Fire Blight

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



Map | Results | More info

Fire Blight Risk Predictions for Peru

Orchard Blight History: Fire blight occurred in your neighborhood last year.
Select the fire blight history in your orchard block of interest and the tool will calculate risk. Toggle orchard blight history to recalculate risk.

First blossom open date: 5/7/2016
The first blossom open date above is estimated based on degree day accumulations. Enter the actual first blossom open date for your orchard block of interest and the tool will calculate the protection period during bloom more accurately.
Accumulated degree days (base 43°F) through 5/11/2016: 275 (0 days missing)

	Past	Past	Current	Ensuing 5 Days				
Date	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
Cougarblight 4-Day DH	Low* 0*	Low* 9*	Low 37	Caution 226	Caution 252	High 318	Caution 289	Low 100
Infection Potential EIP value	Low 7	Low 0	Low 2	Moderate 52	Moderate 53	High 69	Moderate 46	Moderate 22
Wetness Events								
Rain Amount	0.00	0.00	0.00	0.00	0.08	0.01	0.03	0.02
Dew	No	No	No	No	Yes	No	Yes	No
Leaf Wetness (hours)	0	0	0	0	5	3	9	0
Hours >90% RH	0	0	0	0	5	0	3	0
RH max/min	79/35	75/35	87/26	79/25	97/48	83/45	95/56	84/37
Temp avg F	43	50	52	60	59	61	45	46

NA - data not available | View Cougarblight Charts | Download Time: 5/17/2016 23:00

** Indicates incomplete accumulation of the 4-day DH total. The DH value may reach "Caution", "High" or "Extreme" levels before spanning the 4-day accumulation cut-off time of Cougarblight.*

Streptomycin Spray Date: Click to enter date
If you applied streptomycin before all flowers were open, enter the date of the streptomycin application to recalculate fire blight risk predictions.

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IPM: Fire Blight

Map | Results | More info

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	Past	Past	Current	Ensuing 5 Days				
Date	5/9	5/10	5/11	5/12	5/13	5/14	5/15	5/16
Cougarblight 4-Day DH	Low* 0*	Low* 9*	Low 37	Caution 226	Caution 252	High 318	Caution 289	Low 100
Infection Potential EIP value	Low 7	Low 0	Low 2	Moderate 52	Moderate 53	High 69	Moderate 46	Moderate 22
Wetness Events								
Rain Amount	0.00	0.00	0.00	0.00	0.08	0.01	0.03	0.02
Dew	No	No	No	No	Yes	No	Yes	No
Leaf Wetness (hours)	0	0	0	0	5	3	9	0
Hours >90% RH	0	0	0	0	5	0	3	0
RH max/min	79/35	75/35	87/26	79/25	97/48	83/45	95/56	84/37
Temp avg F	43	50	52	60	59	61	45	46

NA - data not available View Cougarblight Charts Download Time: 5/17/2016 23:00

** Indicates incomplete accumulation of the 4-day DH total. The DH value may reach "Caution", "High" or "Extreme" levels before spanning the 4-day accumulation cut-off time of Cougarblight.*

Streptomycin Spray Date: Click to enter date
If you applied streptomycin before all flowers were open, enter the date of the streptomycin application to recalculate fire blight risk predictions.

EIP Thresholds & Bactericides selection

- EIP > 70: streptomycin or kasugamycin
- EIP 40-70: Oxytetracycline or a biological

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IPM: Fire Blight

- 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