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Apple IPM Intensive Workshop

IPM for other Apple Diseases




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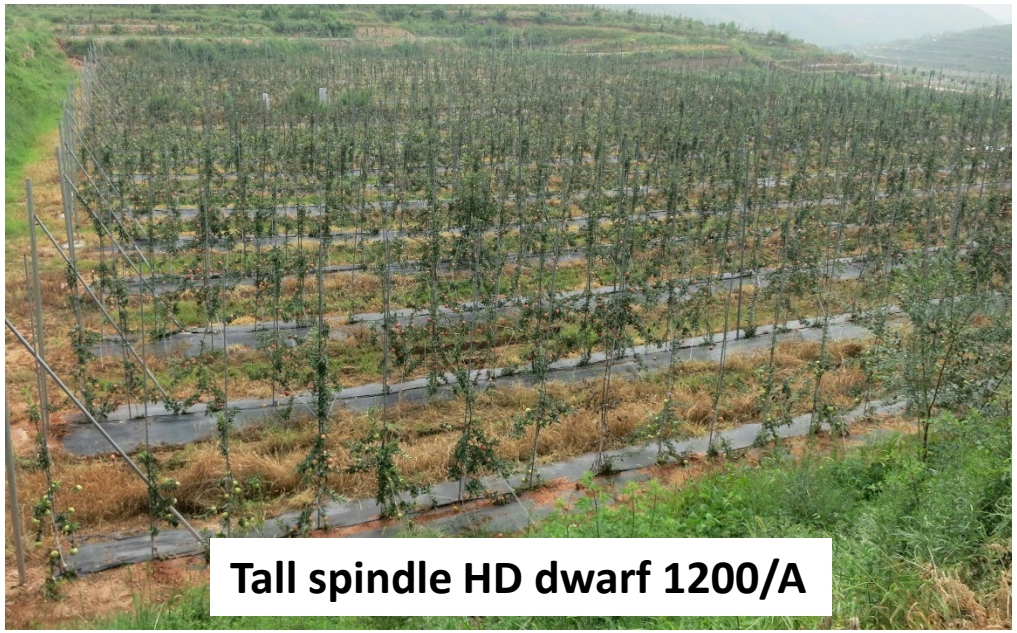
IPM: General

- **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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IPM: General

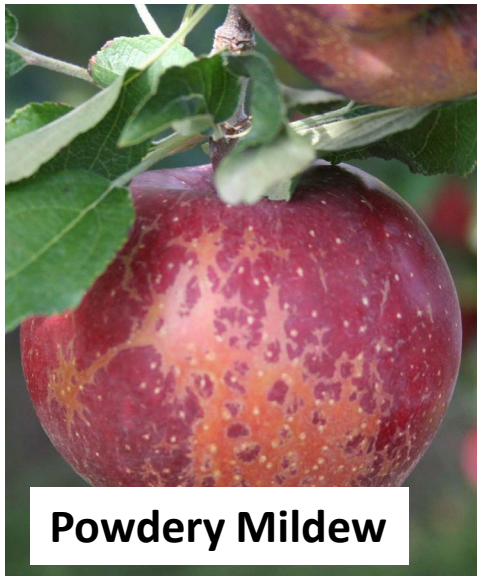
- **Implement the best horticultural practices**: use less sensitive cultivars
  - Not a lot of information & options for resistance for many/multiple diseases

DISEASE SUSCEPTIBILITY OF COMMON APPLES

Cortland	Highly Susceptible[1,4]; Moderately Susceptible[4]; Susceptible[7,8,9]	Highly Susceptible	Susceptible	Susceptible[1]; Highly Susceptible[2, 3]
Cox's Orange Pippin	Moderately Resistant[4]			Susceptible[3]
Creston				Susceptible[3]
Crimson Beauty		Susceptible		
Crimson Crisp (Co-op 39)	Moderately Resistant[7]	Highly Resistant	Susceptible	Moderately Resistant[1]; Highly Susceptible[3]
Crimson Topaz		Resistant		
Cripps Pink (Pink Lady)				Susceptible[3]


Fly Speck & Sooty Blotch


Bitter Rot


Powdery Mildew

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IPM: General

- **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: Powdery Mildew

- Warm dry periods in the spring and summers
- Susceptible cultivars: favored by consumer and producer
- Continues unchecked towards harvest: fungicides not applied for mildew in summer

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IPM: Powdery Mildew

- Fungicide resistance?
- DMI fungicides: “never see mildew” > “doesn’t solve the problem”
- QoI fungicides: less effective than 1990s
- SDHI fungicides – not as effective strong
- Frequent sulfur applications

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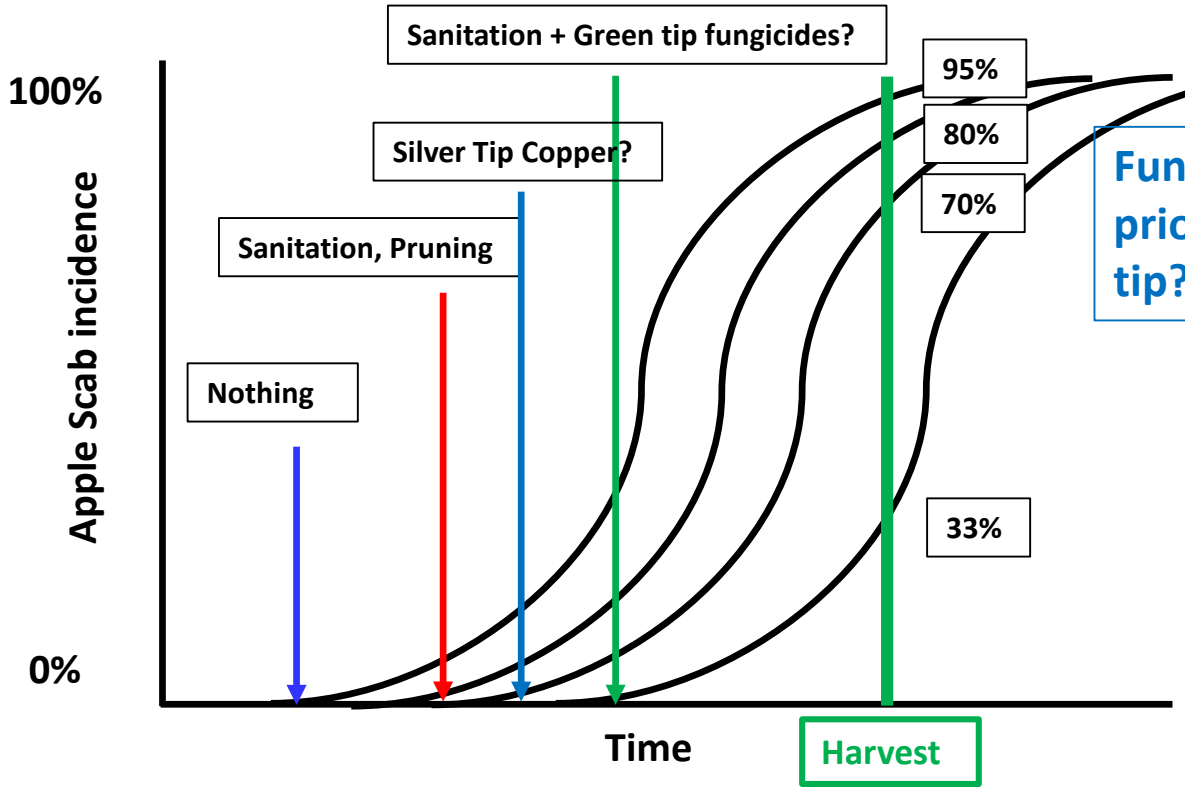
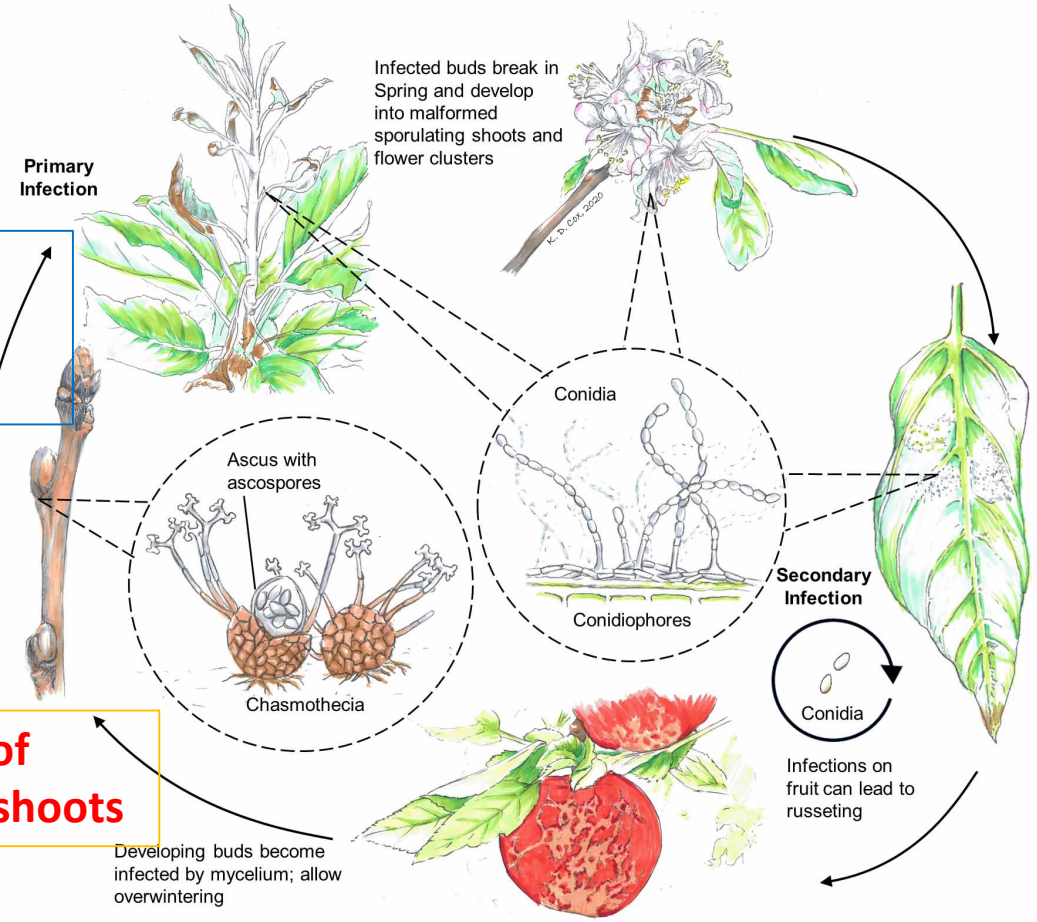
IPM: Powdery Mildew



Fungicides at prior to green tip?



Pruning of primary shoots

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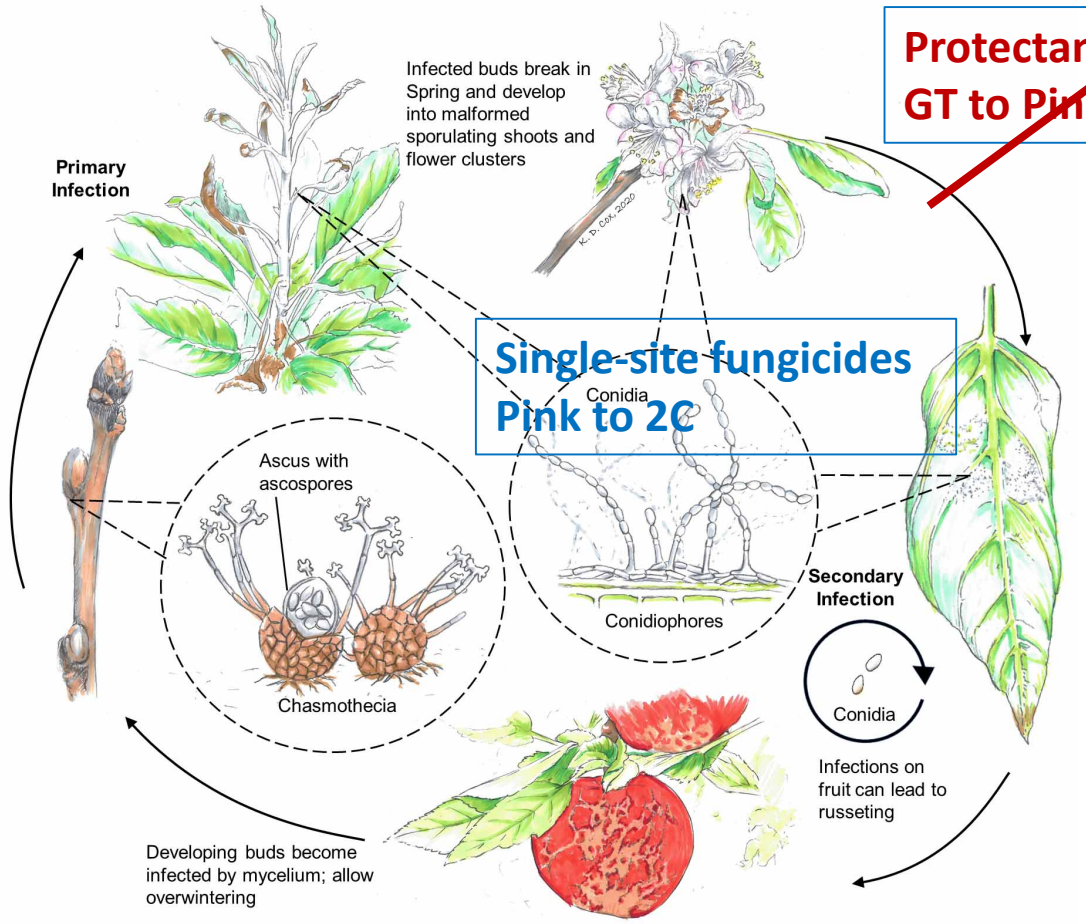
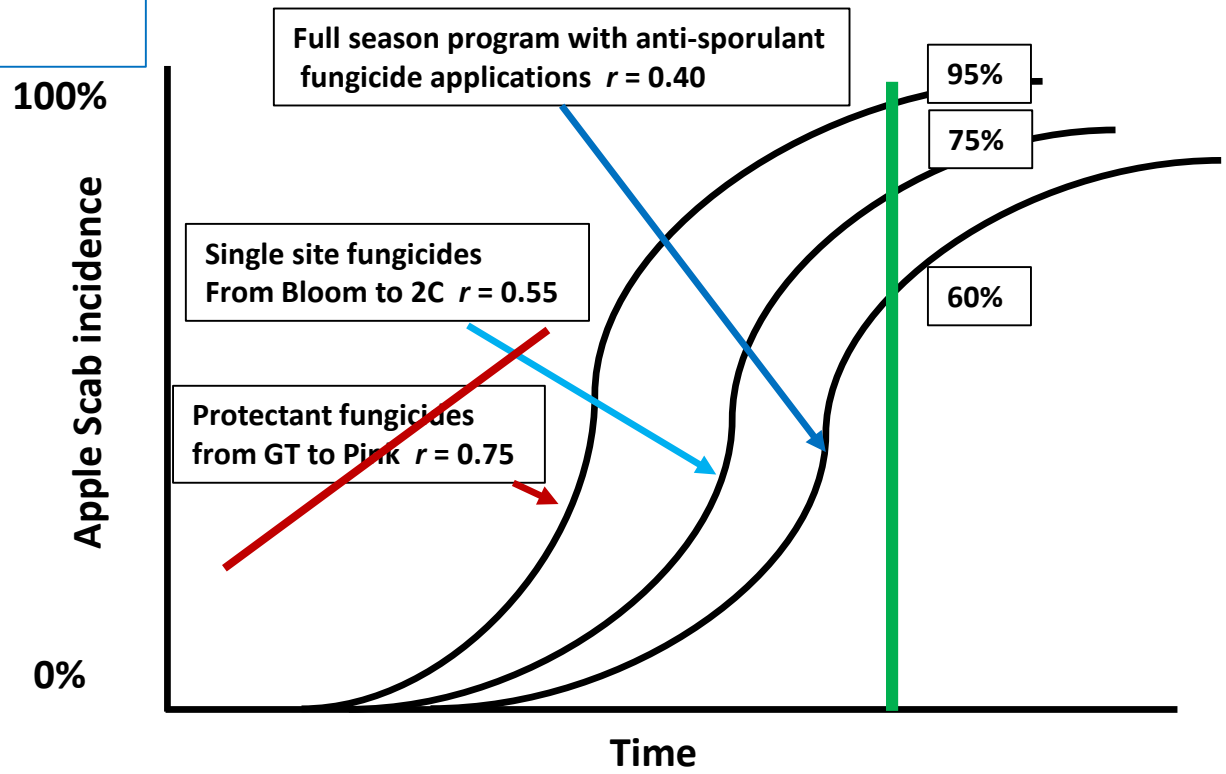
IPM: Powdery Mildew





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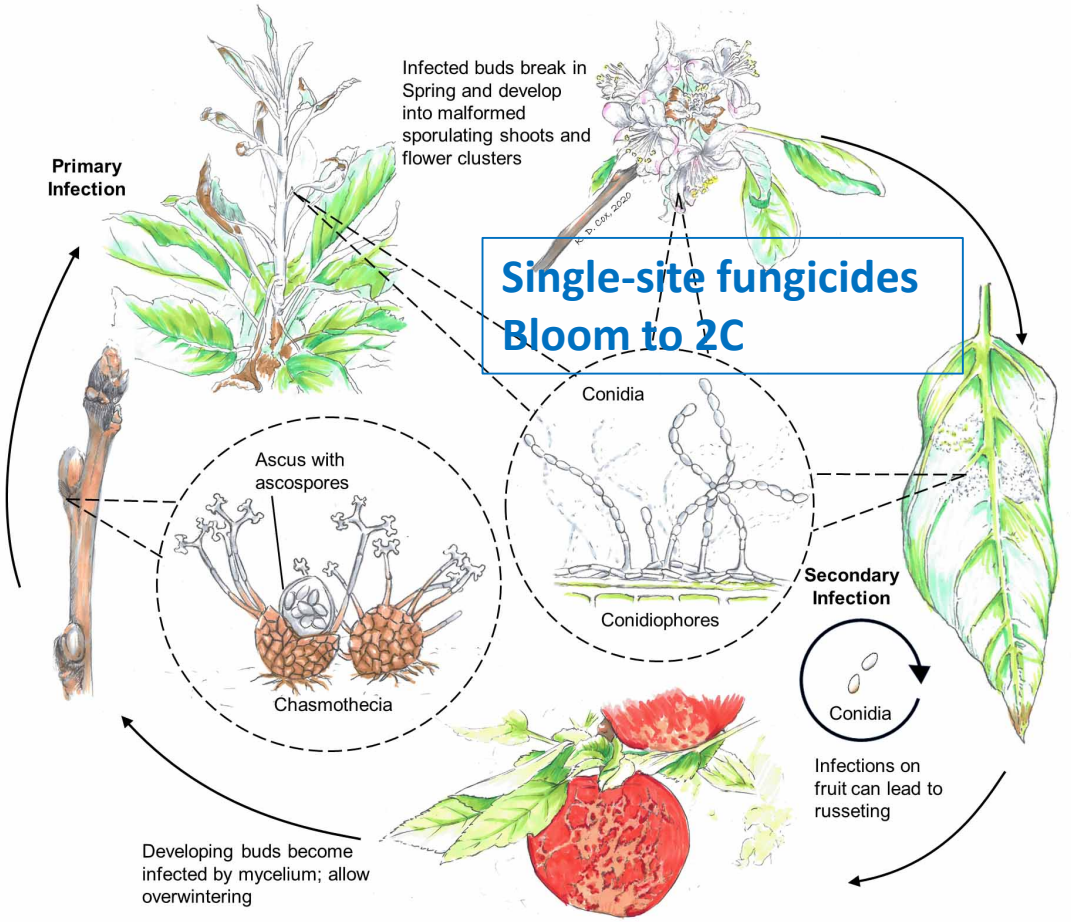
IPM: Powdery Mildew

- **Chemical management**:
  - Secondary powdery mildew: protectant fungicides (sulfur only) Captan & mancozeb not effective
  - Single site fungicides 7-10 days bloom to 2-3rd cover: DMIs, QoIs, SDHIs
  - Models may help, but applications timed for apple scab



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Summer Foliar Diseases

- Glomerella leaf spot, Marsonina leaf blight, Frogeye leaf spots, Alternaria leaf spot
- Managed by apple scab fungicide programs > Infection timings overlap, sometimes
- Problem in organic operations or those heavily reliant on multi-site protectant fungicides

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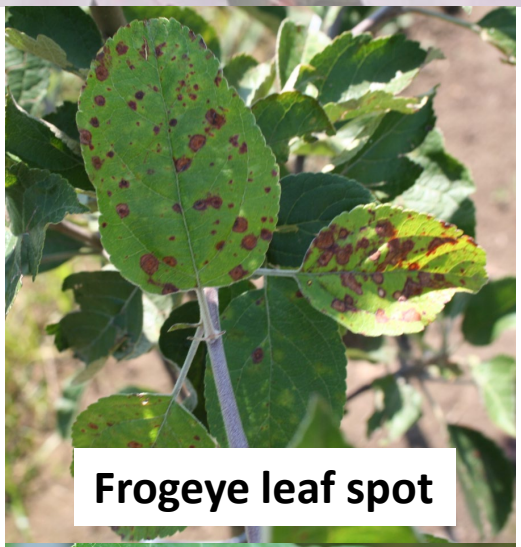
Summer Foliar Diseases

- Single-site fungicides QoIs, SDHIs, and DMI fungicides - provide a high level of control – no fungicide resistance
- Sanitation, summer cover applications, and cultivar selection likely important


Frogeye leaf spot


Marsonina leaf blight


Glomerella Leaf Spot

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Summer fruit diseases

- Fly Speck Sooty Blotch, Bitter rot (anthracnose), Black and white rot (Botryosphaeria)
- latent infection from bloom to early fruit development
- pre-harvest: Fall rains or wounding of mature fruit (birds & herbicides)
- post-harvest/ in storage: Lead to pack out rejections


Black rot


Fly Speck & Sooty Blotch

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Summer fruit diseases

- Problem in warmer sandy regions: Hudson Valley
- Problem in organic operations or those heavily reliant on multi-site protectant fungicides
- Managed by 1) petal fall fungicides 2) summer fungicide programs: Extended intervals 14-21 days, and 3) pre-harvest single-site fungicide application

Bitter rot

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Summer fruit diseases

- Strong program of single-site fungicides at petal fall to 1st cover (SDHIs Aprovia or Fontellis, DMIs Inspire Super, QoI/SDHIs Pristine, Luna Sensation, or Merivon)
- Heavy rains > 1.5 – 2 inches consider another fungicide application if > 5 days
- Summer cover interval to 10-21 days approaching harvest & consider applying Pristine or Merivon right at harvest (low PHIs)

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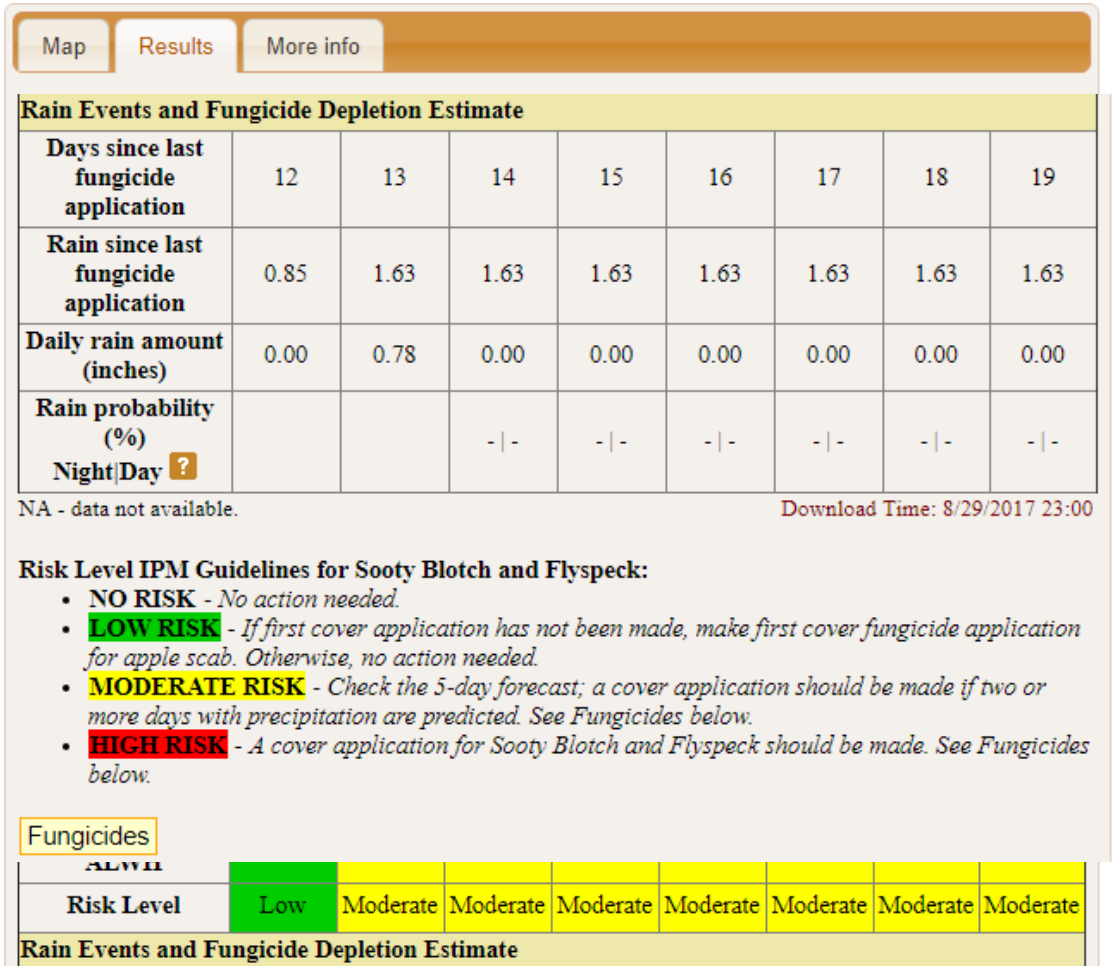
Summer fruit diseases

- NEWA Disease forecasting for flyspeck sooty blotch
- http://newa.nrcc.cornell.edu/newaModel/apple_disease
- Predicts onset of epidemic: 10 days after petal fall
- Assists with determining timing of summer disease fungicide applications
- LW algorithms improve risk tracking in areas without wetness sensors



Map | Results | More info

Rain Events and Fungicide Depletion Estimate

Days since last fungicide application	12	13	14	15	16	17	18	19
Rain since last fungicide application	0.85	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Daily rain amount (inches)	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00
Rain probability (%) Night|Day			- | -	- | -	- | -	- | -	- | -	- | -

NA - data not available. Download Time: 8/29/2017 23:00

Risk Level IPM Guidelines for Sooty Blotch and Flyspeck:

- **NO RISK** - *No action needed.*
- **LOW RISK** - *If first cover application has not been made, make first cover fungicide application for apple scab. Otherwise, no action needed.*
- **MODERATE RISK** - *Check the 5-day forecast; a cover application should be made if two or more days with precipitation are predicted. See Fungicides below.*
- **HIGH RISK** - *A cover application for Sooty Blotch and Flyspeck should be made. See Fungicides below.*

Fungicides

Risk Level	Low	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

Rain Events and Fungicide Depletion Estimate

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Summer fruit diseases

- Considerations for fly speck & sooty blotch models:
  - **Models predict favorable conditions: apply at the highest risk periods not every infection (> 10 days)**
  - Spraying in advance? Use common sense with any model
  - Avoid spraying only after an infection period > selection for resistance

Map | Results | More info

Sooty Blotch and Flyspeck Risk Predictions for Geneva

Petal fall date for McIntosh: 5/2/2017 Click if petal fall has not occurred

Petal fall date above is estimated based on degree day accumulations or user input.
Enter the actual date for blocks of interest and the model will calculate the accumulated leaf wetness hours since 10 days after petal fall more accurately.

Most recent fungicide application date: 8/9/2017

If petal fall has passed, enter the date of your most recent fungicide application.
If no fungicide applications have been made, do not enter a date.

In the Risk Summary table, note the accumulated leaf wetness hours since petal fall (Leaf Wetness Hours) and the Risk Level. Leaf wetness hours, rain events, and the last fungicide application date are taken into consideration in assessing risk level. To estimate risk in the near future, look at the probability of rain.

Consult the Risk Level IPM Guidelines below the **Risk Summary** table.

Sooty Blotch and Flyspeck Risk Summary - Northeastern US Model

	Past	Past	Current	Ensuing 5 Days				
Date	8/21	8/22	8/23	8/24	8/25	8/26	8/27	8/28
Days since petal fall	111	112	113	114	115	116	117	118
Accumulated Leaf Wetness Hours - ALWH	448	455	456	456	456	456	456	456
Risk Level	Low	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Rain Events and Fungicide Depletion Estimate								

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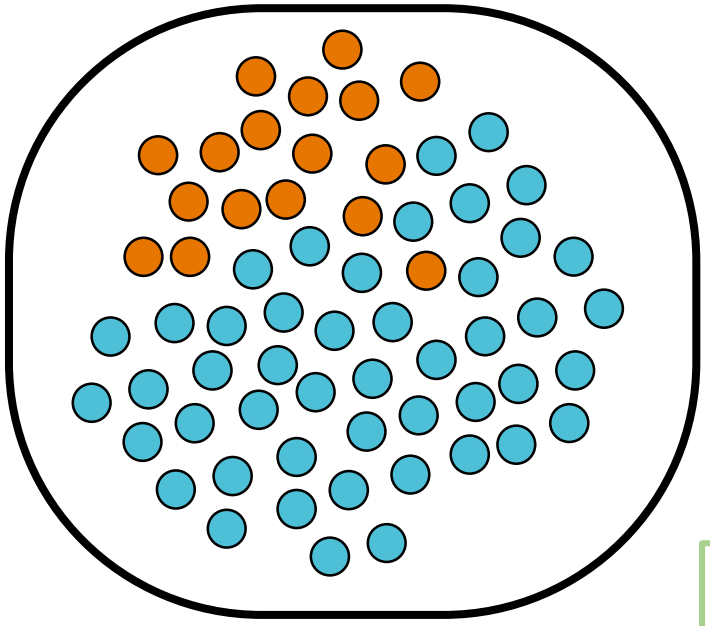
Fungicide/Antibiotic Resistance Development

1. Emergence*
2. Establishment
3. Selection



Pathogen Population

- Sensitive Isolate
- Resistant Isolate

*Fungicides/Antibiotics are not inherently mutagenic, mutations are **pre-existing**
*Advantageous mutations occur **infrequently**

Application of a fungicide does not cause emergence, rather will select for further establishment

(adapted from van den Bosch et al 2011)

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Fungicide/Antibiotic Resistance Development

How does fungicide application rate and the use of fungicide mixtures select for resistant populations?

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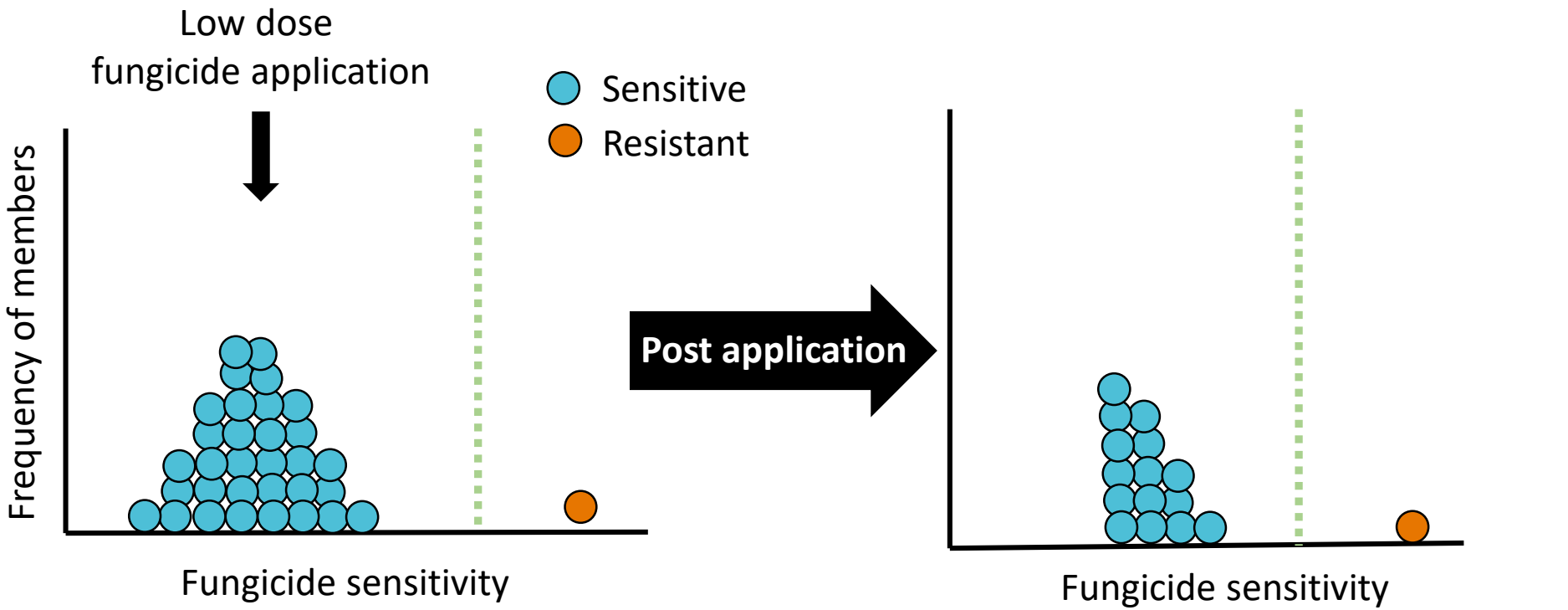
Fungicide/Antibiotic Resistance Development

Hyp A: Low dose → resistance develops slowly



Competition between S and R slows selection down for R

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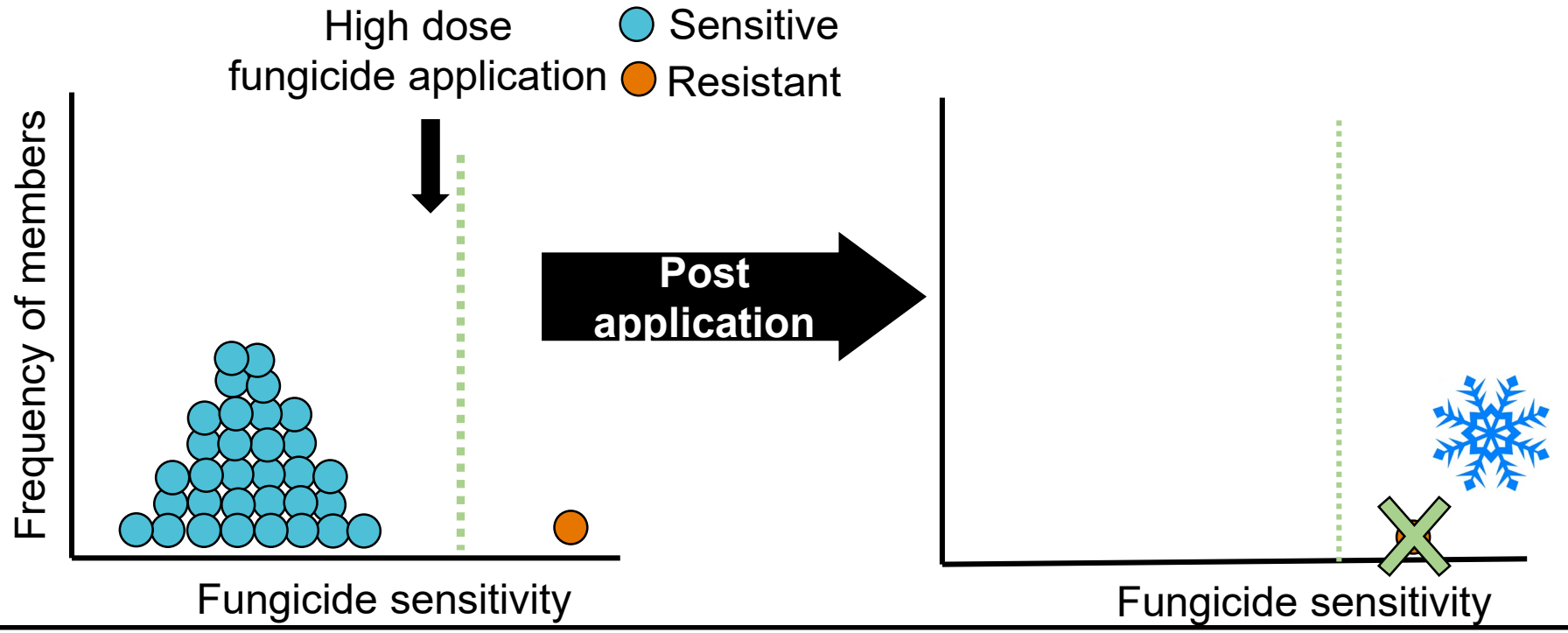
Fungicide/Antibiotic Resistance Development

Hyp B: High dose → resistance development less likely



S population killed → **R** unable to cause disease and/or overwinter

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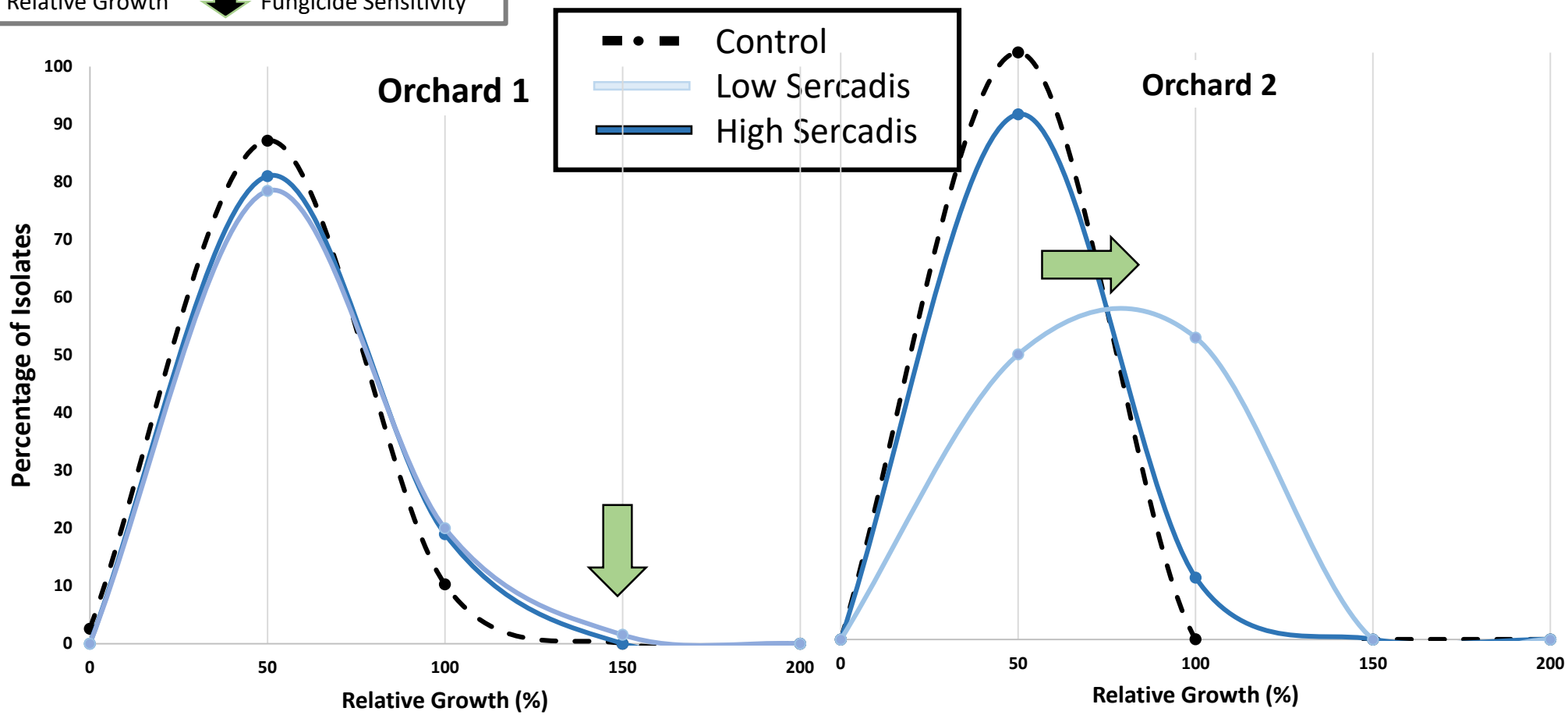
Fungicide/Antibiotic Resistance Development

% Relative Growth Fungicide Sensitivity

Effect of low rate vs. high rate (2018)

after three years



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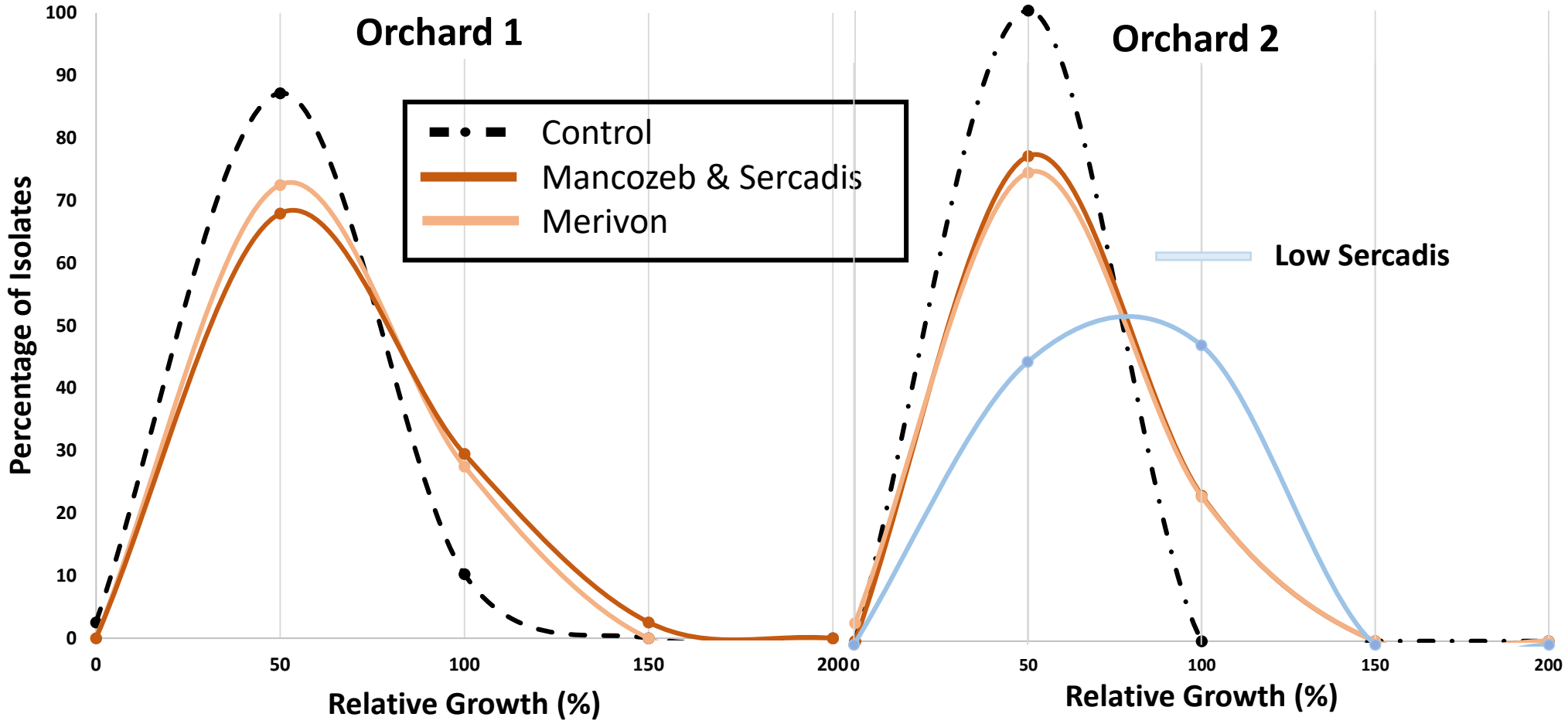
Fungicide/Antibiotic Resistance Development

Effect of Mix w/ Single vs. Multi-site (2018)

after three years



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Fungicide/Antibiotic Resistance Development

- Regardless of treatment > selection towards a resistance
- Subset of isolates with high relative growth → future concern for the establishment of a resistant population? (Low rate)
- Disease pressure has a large influence on a population's fungicide sensitivity?
- Management decisions should be made carefully in high pressure years with emphasis on fungicide class rotation and minimizing use.

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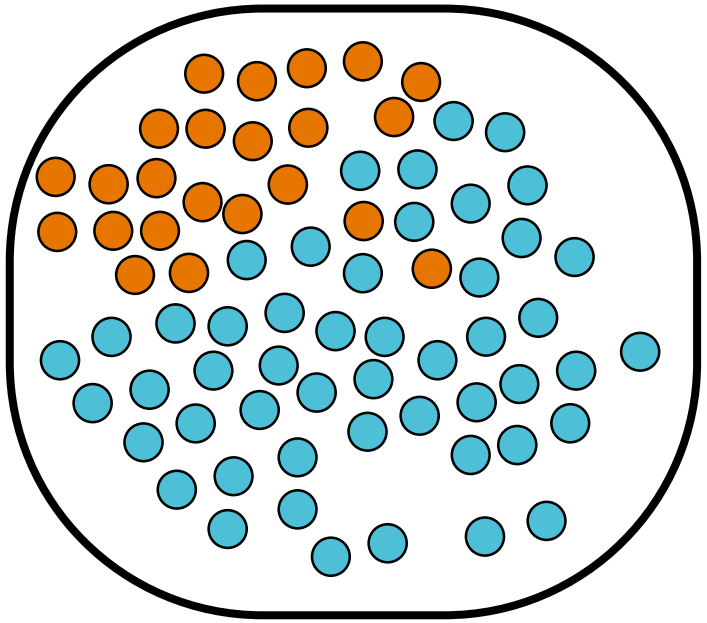
Fungicide/Antibiotic Resistance Development

Large Population Size

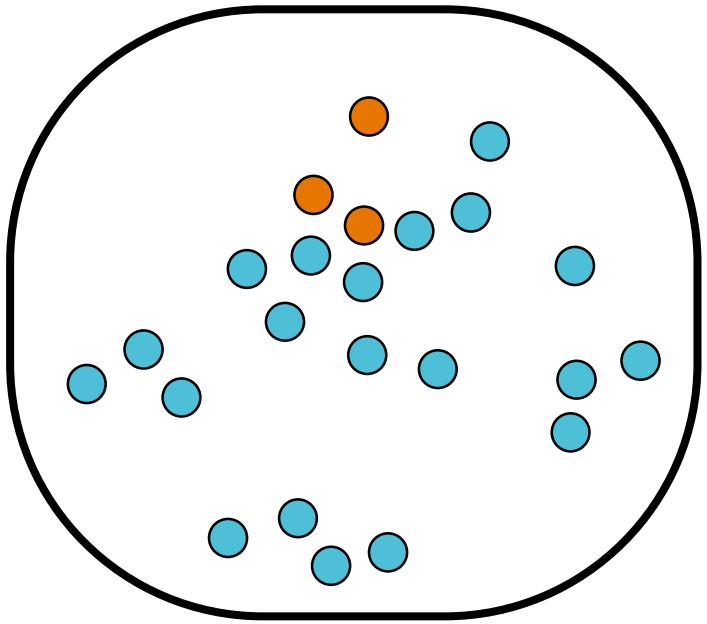


Higher probability of advantageous mutation occurring

Pathogen Population

- Sensitive Isolate
- Resistant Isolate

Small Population Size



Lower probability of advantageous mutation occurring (if it occurs at all)

Summer fruit disease infections first occur

1. During rain early fall rains pre-harvest

2. After wounding by herbicides, insects, and birds as fruit mature

3. From bloom to early fruit development

4. Post-harvest in storage

The fly speck sooty blotch model forecasts risks based on

1. Degree hour accumulations after petal fall
2. Accumulated leaf wetness during precipitation events
3. Accumulated leaf wetness since petal fall
4. Degree day accumulations between applications

Which of the following factors may accelerate selection for fungicide resistance in apples

1. Including a second fungicide tank mix or rotational partner
2. Orchard sanitation to reduce inoculum or population numbers
3. Applying the lowest labeled rate of a fungicide
4. Applying the highest labeled rate of a fungicide