# 2021 DEC HVRL Webinar Session: Organic Production

Cornell University

Hudson Valley Research Laboratory

## Scab Resistant Varieties, 2020 Frost Injuries and Strategies for Sunburn Prevention

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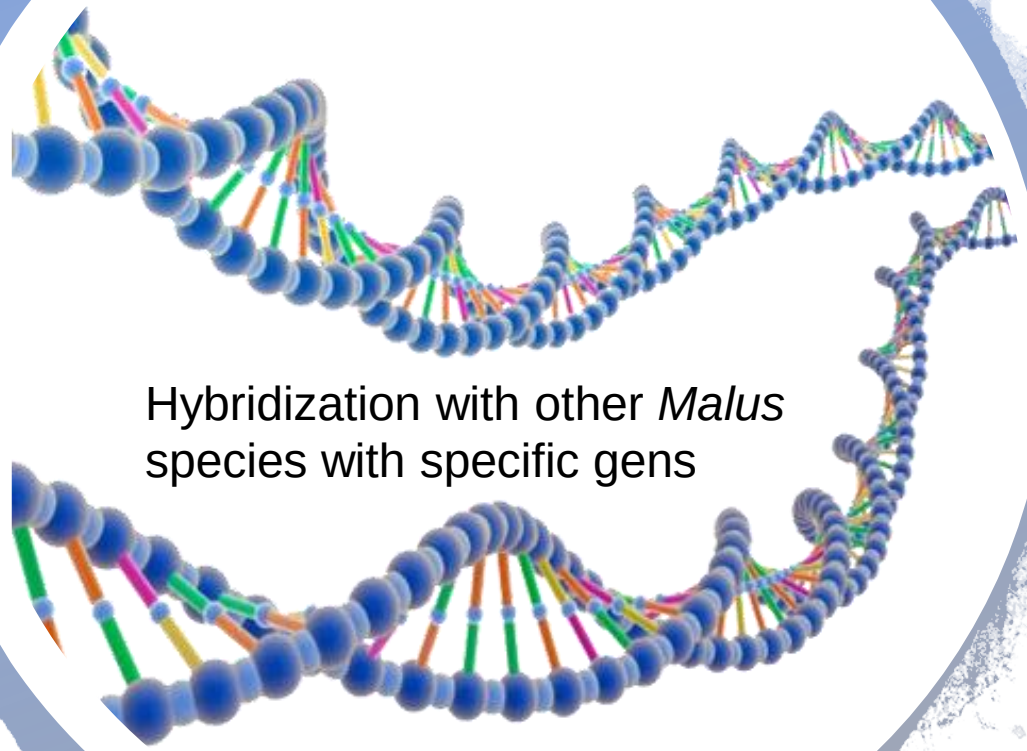
# Disease Resistant Cultivars

- Organic apple production in the Northeast US is challenging
- Materials permitted by the National Organic Program can cause:
  - problems with phytotoxicity (oils and sulfur-based compounds),
  - environmental toxicity (copper-based compounds)
  - resistance effects on human pathogens (streptomycin antibiotics).
- Disease Resistant Cultivars - require minimal disease-control sprays.

# What Makes a Cultivar Resistant?



Hybridization with other *Malus* species with specific gens

*Malus floribunda*
Japanese flowering crabapple
source for the Vf gene

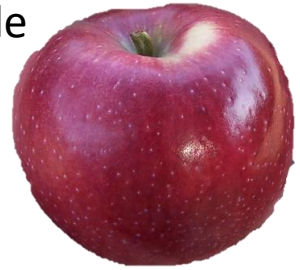
*Malus micromalus*
Kaido crabapple
source for the Vm gene

- Qualitative resistance

# First Scab Resistant Varieties

- *M. floribunda* 821: Purdue University/Rutgers University/the University of Illinois - breeding program (1926).
- 80% of the scab-resistant cultivars carry the *Vf* resistance gene from *M. floribunda* 821.

Williams' Pride



kuffelcreek.files.wordpress.com

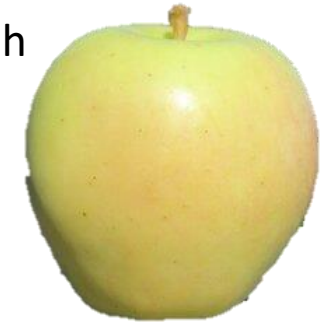
Liberty

foghollowerchards.com

Prima

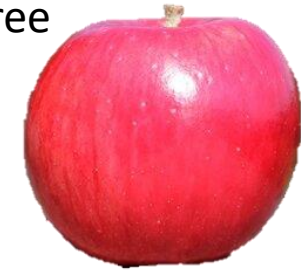
www.saltspringapplecompany.com

GoldRush



saltspringapplecompany.com

Jonafree

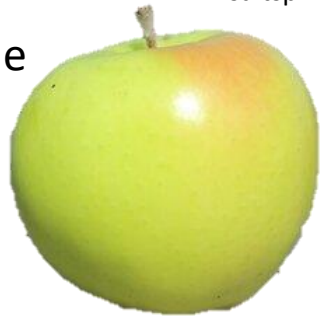


saltspringapplecompany.com

Enterprise

newenglandapples.org

Pristine



saltspringapplecompany.com

# From Scab-Resistant to Scab-Susceptible

- 1993 – Prima (Germany)
- 1994 – *M. floribunda* 821 (England)
- 2007 – *M. floribunda* 821 (Indiana, Illinois, Ohio)
- 2008 – Pristine, Pixie Crunch, and Jonafree (Indiana & Illinois)
- 2009 – Enterprise (Indiana)


Photo by S. G. Aćimović

# More Durable Source for Disease Resistance

- Quantitative polygenic resistance

Antonovka

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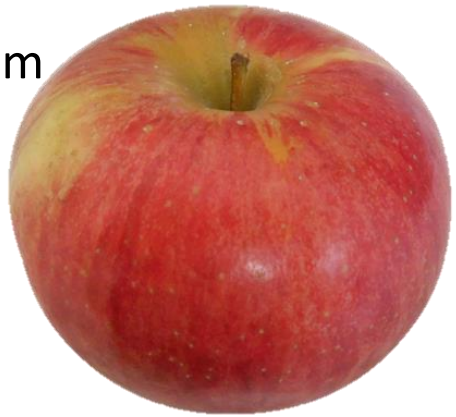
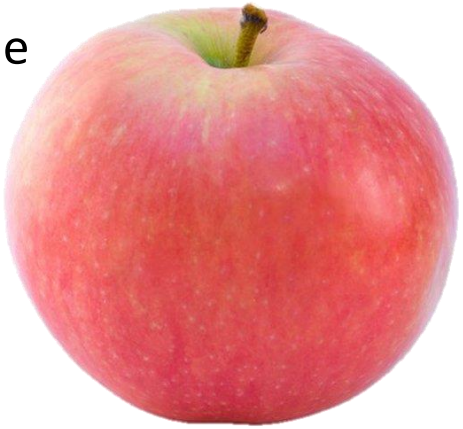
Freedom



newenglandapples.org

Akane



www.instacart.com

Photo by Awais Khan

# SCR Varieties Don’t Need Fungicides - Wrong!

- Reduce inoculum size in leaf litter
- Spray for the primary infection
- Implement good horticultural practice for Scab reduction
- Grow SCR varieties separated from susceptible varieties

# Disease Resistant Varieties

Photos by S. G. Aćimović

| Variety |
| --- |
| Enterprise |
| Freedom |
| Nova Easygro |
| Priscilla |
| Redfree |
| Sundance |
| Williams Pride |

**Apple Scab**

**Cedar Apple Rust**

**Powdery Mildew**

**Fire Blight**

# Disease Resistant Varieties

| Variety |
| --- |
| Akane |
| Co-op 27 |
| Co-op 34 |
| Juliet |
| Pristine |

Photos by S. G. Aćimović

**Apple Scab**

**Cedar Apple Rust**

**Fire Blight**

# Disease Resistant Varieties

| Variety |
| --- |
| Ariane |
| Britegold |
| Wine Crisp |
| Co-op 36 |
| Co-op 37 |
| Dayton |
| GoldRush |
| Richelieu |

Photos by S. G. Aćimović

**Apple Scab**

**Powdery Mildew**

**Fire Blight**

# Disease Resistant Varieties

| Variety |
| --- |
| CrimsonCrisp |
| Scarlet O’Hara |

Photos by S. G. Aćimović

**Apple Scab**

**Cedar Apple Rust**

**Powdery Mildew**

# Disease Resistant Varieties

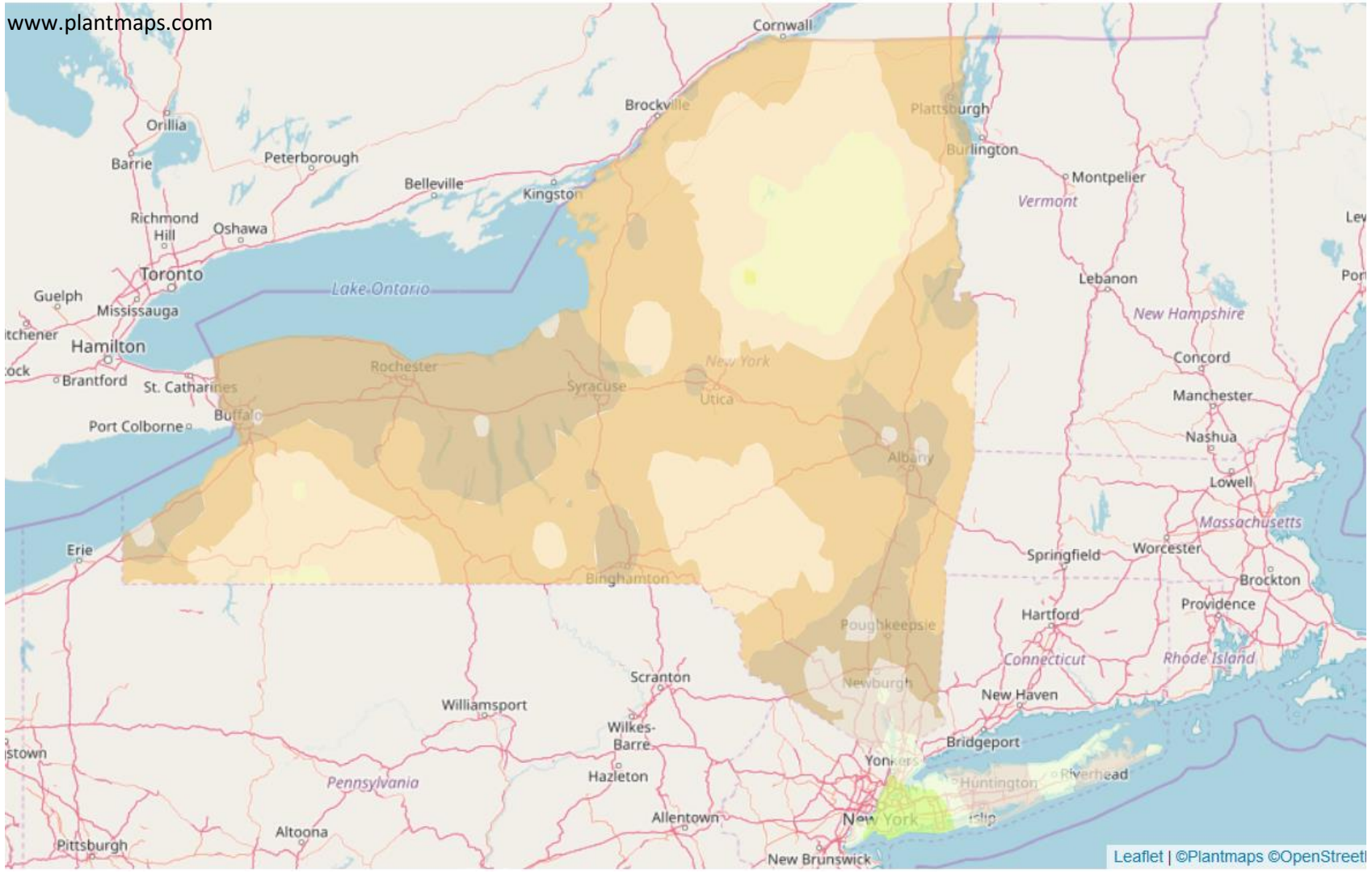
| Variety | Apple Scab | Cedar Apple Rust | Powdery Mildew | Fire Blight |
|---|---|---|---|---|
| Florina (Querina) | + | | | + |
| Belmac | + | | + | |
| Otava | + | | + | |
| Rubinola | + | | + | |
| Sansa | polygenic | | + | |
| Topaz | + | | + | |
| Moira | + | + | | |


Photo by S. G. Aćimović

# Disease Resistant Varieties

| Variety | Apple Scab |
|---|---|
| Co-op 28 | + |
| Ecolette | + |
| Galarina | + |
| Jonafree | + |
| Liberty | + |
| Macfree | + |
| McShay | + |
| Murray | + |
| Novamac | + |
| Nova Spy | + |
| Pixie Crunch | + |
| Priam | + |
| Prima | + |
| Primevere | + |
| Rouville | + / ? |
| Santana | + |
| Sir Prize | + |
| Trent | + |

# Average Last Frost Date For NYS




Zone 11
Apr. 21 - Apr. 30

Zone 12
May 1 - May 10

Zone 13
May 11 - May 20

Zone 14
May 21 - May 31

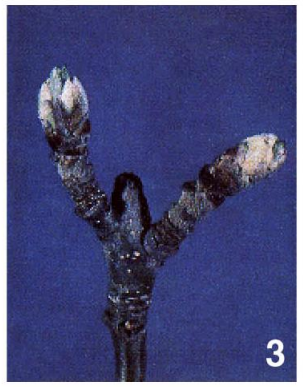
Zone 15
Jun. 1 - Jun. 10

Zone 16
Jun. 11 - Jun. 20

Zone 17
Jun. 21 - Jun. 30

Zone 18
Jul. 1 - Jul. 10

# Critical Temp (°F) for Apple Developmental Stages

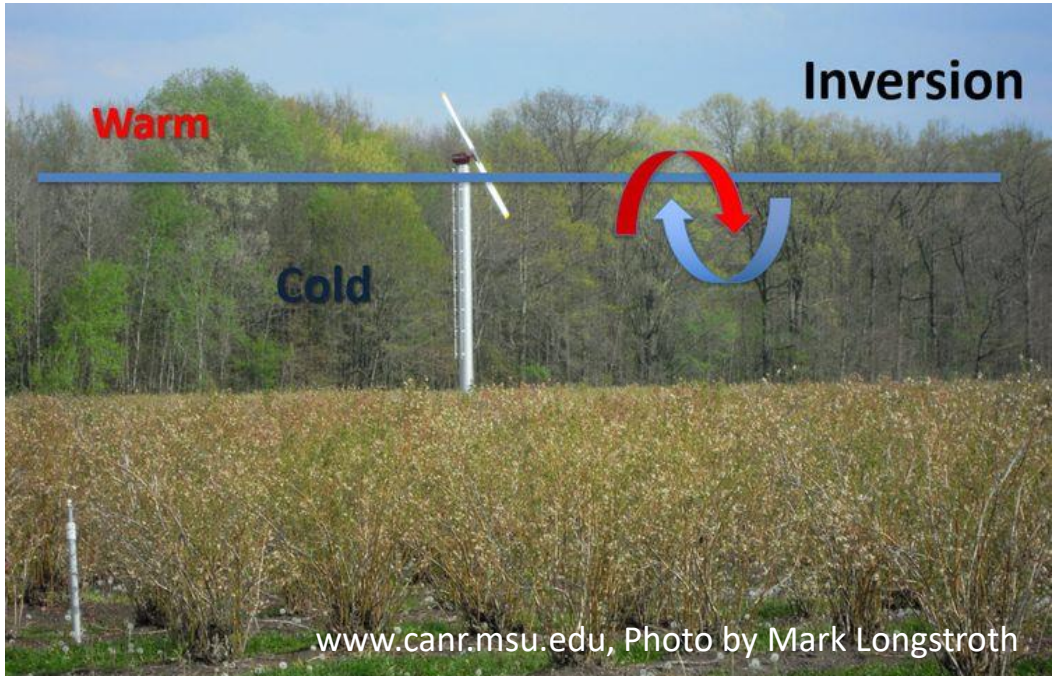



| | Green tip | Tight cluster | Pink | Full bloom | Post bloom |
|---|---|---|---|---|---|
| Temperature for 10% kill | 18 | 27 | 27 | 28 | 28 |
| Temperature for 90% kill | 10 | 21 | 25 | 25 | 25 |

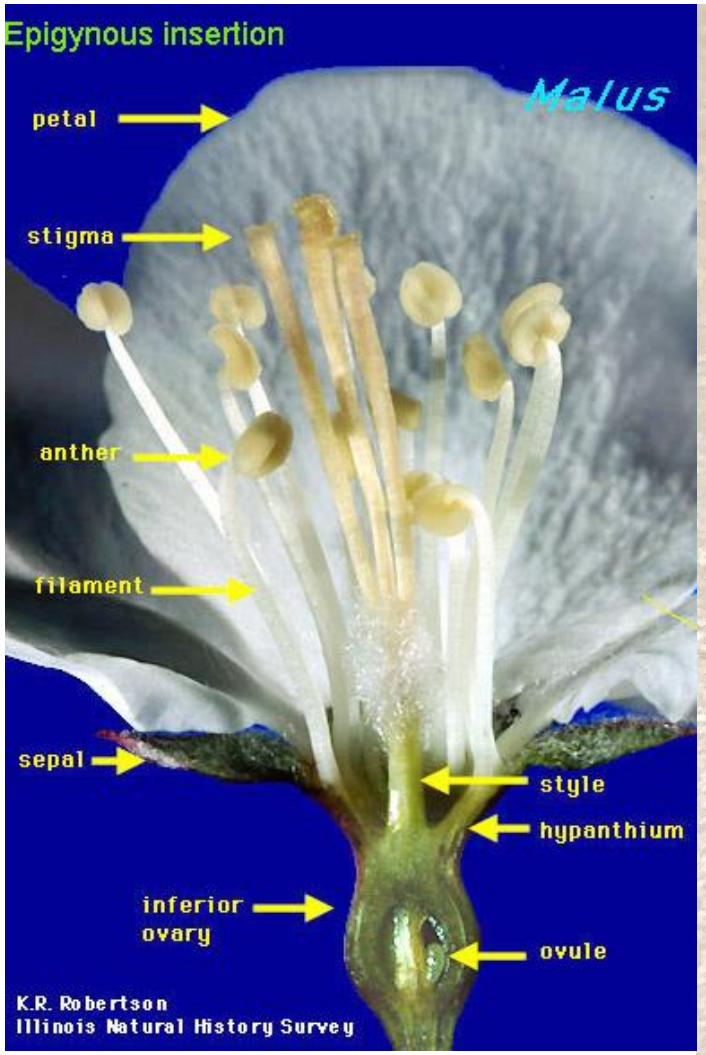
D. C. Ferree & I. J. Warrington, *Apples: Botany, Production and Uses*, Cambridge: CABI, 2003. Print.

# Preventive Strategies


- **Wind Machines & Helicopters**
- **Overhead Irrigation**
- **Under-the-Tree Irrigation**
- **Orchard Heaters or Fires**

# Frost Injury Assessment




- April 23 - 27.5°F for 4 hrs.
- Tight cluster most cultivars, Empire most advanced with 74% in pink.
- 20 flower buds per cultivar for frost injury estimation.

# Frost Injury Assessment

- May 9 - 30.1°F
- Full bloom

Flower injuries after the frost on April 23 and May 9, 2020

| Variety | % Total Mortality | | % King Mortality | | % Lateral Mortality | |
|---|---|---|---|---|---|---|
| | 3-May | 11-May | 3-May | 11-May | 3-May | 11-May |
| Empire | 58 | 80 | 81 | 95 | 51 | 76 |
| Gala | 8 | 66 | 15 | 65 | 6 | 67 |
| Honey Crisp | 19 | 28 | 45 | 40 | 12 | 24 |
| Fuji | 36 | 38 | 65 | 70 | 30 | 31 |
| NY1 | 9 | 67 | 38 | 75 | 3 | 65 |
| NY2 | 31 | 85 | 64 | 80 | 24 | 87 |

- Less than 40% king bloom losses as the threshold for bloom thinning
- Over 80% of total flower damage – do not apply thinners

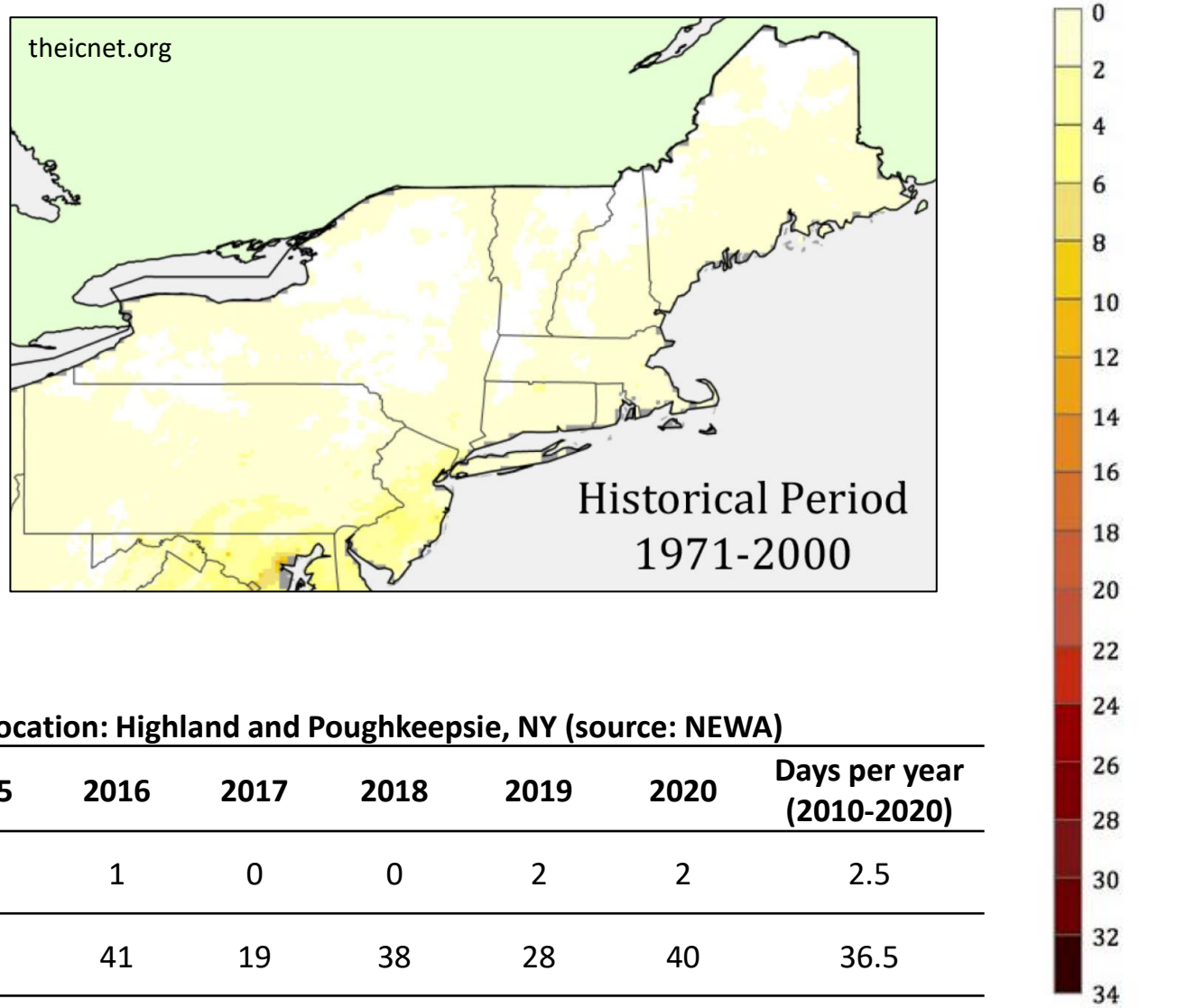
# Frost Damages: Conclusions

1. Preventive strategies: wind machines, overhead irrigation, heaters.
2. 8 to 10% of all flowers to set a good crop
3. No bloom thinning if 40% king bloom is injured
4. No thinning at all if over 80% of total flower is damaged

# Get Ready For 2050s

By the year 2055, according to NESDIS – NOAA, the Hudson Valley region will likely experience an **additional 6-12 days with a maximum temperature exceeding 95°F** (scenar-ios.globalchange.gov).

This trend would likely cause an increase of the occurrence of temperature dependent types of sunburn.

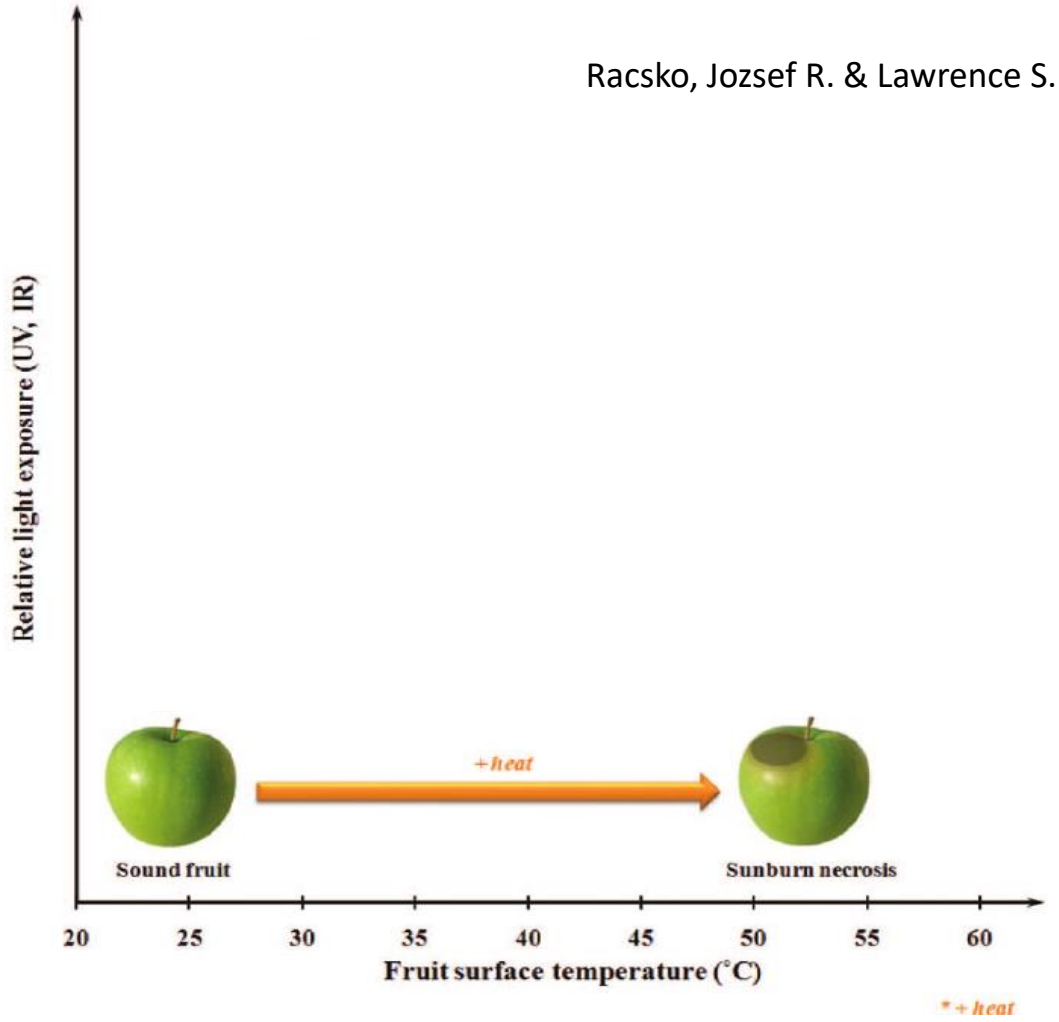



**Growing Season (1-Mar to 31-Oct), Location: Highland and Poughkeepsie, NY (source: NEWA)**

| Year | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Days per year (2010-2020) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Days per year over 35°C/95°F** | 6 | 5 | 6 | 2 | 0 | 3 | 1 | 0 | 0 | 2 | 2 | 2.5 |
| **Days per year over 30°C/86°F** | 54 | 30 | 43 | 28 | 27 | 54 | 41 | 19 | 38 | 28 | 40 | 36.5 |

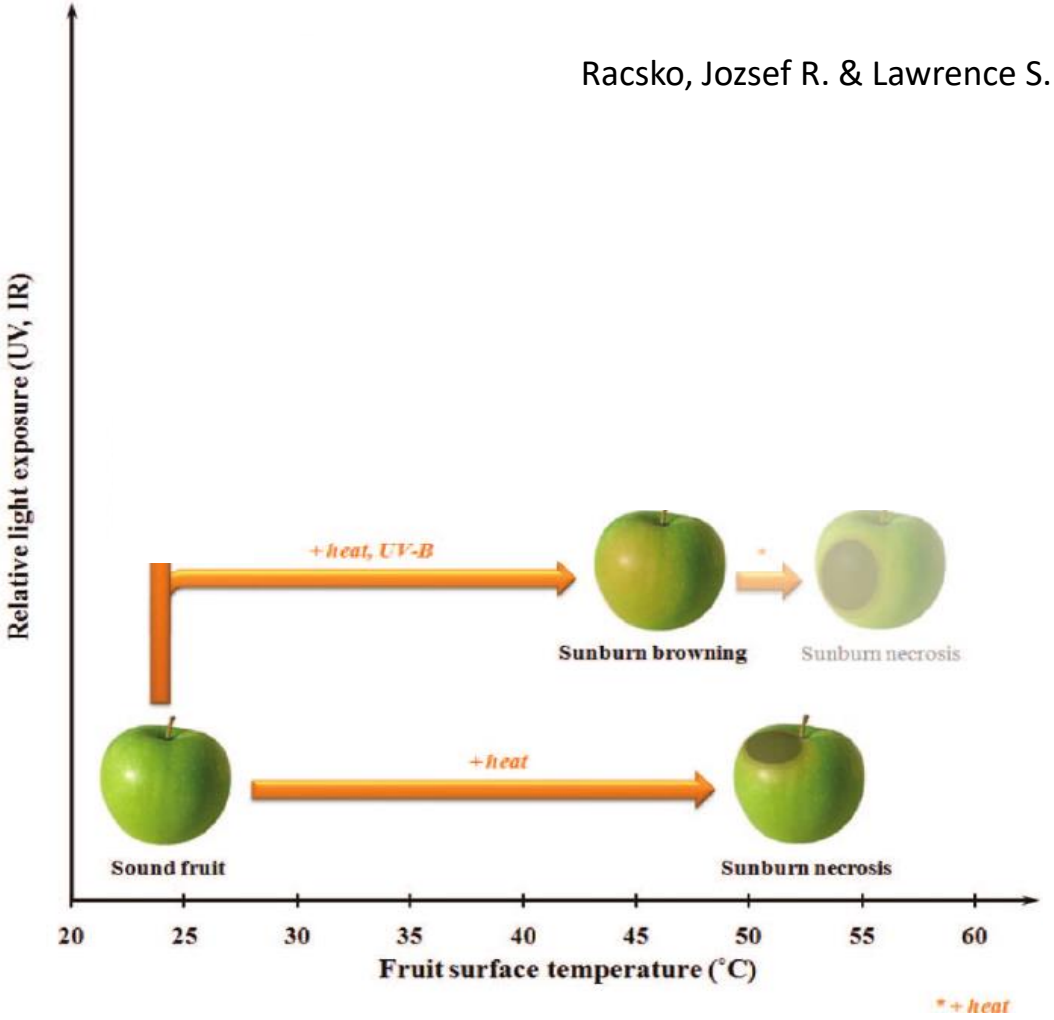
# Temperature Dependent Sunburn Type: Necrosis

Racsko, Jozsef R. & Lawrence S. (2012)

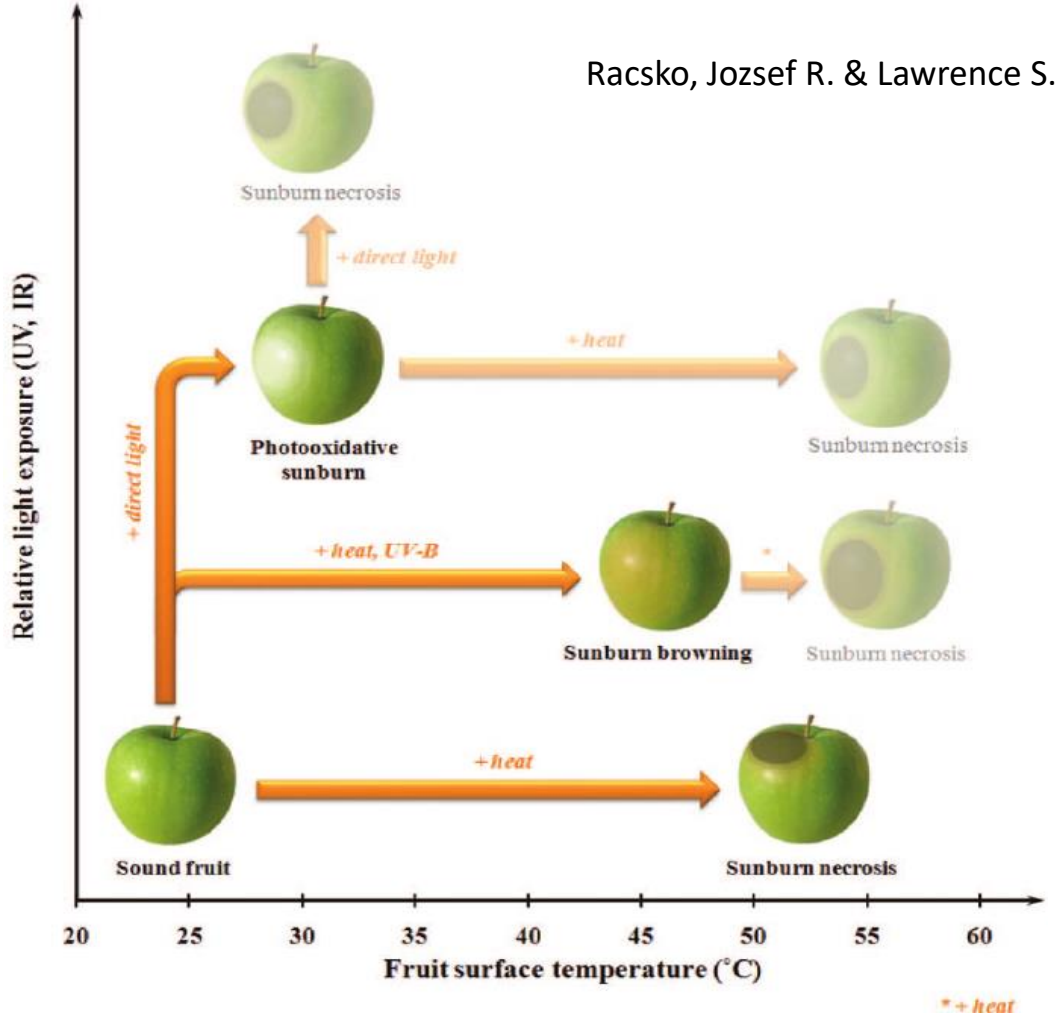


# Temperature Dependent Sunburn Type: Browning

Racsko, Jozsef R. & Lawrence S. (2012)



# Temperature Independent Sunburn Type: Photooxidative



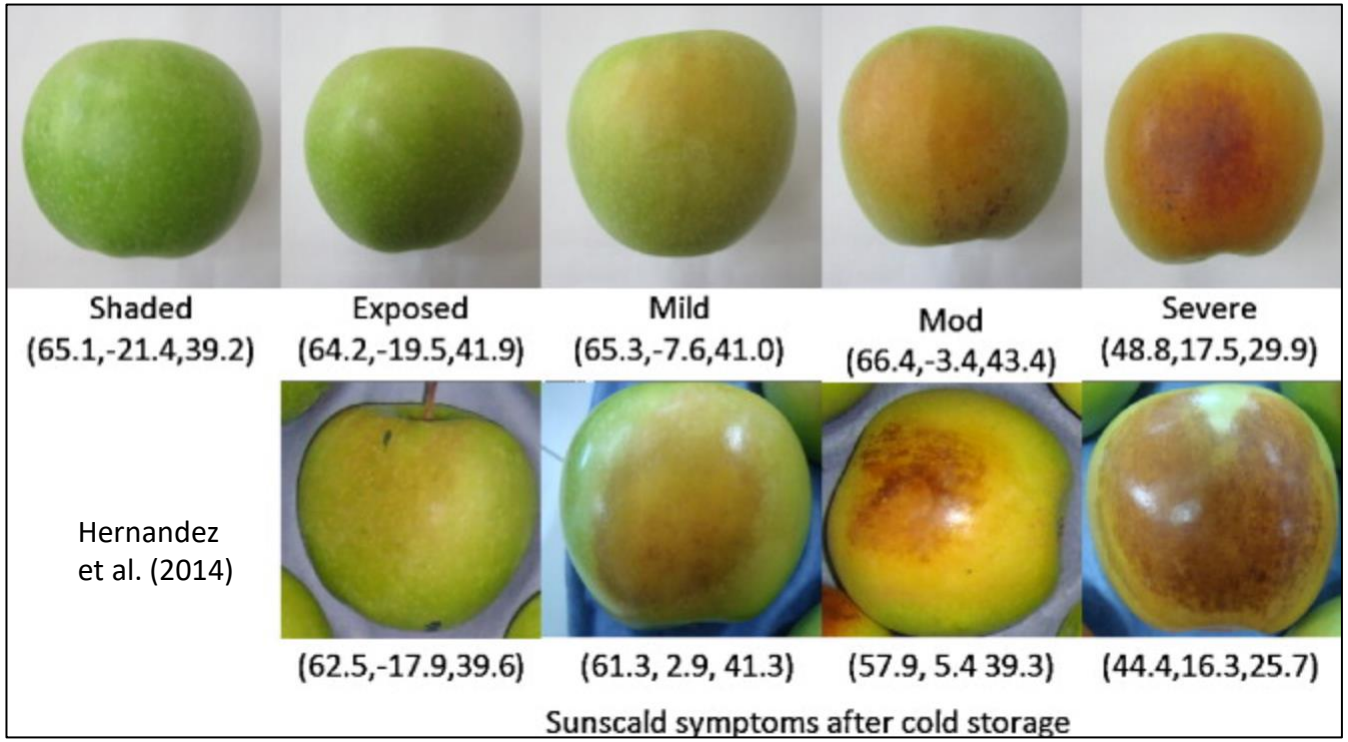

Racsko, Jozsef R. & Lawrence S. (2012)

# Undetected Sunburn Turns Into A Financial Loss: Sunscald

**Delayed sunburn or sunscald:** fruit surface browning that appears after storage.

$100 million in losses every year in both Washington State.

Sunscald models predict the likelihood of sunscald development after a cold storage so fruit that's likely to develop damage in storage can be sold quickly.



# Predicting Factors: Fruit Surface Temperature (FST) vs. Air Temperature


Air temperature provides the most convenient indicator of risk.


| Air Temperature | Risk Level |
|---|---|
| **≥ 40°C / 104°F** | High Risk of Sunburn Necrosis |
| **≥ 35°C / 95°F** | High Risk of Sunburn Browning |
| **30 to 35° C / 86 to 95°F** | Variable Risk, Depending on Other Risk Factors |

# Other Factors That Increase The Risk of Sunburn

Calm days - hot, sunny, and calm days increase the risk.

Cool, cloudy weather followed by clear-sky days greater than 30°C.

Air humidity and drought - water stress on hot days.

Bare fallow between the tree rows - reflecting additional heat into the tree canopy.

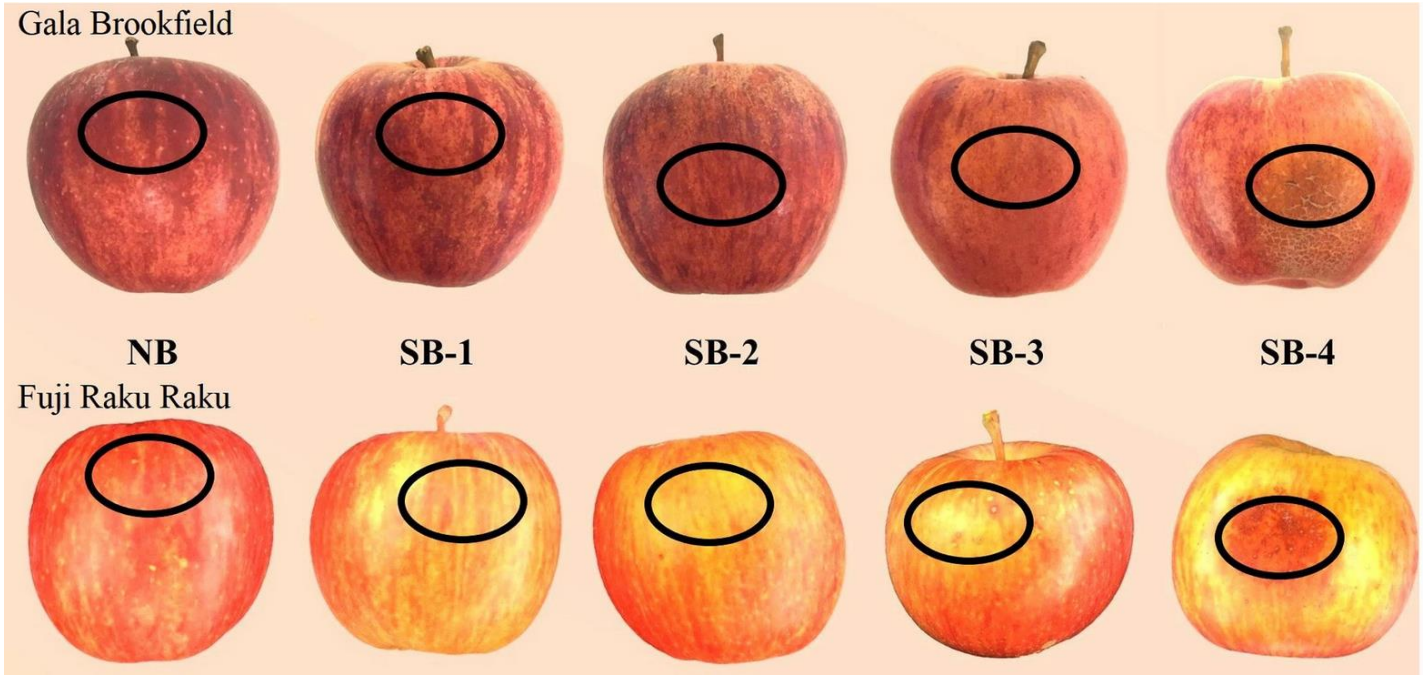
Sudden exposure to the direct sunlight - summer pruning, picked apples in bins.

Production style - high density orchard, dwarfing rootstocks, training system with a good light penetration.

www.beaulieutechnicaltextiles.com

# Other Factors That Increase The Risk of Sunburn

Olivares-Soto et al. (2020)




Lotze, Daiber & Midgley (2017)


**Figure 1**. Sunburn classification for GD adapted by Daiber [3]

Sensitive Varieties:

Granny Smith

Royal Gala

Jonagold

Braeburn

Golden Supreme

Ginger Gold

Golden Delicious

Fuji

Cameo

Honeycrisp

Snow Sweet

# Products Used In 2020 Season Trial

| Materials | Description & Ingredients | Mode of Action | Company |
|---|---|---|---|
| RAYNOX Plus® | - carnauba wax, organically modified clay, and emulsifiers | - particle film reduces the amount of UV and visible light that reaches the fruit surface | Valent |
| Parka™ POWERED BY SureSeal | - blend of phospholipids | - a supplement for cuticle development of the growing fruit and foliage | Cultiva |
| VAPOR GARD® ANTI-TRANSPIRANT CONCENTRATE | - pine resin emulsion composed of 96% di-1-p-Menthene | - a physical barrier to water vapor loss from plant tissues | Miller Chemical |
| DrapeNet® cost effective crop protection | - complete exclusion protective netting system, white color | - shading effect | Drape Net North America |

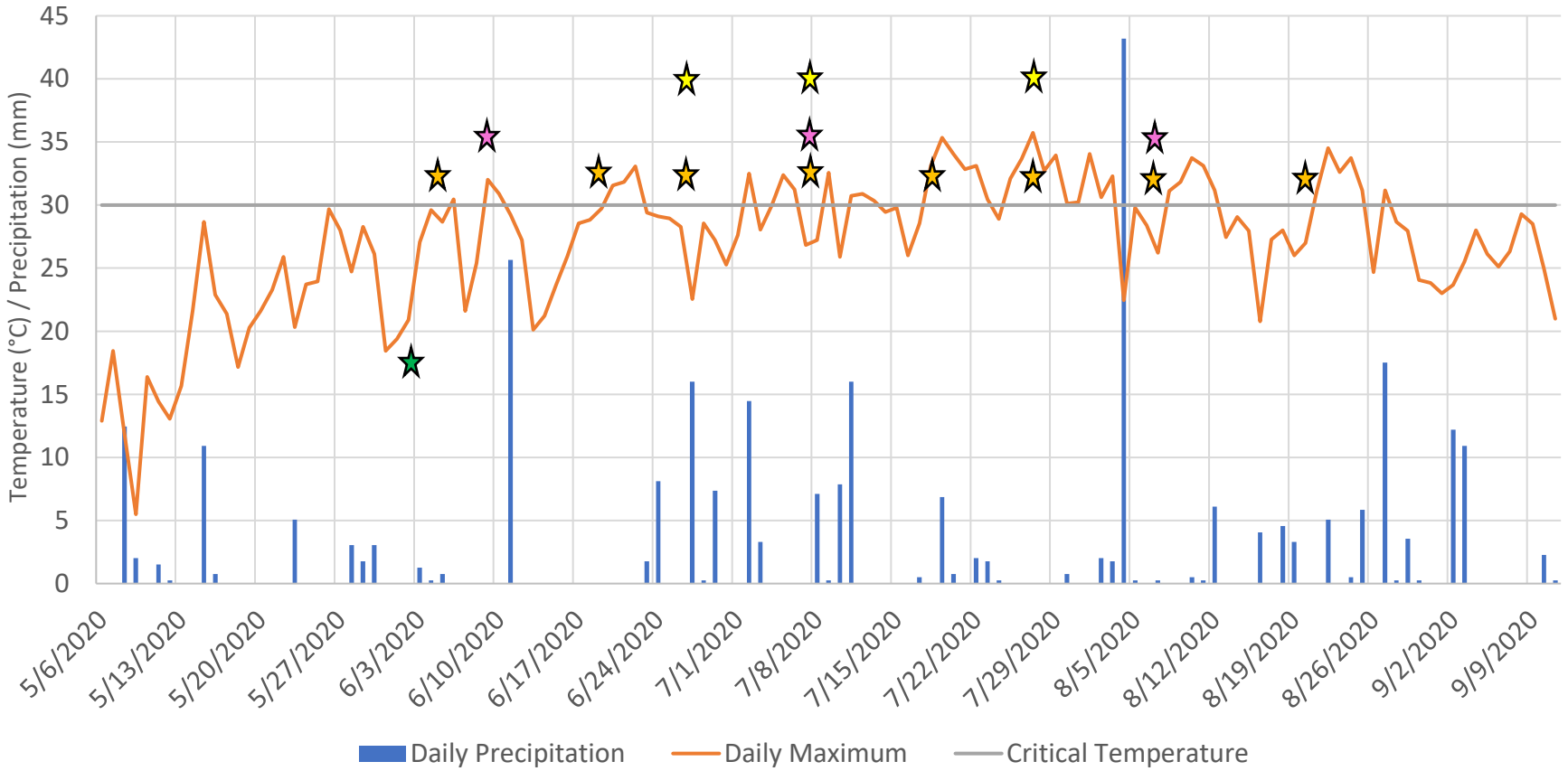
# List Of Treatments

| Treatment | Rate | Spray/Installation Date |
|---|---|---|
| 1. Raynox Plus | 1 Gal/A | 26-June; 7-July; and 27-July |
| 2. Parka | 1 Gal/A | 8-June; 7-July; and 6-August |
| 3. Vapor Gard | 1 Gal/A | 4-, 18-, 26-June; 7-, 18-, 27-July; and 6-, 20-August |
| 4. White Drape Net | | 2-June, and removed on 11-Sep (Honeycrisp) and 25-Sep (Snow Sweet) |
| 5. White Drape Net + 1 WAH* | | 2-June, and removed on 18-Sep (Honeycrisp) and 1 Oct (Snow Sweet) |
| 6. White Drape Net + 2 WAH | | 2-June, and removed on 22-Sep (Honeycrisp) and 6 Oct (Snow Sweet) |

*WAH – Week after Harvest

# Daily Maximum And Precipitation From Bloom To Harvest

2020 Season: 2,600 GDD (base 50°F) by Sep 1st (like 2015, the warmest year on record since 1950)




- Tall Spindle, 3 ft x 14 ft
- Honeycrisp (Nic.29.) & Snow Sweet (M.9T337, B.9.)
- CRBD: 9 blocks Honeycrisp & 3 blocks Snow Sweet

Colored stars indicate treatment applications: Raynox Plus – Yellow, Parka – Pink, Vapor Gard – Orange, and Drape Net – Green.

# The Treatment Effect On Harvest Parameters

| Treatment | Honeycrisp | | | |
|---|---|---|---|---|
| | Number of Fruit | Yield per Tree (kg) | Fruit Drop per Tree | Fruit Weight (g) |
| **UTC** | 124.3 ab | 19.1 ab | 19.1 d | 177.9 c |
| **Raynox Plus** | 125.6 a | 22.7 a | 20.7 cd | 202.9 a |
| **Parka** | 92.6 bc | 16.2 bc | 24.9 bcd | 188.4 b |
| **Vapor Gard** | 104.3 ab | 19.4 ab | 24.3 bc | 192.3 ab |
| **White Drape Net** | 102.6 abc | 17.4 bc | 31.4 b | 188.4 bc |
| **White Drape Net +1WAH** | 95.0 abc | 15.8 bc | 56.3 a | 199.5 ab |
| **White Drape Net +2WAH** | 76.3 c | 13.1 c | 65.6 a | 192.8 ab |
| p† or ChiSq‡ -statistics | 0.0177† | 0.0082† | <.0001† | <.0001‡ |

UTC – Untreated Control
WAH – Week after Harvest

# The Treatment Effect On Harvest Parameters

| Treatment | Snow Sweet | | | | |
|---|---|---|---|---|---|
| | **Number of Fruit** | **Yield per Tree (kg)** | **Fruit Drop per Tree** | **Fruit Weight (g)** | |
| **UTC** | 58.0 | 10.2 | 1.3 | 168.4 | e |
| **Raynox Plus** | 88.7 | 15.4 | 1.3 | 186.4 | d |
| **Parka** | 77.7 | 14.3 | 1.0 | 194.2 | cd |
| **Vapor Gard** | 97.7 | 17.4 | 3.7 | 209.6 | ab |
| **White Drape Net** | 86.7 | 15.2 | 5.0 | 186.2 | d |
| **White Drape Net +1WAH** | 87.3 | 15.2 | 3.0 | 197.3 | bc |
| **White Drape Net +2WAH** | 66.0 | 13.1 | 9.0 | 214.2 | a |
| p-statistics | 0.1056 | 0.1333 | 0.1014 | <.0001 | |

UTC – Untreated Control
WAH – Week after Harvest

# The Treatment Effect On Fruit Chemistry

| Treatment | Honeycrisp | | | | | |
|---|---|---|---|---|---|---|
| | Fruit Firmness (kg) | | Soluble Solids Concentration | | TA (g/100mL as malic acid) | |
| | (B-side) | (NB-side) | (B-side) | (NB-side) | (B-side) | (NB-side) |
| **UTC** | 7.5 ab | 7.4 a | 14.0 | 13.2 | 0.51 | 0.50 |
| **Raynox Plus** | 7.3 ab | 7.1 ab | 14.5 | 13.4 | 0.52 | 0.53 |
| **Parka** | 7.5 a | 7.3 ab | 14.2 | 13.6 | 0.53 | 0.53 |
| **Vapor Gard** | 7.5 ab | 7.2 ab | 14.1 | 13.0 | 0.51 | 0.51 |
| **White Drape Net** | 7.4 ab | 7.4 a | 13.8 | 13.0 | 0.52 | 0.54 |
| **White Drape Net +1WAH** | 7.3 b | 7.1 b | 14.5 | 13.3 | 0.50 | 0.50 |
| **White Drape Net +2WAH** | 7.2 b | 7.2 ab | 13.4 | 12.7 | 0.50 | 0.50 |
| ChiSq -statistics | 0.0005 | 0.0004 | 0.4348 | 0.999 | 0.9449 | 0.8256 |

B – Sun exposed side.
NB – Shade side.
UTC – Untreated Control.
WAH – Week after Harvest.

# The Treatment Effect On Fruit Chemistry

| Treatment | Snow Sweet | | | | | |
|---|---|---|---|---|---|---|
| | Fruit Firmness (kg) | | Soluble Solids Concentration | | TA (g/100mL as malic acid) | |
| | (B-side) | (NB-side) | (B-side) | (NB-side) | (B-side) | (NB-side) |
| **UTC** | 7.9 abc | 7.6 ab | 14.1 | 13.0 | 0.46 | 0.47 |
| **Raynox Plus** | 7.9 bc | 7.4 bc | 13.4 | 12.0 | 0.39 | 0.38 |
| **Parka** | 8.2 ab | 7.7 ab | 13.5 | 12.3 | 0.39 | 0.39 |
| **Vapor Gard** | 7.8 c | 7.2 c | 13.0 | 12.4 | 0.39 | 0.44 |
| **White Drape Net** | 8.4 a | 8.1 a | 13.0 | 12.0 | 0.39 | 0.39 |
| **White Drape Net +1WAH** | 8.0 abc | 7.9 a | 13.0 | 12.2 | 0.39 | 0.39 |
| **White Drape Net +2WAH** | 7.9 bc | 7.9 a | 13.5 | 12.8 | 0.40 | 0.40 |
| p-statistics | <.0001 | <.0001 | 0.8035 | 0.2666 | 0.6819 | 0.1227 |

B – Sun exposed side.
NB – Shade side.
UTC – Untreated Control.
WAH – Week after Harvest.

# The Treatment Effect On Fruit Color

| Treatment | Honeycrisp | | | | |
|---|---|---|---|---|---|
| | Hue (B-side) | a*/b* (B-side) | Hue (NB-side) | a*/b* (NB-side) | Blush (%) |
| **UTC** | -42.9 a | 0.9 c | -33.3 b | 0.2 b | 48.3 b |
| **Raynox Plus** | -45.6 bc | 1.2 b | -34.6 b | 0.4 b | 51.7 b |
| **Parka** | -43.6 a | 1.0 c | -33.8 b | 0.3 b | 48.8 b |
| **Vapor Gard** | -46.7 c | 1.3 ab | -31.8 a | 0.2 b | 49.8 b |
| **White Drape Net** | -44.4 ab | 1.0 c | -33.2 ab | 0.2 b | 48.4 b |
| **White Drape Net +1WAH** | -46.9 c | 1.4 a | -36.2 c | 0.5 a | 62.7 a |
| **White Drape Net +2WAH** | -46.7 c | 1.5 a | -37.6 c | 0.7 a | 58.8 a |
| ChiSq-statistics | <.0001‡ | <.0001‡ | <.0001‡ | <.0001‡ | <.0001‡ |

B – Sun exposed side.
NB – Shade side.
UTC – Untreated Control.
WAH – Week after Harvest.

# The Treatment Effect On Fruit Color

| Treatment | Snow Sweet | | | | | | | | Blush (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hue | | a*/b* | | Hue | | a*/b* | | | |
| | B-side | | | | NB-side | | | | | |
| **UTC** | -50.2 | ab | 2.4 | a | -42.7 | b | 1.4 | a | 77.2 | a |
| **Raynox Plus** | -49.3 | ab | 2.1 | ab | -39.0 | a | 0.8 | c | 69.4 | c |
| **Parka** | -51.0 | b | 2.4 | a | -39.1 | ab | 0.8 | bc | 70.4 | bc |
| **Vapor Gard** | -48.3 | a | 1.8 | b | -40.6 | ab | 1.0 | abc | 68.2 | c |
| **White Drape Net** | -49.1 | ab | 2.3 | a | -41.0 | ab | 1.1 | ab | 75.1 | ab |
| **White Drape Net +1WAH** | -49.6 | ab | 2.3 | a | -41.6 | ab | 1.1 | ab | 74.2 | abc |
| **White Drape Net +2WAH** | -50.6 | ab | 2.3 | a | -41.7 | ab | 1.2 | a | 71.9 | abc |
| ChiSq-statistics | 0.0088 | | <.0001 | | 0.0117 | | <.0001 | | <.0001 | |

B – Sun exposed side.
NB – Shade side.
UTC – Untreated Control.
WAH – Week after Harvest.

# The Treatment Effect On Honeycrisp Sunburn Incidence

| Treatment | 'Honey Crisp' | | |
|---|---|---|---|
| | **Total Sunburn (%)** | **PS (%)** | **SB (%)** |
| **UTC** | 9.6 | 0.7 | 8.9 |
| **Raynox Plus** | 11.5 | 2.6 | 8.5 |
| **Parka** | 8.9 | 1.5 | 7.4 |
| **Vapor Gard** | 12.6 | 2.6 | 10.0 |
| **White Drape Net** | 11.5 | 1.1 | 10.7 |
| **White Drape Net +1WAH** | 13.8 | 0.6 | 13.2 |
| **White Drape Net +2WAH** | 10.8 | 1.5 | 9.4 |
| ChiSq -statistics | 0.4702 | 0.1627 | 0.3198 |

UTC – Untreated Control.
WAH – Week after Harvest.
SB – Sunburn Browning
PS – Photooxidative Sunburn.

**UTC**

**Raynox Plus**

**Parka**

**Vapor Gard**

**White Drape Net**

**White Drape Net +1WAH**

**White Drape Net +2WAH**

# The Treatment Effect On Snow Sweet Sunburn Incidence

| Treatment | 'Snow Sweet' | | |
|---|---|---|---|
| | **Total Sunburn (%)** | **PS (%)** | **SB (%)** |
| **UTC** | 32.2 | 1.1 | 31.1 |
| **Raynox Plus** | 30.0 | 0.0 | 30.0 |
| **Parka** | 31.1 | 1.1 | 30.0 |
| **Vapor Gard** | 26.7 | 0.0 | 26.7 |
| **White Drape Net** | 30.0 | 0.0 | 30.0 |
| **White Drape Net +1WAH** | 34.4 | 1.1 | 33.3 |
| **White Drape Net +2WAH** | 33.3 | 0.0 | 33.3 |
| *p*-statistics | 0.8549 | 0.6785 | 0.9298 |

| **Factor** | **Fruit Surface Temperature (°C)** | |
|---|---|---|
| **Treatment** | **Aug 11th AAT 31.2°C** | **Aug 31st AAT 22.1°C** |
| UTC | 29.9 a | 19.3 a |
| Raynox Plus | 30.6 a | 19.5 a |
| Parka | 30.1 a | 19.4 a |
| Vapor Gard | 29.7 a | 18.9 b |
| White Drape Net | 30.8 a | 19.5 a |
| ANOVA (*p*-value) | 0.8468 | 0.0246 |

**UTC**

**Raynox Plus**

**Parka**

**Vapor Gard**

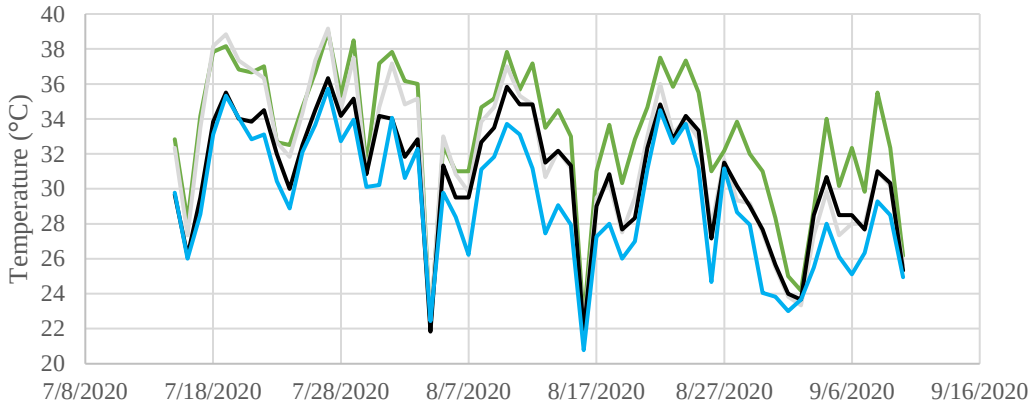
**White Drape Net**

**White Drape Net +1WAH**

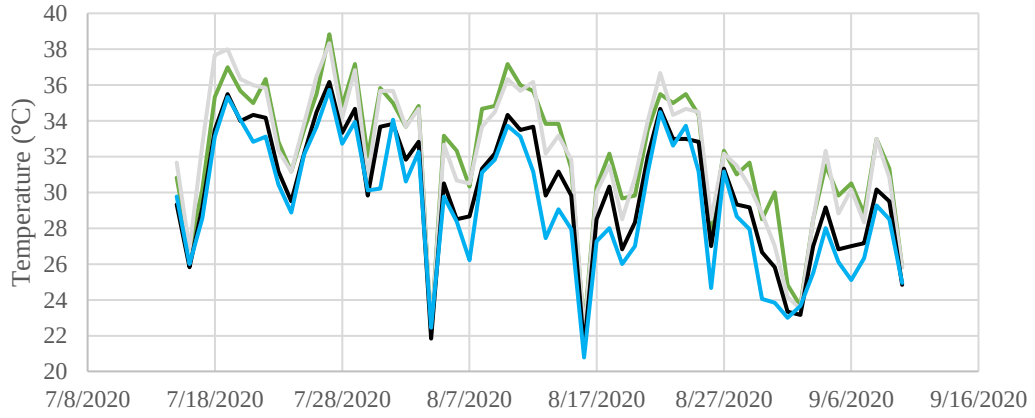
**White Drape Net +2WAH**

# Maximum Daily Temperature of the Tall Spindle Canopy Recorded from 7/15 to 9/ 10/2020

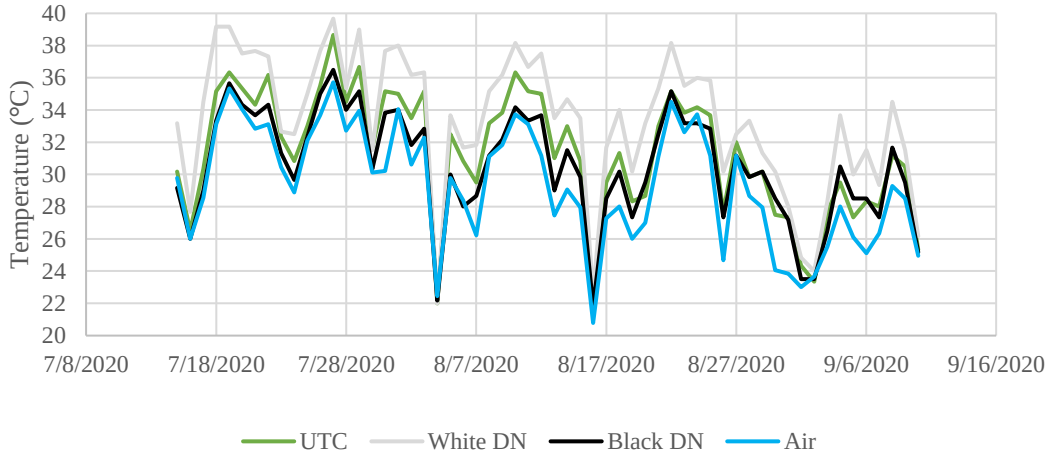
Upper Canopy




Medium Canopy




Lower Canopy



# Honeycrisp's Fruit Surface Temperature Measured on August 11 and 31, 2020.

| Factor | Fruit Surface Temperature (°C) | |
|---|---|---|
| **Treatment** | **Aug 11** | **Aug 31** |
| ***UTC*** | 28.5 a | 19.8 a |
| ***White Drape Net*** | 28.6 a | 20.5 a |
| ***Black Drape Net*** | 27.0 b | 18.1 b |
| ANOVA (*p*-value) | <.0001 | <.0001 |
| **Canopy Position** | | |
| ***Upper Canopy*** | 28.6 a | 20.1 a |
| ***Middle Canopy*** | 28.0 ab | 19.3 b |
| ***Lower Canopy*** | 27.6 b | 19.0 b |
| ANOVA (*p*-value) | 0.0142 | 0.0117 |
| **Row Side** | | |
| ***East*** | 29.9 a | 21.7 a |
| ***West*** | 26.1 b | 17.2 b |
| ANOVA (*p*-value) | <.0001 | <.0001 |

Means followed by the same letter are not significantly different at α=0.05 according to Student's t-test.
UTC – Untreated Control.
Average air temperature on Aug 11, during period the FST measurements took place, from 9am to 2.30pm, was 30.4°C.
Average air temperature on Aug 31, during period the FST measurements took place, from 11am to 13pm was 20.5°C.

# Intercepted Light in Honeycrisp Trees Covered with Drape Net, Measured on August 1 and 14, 2020.

| Factor<br>Treatment | Share of PAR intercepted by the canopy (%) |
|---|---|
| ***UTC*** | 24.3 ab |
| ***White Drape Net*** | 29.3 a |
| ***Black Drape Net*** | 18.1 b |
| ANOVA (*p*-value) | 0.0159 |
| **Canopy Position** | |
| ***Upper Canopy*** | 52.4 a |
| ***Middle Canopy*** | 12.7 b |
| ***Lower Canopy*** | 6.6 c |
| ANOVA (*p*-value) | <.0001 |

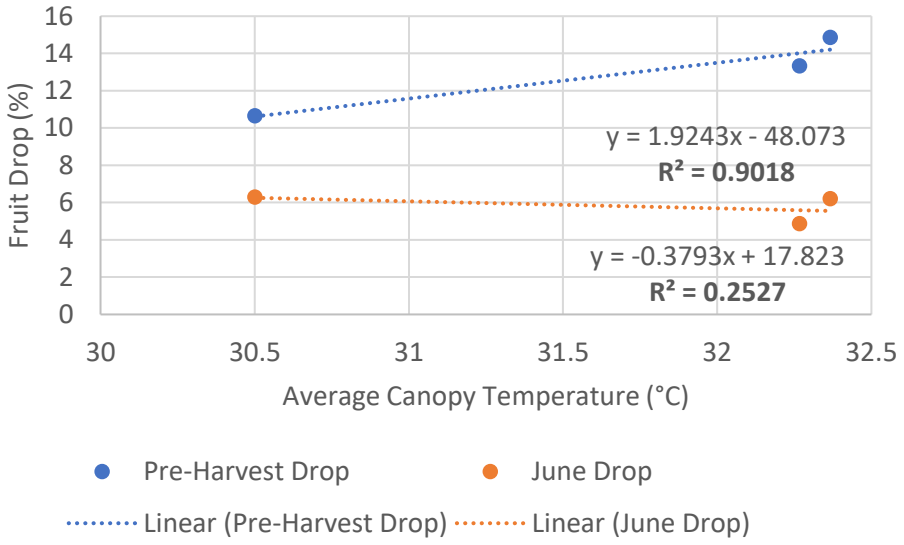
Means followed by the same letter are not significantly different at α=0.05 according to Student's t-test.
UTC – Untreated Control.
Level of the photosynthetic active radiation (PAR) was measured on August 1 and 14, 2020


# Drape Net Effect on Honeycrisp's Per-Harvest Fruit Drop

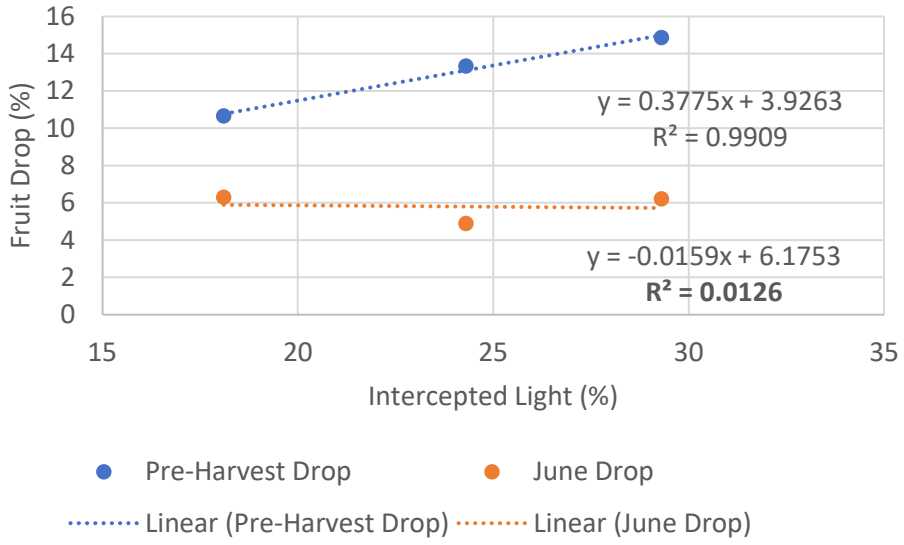
| Treatment | Fruit Set (%) | June Drop (%) | Number of Fruits at Harvest (Sep. 9) | Yield per tree (kg) | Pre-Harvest Drop (%) |
|---|---|---|---|---|---|
| ***UTC*** | 15.3 | 4.9 | 95.1 | 19.1 | 13.3 |
| ***White Drape Net*** | 17.4 | 6.2 | 109.7 | 20.1 | 14.9 |
| ***Black Drape Net*** | 14.8 | 6.3 | 99.0 | 16.8 | 10.7 |
| ANOVA (*p*-value) | 0.1729 | 0.5725 | 0.3867 | 0.1495 | 0.3808 |

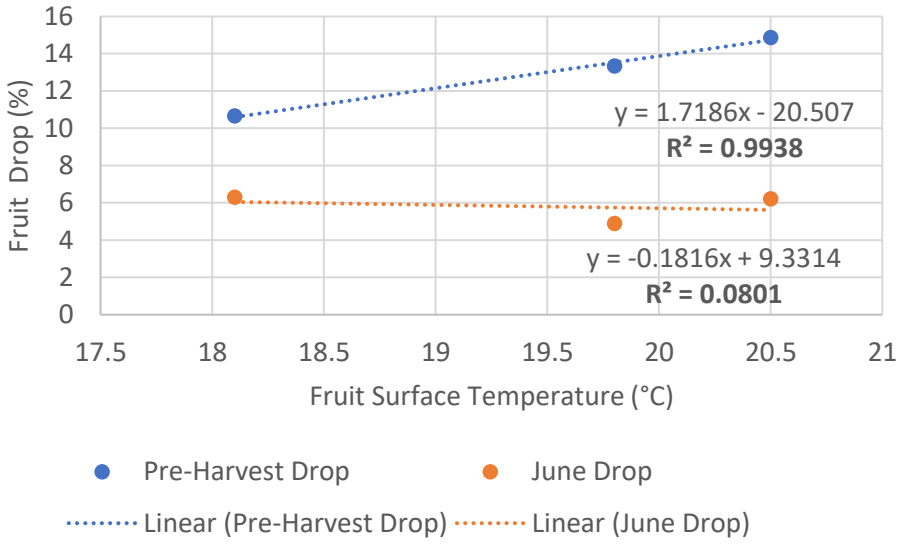
Means followed by the same letter are not significantly different at α=0.05 according to Student's t-test.
UTC – Untreated Control.


# Do Canopy Temperature And FST Affect Fruit Drop?




# Does the Intercepted Light Affect Fruit Drop?



# Sunburn Damage: Conclusions

1. The postponed harvest of Drape Net covered Honeycrisp can improve fruit color development.

2. Spray products (Raynox Plus®, Parka™, and Vapor Gard®) and Drape Net White did not control sunburn incidence in Honeycrisp and Snow Sweet in 2020.

3. Additional shading and altered canopy temperature caused by Drape Net does not affect June drop. However, more light penetration into the canopy and higher FST promote pre-harvest drop.

# Thank You For Your Attention


Technical Support:

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  Drape Net North America


# When to Apply a Frost-Rescue Spray?

| Year | 2012 | 2016 |
|---|---|---|
| **Growth Stage** | Full Bloom | Green Tip/ Tight Cluster |
| **Temperature** | High 20s | Low 20s |




- Between pink stage to petal fall.
- Promalin: 2 pints/A in 75-150 gallons of water, within 24 hours of the frost event.
- Best results if applied after hard frost (lower than 29°F) when there is significant flower damage.
- 8 to 10% of all flowers to set a good crop.

# How Does It Work?

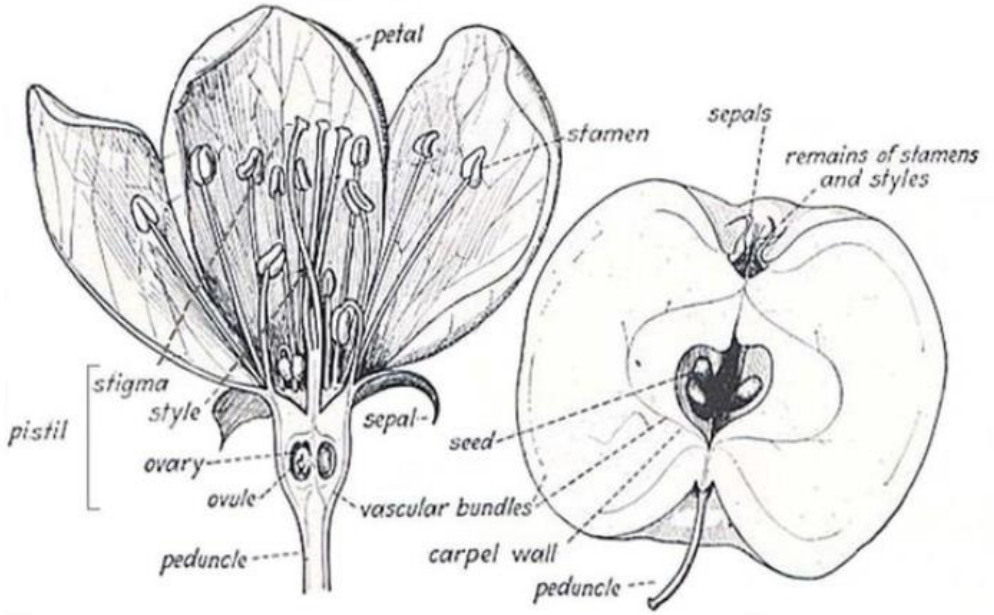


Photo credit: Peter William Edward Kearns

- **Perlan** ® (Fine Agrochemicals Limited) & **Promalin** ® (Valent BioSciencesCorporation)
  - N-(phenylmethyl)-1H-purine 6-amine (1. 8% w/w)
  - Gibberellins $A_4A_7$ (1. 8% w/w)
- Supplemental label (2EE) in New York for frost damage remediation in apples during the bloom period, within 24 hours after the frost event.
- The gibberellins in Promalin mimic those that would have been produced by the non-existent seeds in the damaged fruitlets. As a result, the seedless fruit remain on the tree.