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Freeze and Other Weather Impacts on Fruit Production





Image Credit. R. Crassweller, PSU

extension.psu.edu

Frosts and Freezes

- Frost and freeze damage occurs on a spectrum.
- Temperature and growth stage of the affected trees are of critical importance.



Image Credit. R. Crassweller, PSU



Critical Temperatures - Apple

	Silver Tip	Green Tip	¹ / ₂ " Green	Tight Cluster	1 st Pink	Full Pink	First Bloom	Full Bloom	Post Bloom
10% Kill	15	18	23	27	28	28	28	28	28
90% Kill	2	10	15	21	24	25	25	25	25

Data Credit: Michigan State Extension



Critical Temperatures - Peach

	Bud Swell	Calyx Green	Calyx Red	1 st Pink	1 st Bloom	Full Bloom	Post Bloom
10% Kill	18	21	23	25	26	27	28
90% Kill	1	5	9	15	21	24	25

Data Credit: Michigan State Extension



Types of Frost

Advective Frost Large mass of cold air moving into an area, usually from polar and/or arctic regions. **Temperatures** get colder as elevation increases.



Types of Frost

Radiation Frost

 Occurs when heat that is stored in the soil is radiated back at night. An inversion layer usually develops. Air near the soil is at/below freezing and as elevation increases temperature increases to rest of the air profile.





Factors Affecting Temperature Drops

- Cold air is denser than warm air and will settle in lower elevations.
- Cloud cover is helpful since it will trap heat radiated from soils.
- Rapidity and depth of temperature drop is influenced by the dew point.
- Low dew points mean drier air which can negatively affect attempts at heating orchards.
- Windy conditions can break up inversion layers and prevents lower levels of the atmosphere from stabilizing.



- The Network for Environment and Weather Applications (NEWA) monitors the Mid-Atlantic region
 - Can be found at: newa.cornell.edu
 - Examples of website on next slides
- Thermometers should be calibrated each season.
- Place thermometers in lowest sites at the canopy height of fruit.















Winter Pruning Tips to Reduce Cold Stress

- Prune hardiest species first.
 Pears -> Apples -> Cherries -> Peaches
- Prune your oldest trees first
- If there is going to be a cold snap, avoid pruning.
 - NEWA weather monitoring



Passive Frost Protection – Site Selection

"No frost protection can overcome poor site selection for an orchard." – Dr. Rob Crassweller, Professor Emeritus of Horticulture, Penn State University



Passive Frost Protection - Soils

Soil Coverage	Temperature differences
Bare, firm, moist ground	Warmest
Shredded cover crop, moist ground	¹ ∕₂°F colder
Low growing cover crop	1°-3°F colder
Dry, firm ground	2°F colder
Freshly disked, fluffy ground	2°F colder
High cover crop or tall weeds	2°-4°F colder
Where cover crop restricts air drainage	6°-8°F colder



Active Frost Protection - Heaters

- Very common at one point
- Have generally fallen out of favor due to fuel costs and pollution concerns.
- Radiant heat provided by heaters is the least efficient method of frost protection.
- 36 smudge pots/acre





Active Frost Protection – Mobile Propane Heaters

- Require 10-minute loops to protect acreage.
- At 4 4.5 mph, can protect roughly 5 acres.
- Unless efficient fueling is available, can only protect for about 4 hours.
- Can't be used when windy
- Works down to 18.6°F





Active Frost Protection – Wind Machines

• Expensive

- Cost between
 \$20,000 \$30,000
- A single wind machine can protect about 10 acres
- Need heat. Require an inversion layer to mix.





Active Frost Protection - Helicopters

- Expensive
 - ∘ ~\$1600/hour
- Hard to find companies offering the service at this point
- Need to contact services well in advance of need



Active Frost Protection – Overhead Irrigation

- Short explanation: Water continually freezes and not the flower buds.
- Uses between 0.1 –
 0.15 inches per hour
- Needs to be started at 33°F
- Only protects down to 24°F and does not work in high winds.





Active Frost Protection – "Anti-Freeze" Chemicals

- Several products have come to market over the years
- None of them have shown consistent, scientific efficacy in preventing frost damage
- As far as I am aware, no work in the Mid-Atlantic is being done on these products



Active Frost Protection – Bloom Delay

- In the 1970s, work was done in delaying bloom by applying overhead irrigation mists when air temps were above 45°F.
- The idea was to avoid early season frosts.
- Bloom was able to be delayed between 10 – 14 days.
- Fruit set after bloom delay was reduced.



Active Frost Protection – Ethephon on Peach

- A Fall application of Ethephon has been shown to delay Spring bloom timing.
- Most recent label of Ethrel I found did not have this as an approved application.
- More research/Extension work would need to be done to encourage manufacturers to label this as an approved use.



Hail Damage

- Cornell University has shown efficacy of hail nets to protect fruit trees.
- Cost and labor intensive.
- If growing apples, save a streptomycin application for emergencies.





Thank you! Any Questions?





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