



RUTGERS

New Jersey Agricultural
Experiment Station

Current Frost Protection Methods In The Orchard

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Jan 30, 2018

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MORE ISSUES

ARTICLE

COMMENTS



PEACH FARMING IN THE GARDEN STATE: NOT AS SWEET A DEAL AS IT USED TO BE

TARA NURIN | JULY 27, 2016

New Jersey's peach industry is going through some changes, some for the better, others – it remains to be seen



This spring, people worried about peaches. After an early April frost killed a quarter of New Jersey's crop, by one estimate, farmers, chefs, and consumers fretted that there wouldn't be enough of



Passive Frost Protection Methods

1. Site selection
2. Managing cold air drainage
3. Variety selection
4. Delayed pruning
5. Misting for bud cooling










Active Protection Methods








1. Heaters/smudge pots
2. Wind machines
3. Over head sprinklers
4. Under tree irrigation
5. Frost dragon
6. Helicopters
7. Chemicals (PGR and Fungicides)

First step:

Monitoring the weather and bud development

CRITICAL SPRING TEMPERATURES FOR TREE FRUIT BUD DEVELOPMENT STAGES

Pome Fruit (Apples and Pears)									
Apples									
Apples	Silver tip	Green Tip	Half inch green	Tight Cluster	First Pink	Full Pink	First Bloom	Full Bloom	Post Bloom
Old temp	16	16	22	27	27	28	28	29	29
10% kill	15	18	23	27	28	28	28	28	28
90% kill	2	10	15	21	24	25	25	25	25

Peaches									
Peaches	Swollen Bud	Calyx Green	Calyx Red	First Pink	First Bloom	Full Bloom	Post Bloom		
Old temp	23	--	--	25	--	27	30		
10% kill	18	21	23	25	26	27	28		
90% kill	1	5	9	15	21	24	25		

☁️ 57° Princeton, NJ



☁️ 59° Hammonton, NJ



+ ADD

Today

Hourly

5 Day

10 Day

PRINCETON, NJ 📍
as of 1:26 pm EST

57°
PARTLY CLOUDY

feels like 57°
H 55° / L 34°
UV Index 2 of 10



Latest Forecast: Wintry Mess Invading NE



RIGHT NOW

Wind
NW 3 mph

Humidity
78%

Dew Point
50°

Pressure
29.58 in ↓

Visibility
10.0 mi

Second step:

Estimate risk of damage Vs. cost-benefits of method

Active frost protection methods are more effective however ...

Doing it incorrectly – at the wrong time or under the wrong conditions is more damaging than doing nothing at all.

Heaters or Smudge Pots

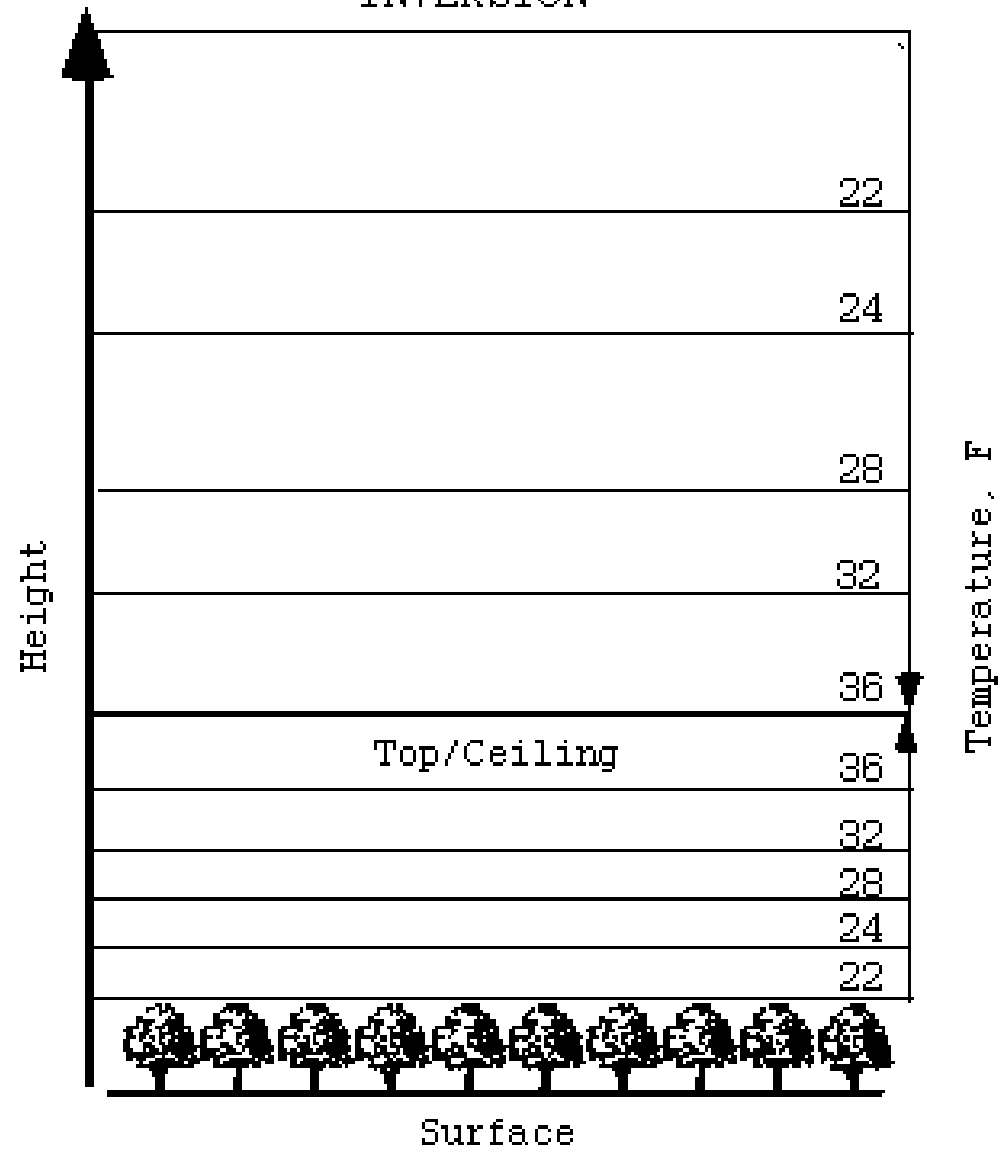
- Heaters provide supplemental heat to help replace energy losses.
- However, the systems are generally inefficient so proper design and management is necessary.
- High winds >>> energy loss is faster

Monitor the Inversion Layer

Strong inversion (i.e. a low ceiling), requires less heated volume >>> heaters are more effective at raising the temp.



INVERSION



**weak
inversion**



**high
ceiling**



**bigger volume to
heat**

If no inversion layer, there should be slow wind to move heat around.



Does smoke helps?

- Smoke does not help and it does pollute the environment, and should be avoided.

Wind machines

- Uses only 5 percent to 10 percent of the fuel consumed by a fuel-oil heater.
- Lower labor requirements and operational costs than other methods.
- Initial investment is high (~ \$ 20 000 per machine).

Wind Machine

Warm Air



Inversion Layer

Draw down warmer air from above & mix it with the colder air to prevent stratification.

Cold Air



Over-head Irrigation for icing

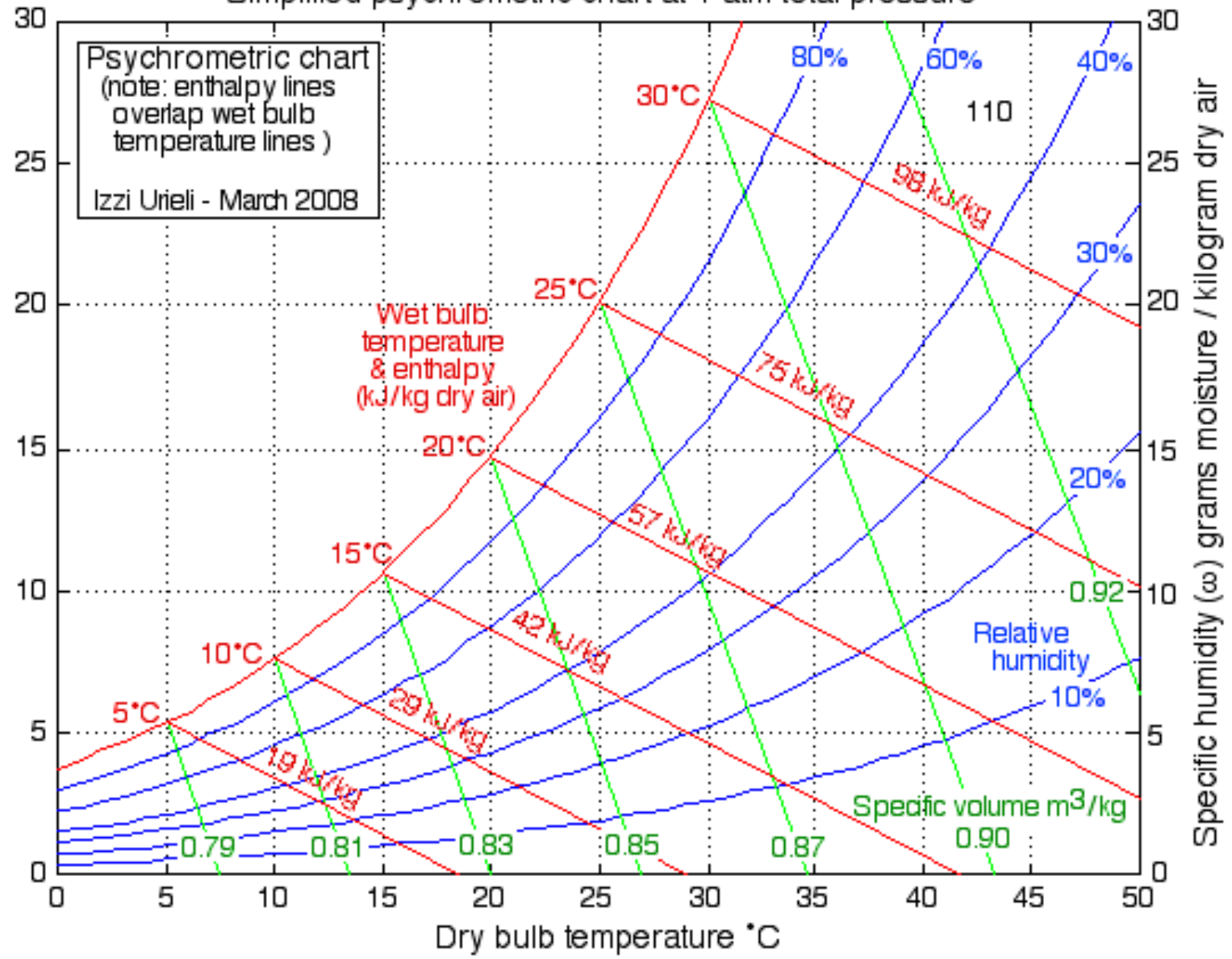


- Very effective
- Needs strong scaffold branches
- Target only the canopy

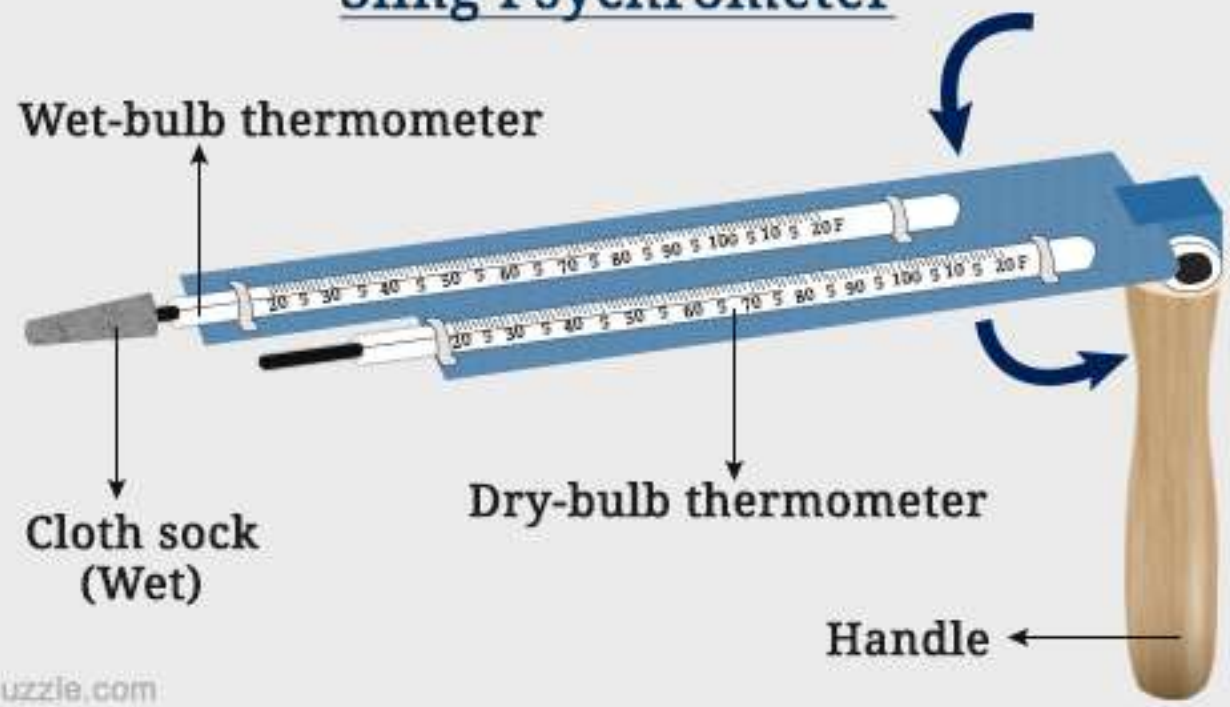
A mixture of ice and water exposed to below freezing point remains at 32°F until all the water is frozen

- As the liquid water is applied to plants, evaporation will cool the air below.
- Moisture in the air transitions from a gas to a liquid - This is called the “condensation point” or “dew point.”
- Trees will be dealing with this ‘cooled temp’ when you start irrigation, not the ambient temp.

Simplified psychrometric chart at 1 atm total pressure



Sling Psychrometer



Buzzle.com





Calculated Wet-Bulb Temperatures based on $Ta - [(Ta - DP) \times 0.3333]$, (Knox et al, 2017).

Dew Point (°F)	Air (Dry-Bulb) Temperature (°F)								
	32 ^z	33	34	35	36	37	38	39	40
34			34.0	34.7	35.3	36.0	36.7	37.3	38.0
33		33.0	33.7	34.3	35.0	35.7	36.3	37.0	37.7
32	32.0 ^y	32.7	33.3	34.0	34.7	35.3	36.0	36.7	37.3
31	31.7	32.3	33.0	33.7	34.3	35.0	35.7	36.3	37.0
30	31.3	32.0	32.7	33.3	34.0	34.7	35.3	36.0	36.7
29	31.0	31.7	32.3	33.0	33.7	34.3	35.0	35.7	36.3
28	30.7	31.3	32.0	32.7	33.3	34.0	34.7	35.3	36.0
27	30.3	31.0	31.7	32.3	33.0	33.7	34.3	35.0	35.7
26	30.0	30.7	31.3	32.0	32.7	33.3	34.0	34.7	35.3
25	29.7	30.3	31.0	31.7	32.3	33.0	33.7	34.3	35.0
24	29.3	30.0	30.7	31.3	32.0	32.7	33.3	34.0	34.7
23	29.0	29.7	30.3	31.0	31.7	32.3	33.0	33.7	34.3
20	28.0	28.7	29.3	30.0	30.7	31.3	32.0	32.7	33.3
19	27.7	28.3	29.0	29.7	30.3	31.0	31.7	32.3	33.0
18	27.3	28.0	28.7	29.3	30.0	30.7	31.3	32.0	32.7

^z Row is dry-bulb temperatures in °F

^y Wet-bulb calculated temperatures

Start sprinklers when the wet-bulb temperature is above 32 °F (Between blue and gray boxes)

Under tree micro-sprinklers

- Gaining popularity with growers for irrigation and frost protection.
- Same principle as over-head irrigation.
- Keeps only the ground under the plants near 32 °F (0 °C).

- More effective in dry springs.
- The goal is to maintain the soil water content near field capacity.
- However, if evaporation rates are high, more energy can be lost to vaporize water than is gained by the freezing process.

Frost dragons





Milehighcopters.com

Drones for frost control?



Combination of methods: overhead, under tree and wind machines

The addition of wind machines could potentially increase protection by up to 4 °F over the under-plant sprinklers alone.

- Mercy Olmstead, Uni. of Florida

Observations of PGR Promalin for Frost Protection in Apple (By Alacandro, Cornell Uni.)

- One guy who used it actually had a big crop, and his neighbor had nothing.”
- Apply within 24 hours after a frost event when the majority of the crop is between early and full bloom.
- Apply in 75-150 gallons of water per acre.

A close-up photograph of two ripe, red peaches hanging from a branch. The peaches are round and have a vibrant red color with some yellow-orange undertones. They are surrounded by several green, serrated leaves. The background is a soft-focus green, suggesting a peach orchard. The word "Thanks" is written in white, bold, sans-serif font across the middle of each peach.

Thanks

Thanks

Over-head Sprinklers

- The secret to protection with over-head sprinklers is to re-apply water frequently at a sufficient application rate to prevent the plant tissue temp. from falling too low between pulses of water.
- Lower the threshold temp. >> higher the flow rate.



- Under windy conditions or when the air temperature falls so low that the application rate is inadequate to supply more heat than is lost to evaporation, the method can cause more damage than an unprotected crop.