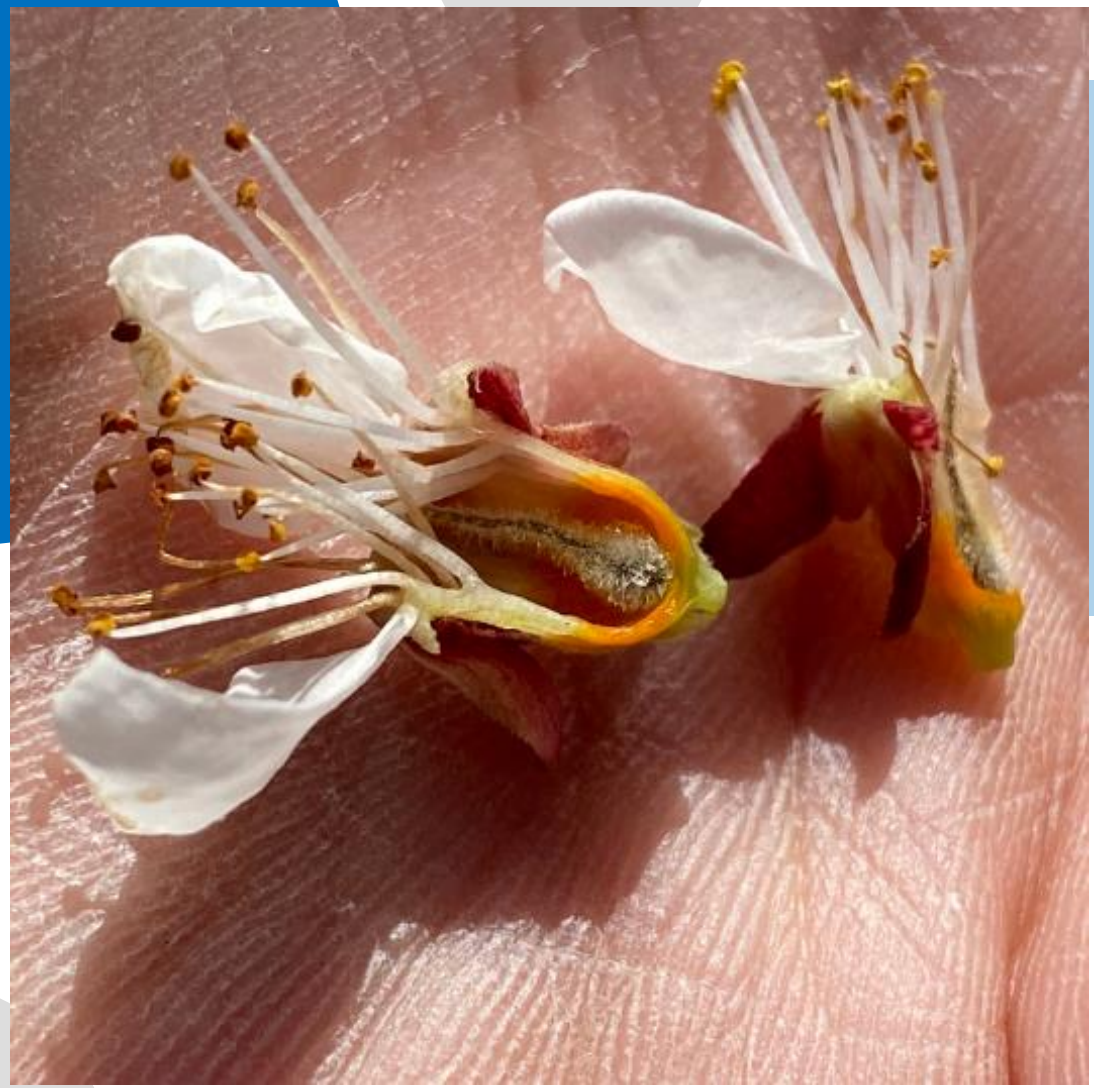


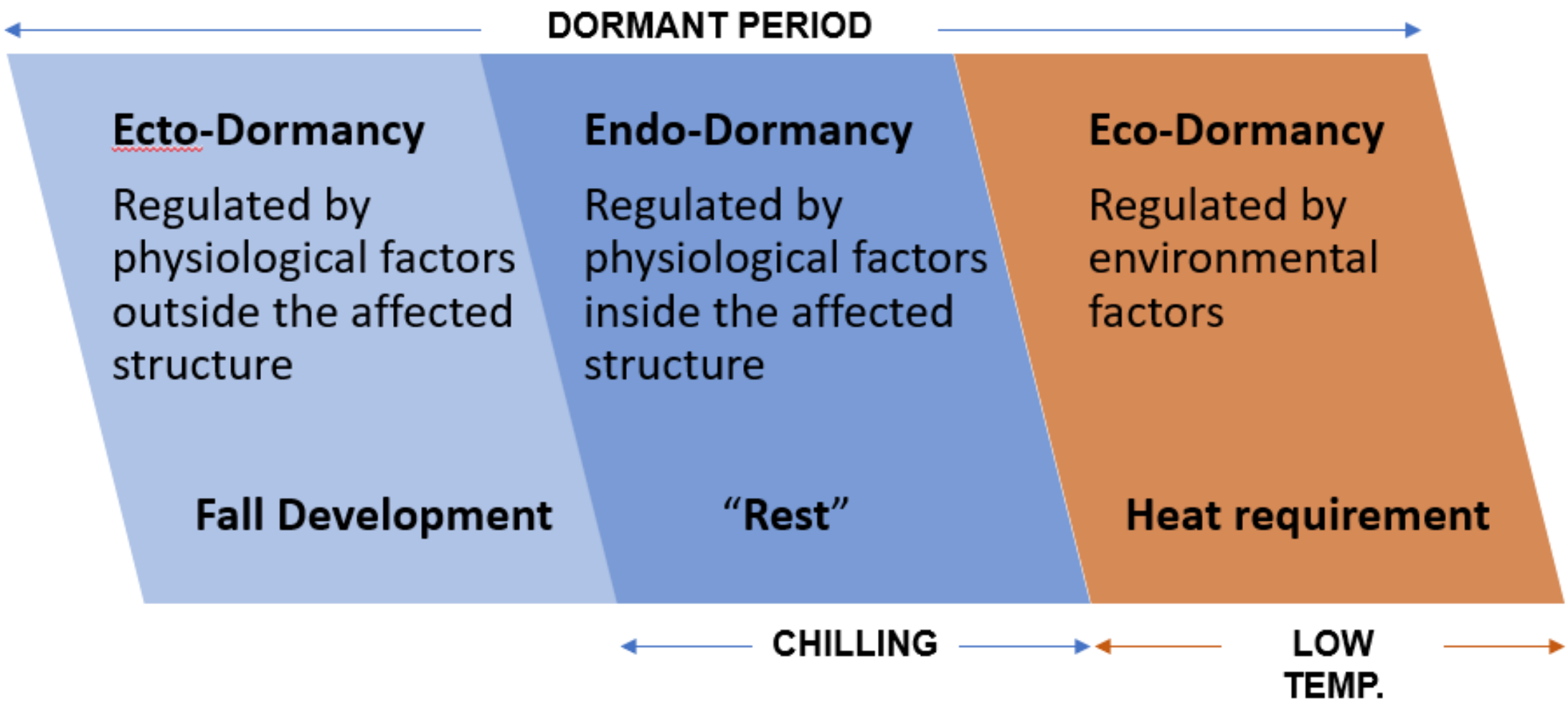
COLD INJURY IN FRUIT

SHERIDEN HANSEN, M.S.
USU EXTENSION | DAVIS COUNTY
HORTICULTURE, HOME ORCHARDS

What is Dormancy?

- To understand the damage and timing we need to understand dormancy
- Sometimes called REST
- We correlate it with leaf drop and cessation of growth
- Woody plants **gradually** acclimate to low temperatures
- Dormancy consists of three stages

Stages of Dormancy



ECTO-DORMANCY

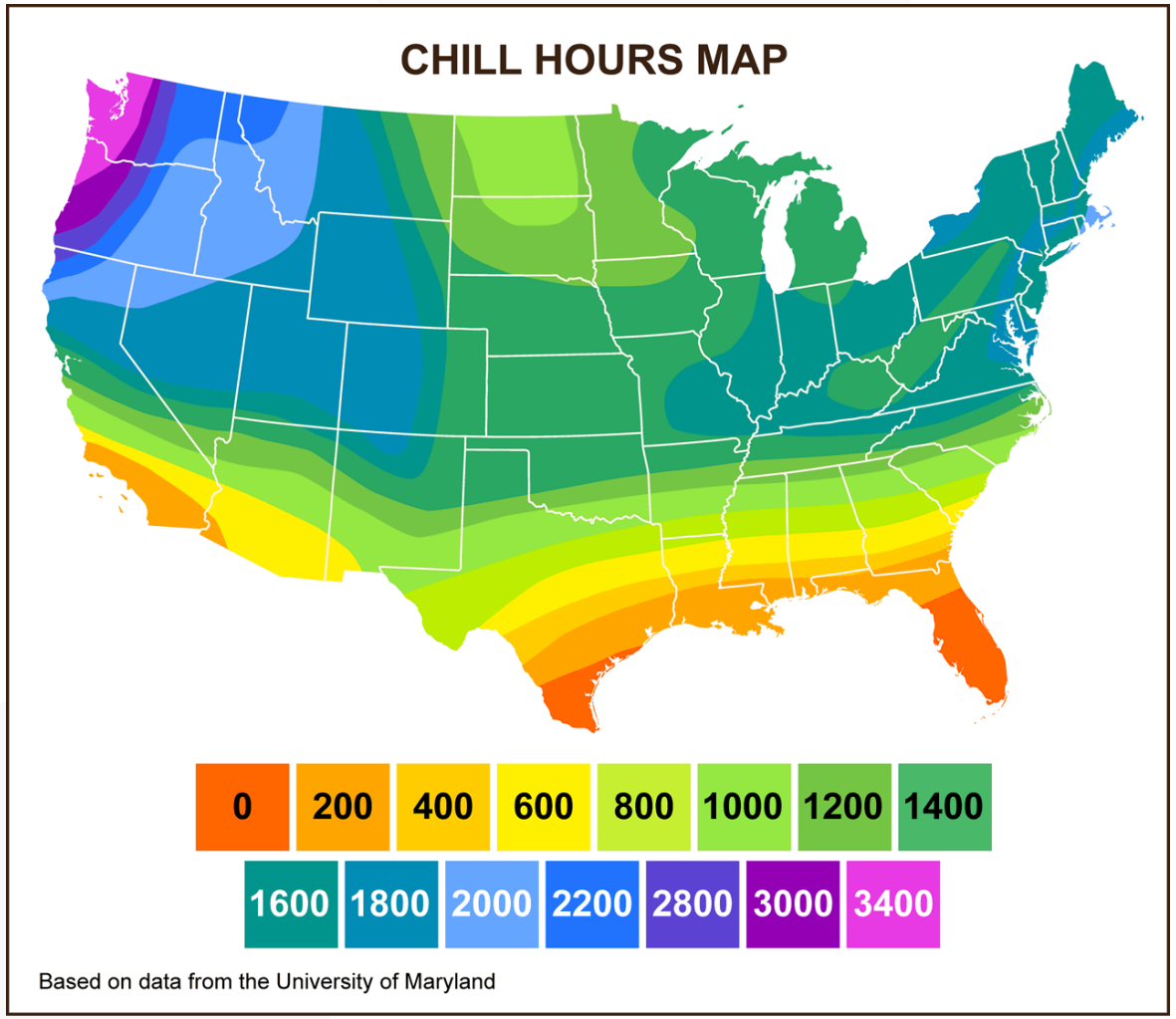
Acclimation to freezing temperatures

- Short photoperiods in the fall trigger 10-15° of cold tolerance
- Periods of cool, non-freezing temps followed by exposure to subfreezing temps
  - Trees can be as much as 10° hardier the day after a frost than the previous day
- Exposure to temperatures approaching 0° ➡ MAXIMUM COLD TOLERANCE

ENDO-DORMANCY

Sometimes called “Rest”

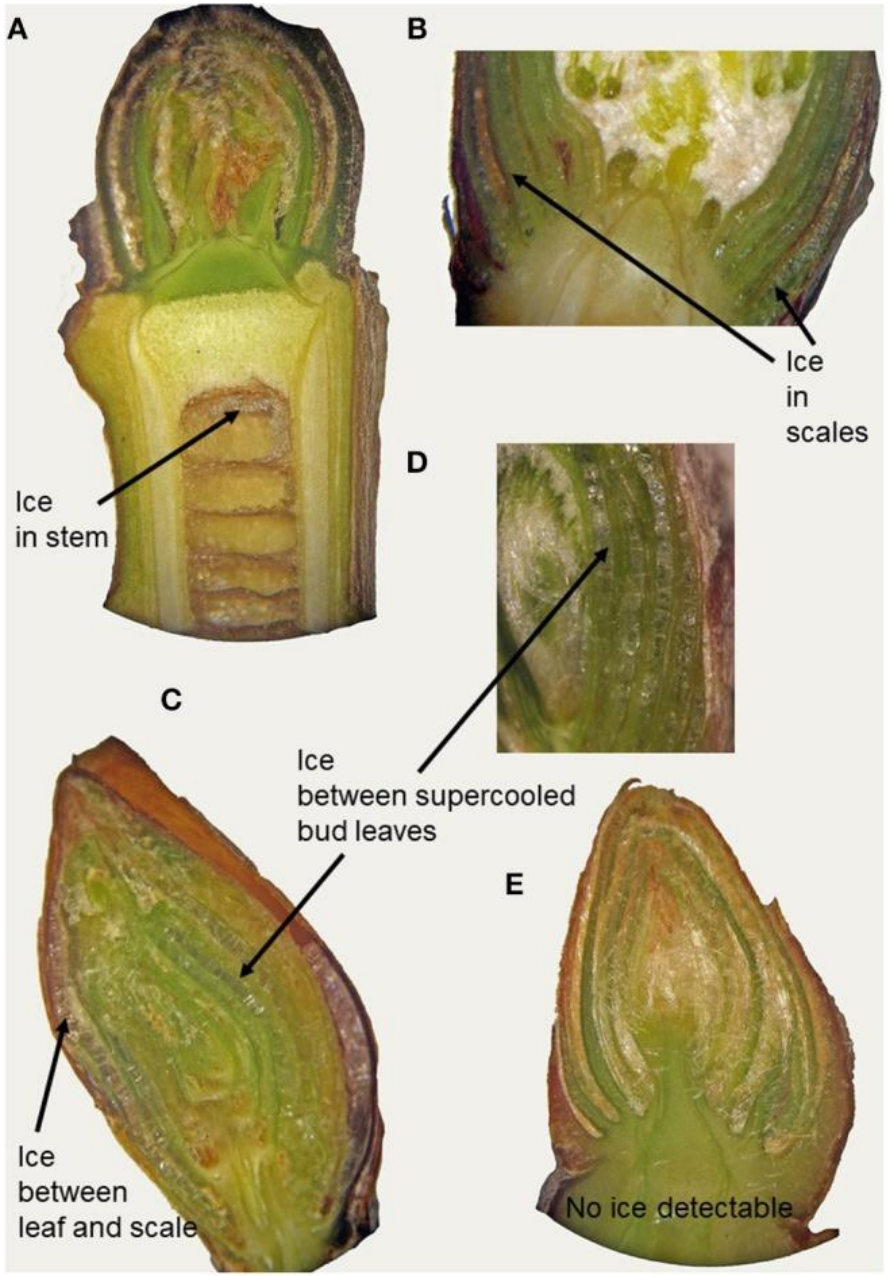
- Once plants enter rest phase they will not grow
- Need to meet chill hour requirements



What are CHILL HOURS?

Chill hours are time spent above freezing

- Ideally temperatures between 40° to 50° F
- Temperatures below 40° F and above 50° F are less effective
- Above 60° F, can have a negative effect on the plant
  - Peaches/Nectarines: 500-1,200
  - Apples/Pears: 500-1,000
  - Cherries: 700-1,200



Neuner, G., Monitzer, K., Kaplenig, D., & Ingruber, J. 2019. Survival mechanism of vegetative buds in temperate trees: deep supercooling and extraorgan freezing vs. ice tolerance. *Front Plant Sci* : 10:537.

Different Methods of Survival

- Using these mechanisms <u>apples</u> can survive temperatures -22 to -58° F
- Damage can still occur

Supercooling

- Plant moves H_2O out of the cell, concentrating sugars.
- Prevents ice formation in the bud cells.

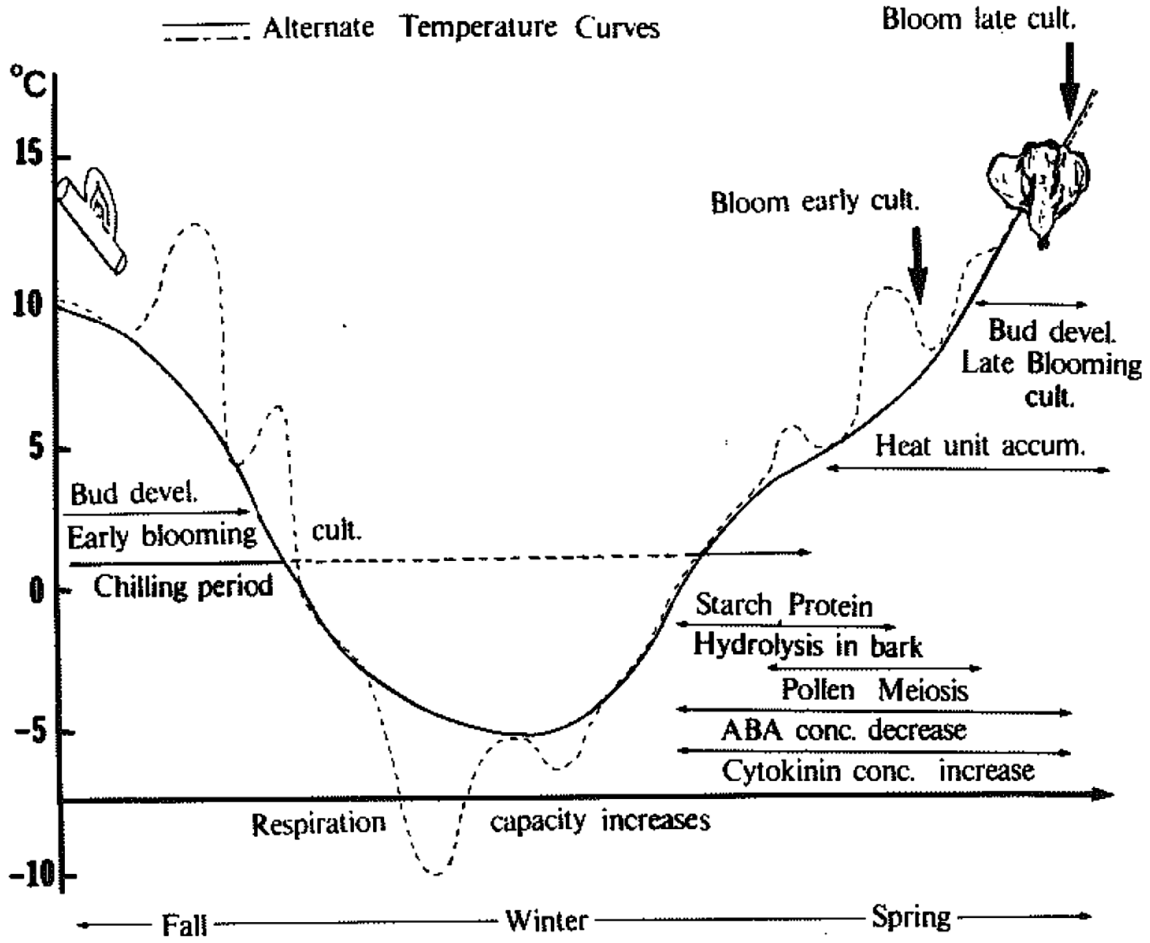
Extraorgan Freezing

- Allows for ice formation to occur in less-critical tissues
- Sometimes in bud scales or in stems

ECO-DORMANCY

After chilling requirement is met usually some time in Jan/Feb, the plant moves into eco-dormancy

- Plants remain dormant as long as there is cool weather
- Warmer temps in the 40’s will allow growth to begin (visible with bud swell)
- **Lose the ability to re-adjust to colder temps**



Injury Timing

- Most often injury occurs during ecto-dormancy and/or eco-dormancy
- Why?
- Can damage occur during endo-dormancy?

Photos: W. Shane, Michigan State University

FALL DAMAGE

Ecto-dormancy

- Damage occurs due to wide temperature fluxuations coupled with mild fall temperatures
- Temperature drops faster than trees can acclimate
  - Damaged/dead buds, “bud drop”
  - Branch end die back or sparse leafing out
  - Whole tree death
- Don’t see symptoms until the following spring/summer

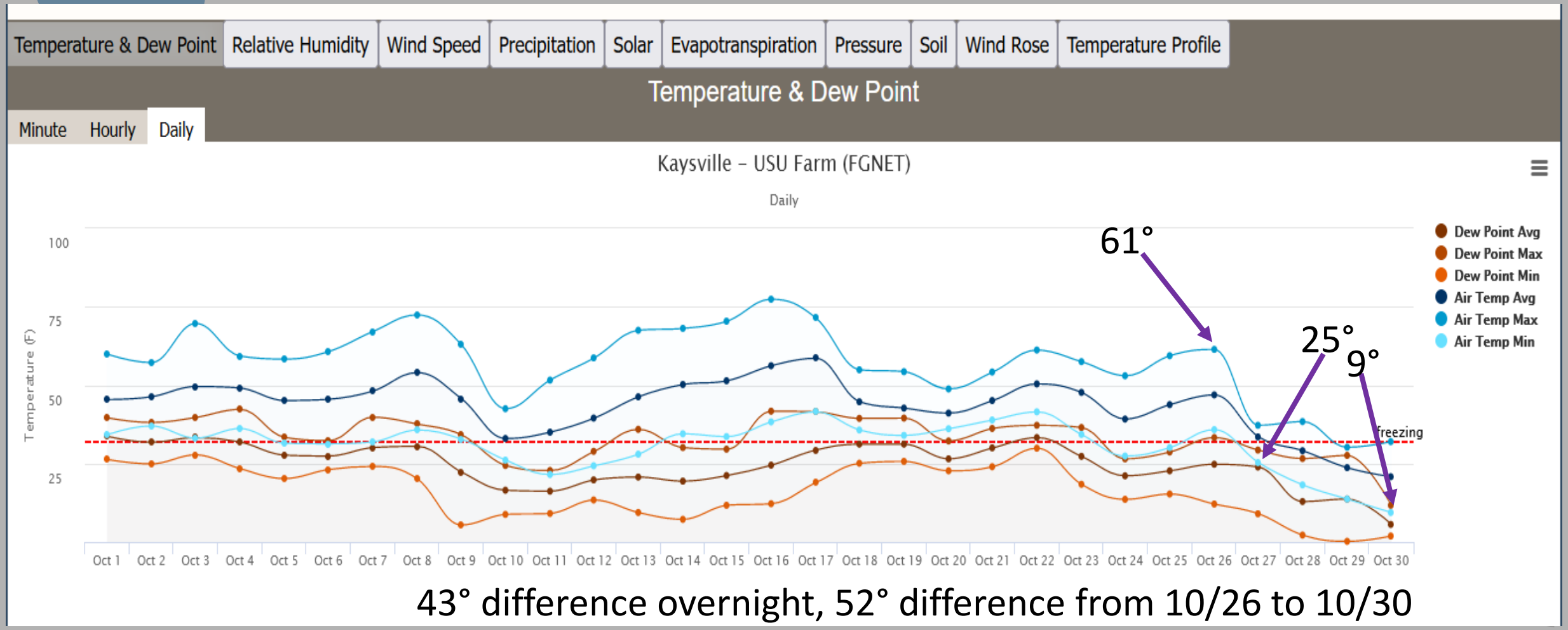
Photos: W. Shane, Michigan State University

FALL DAMAGE

Ecto-dormancy

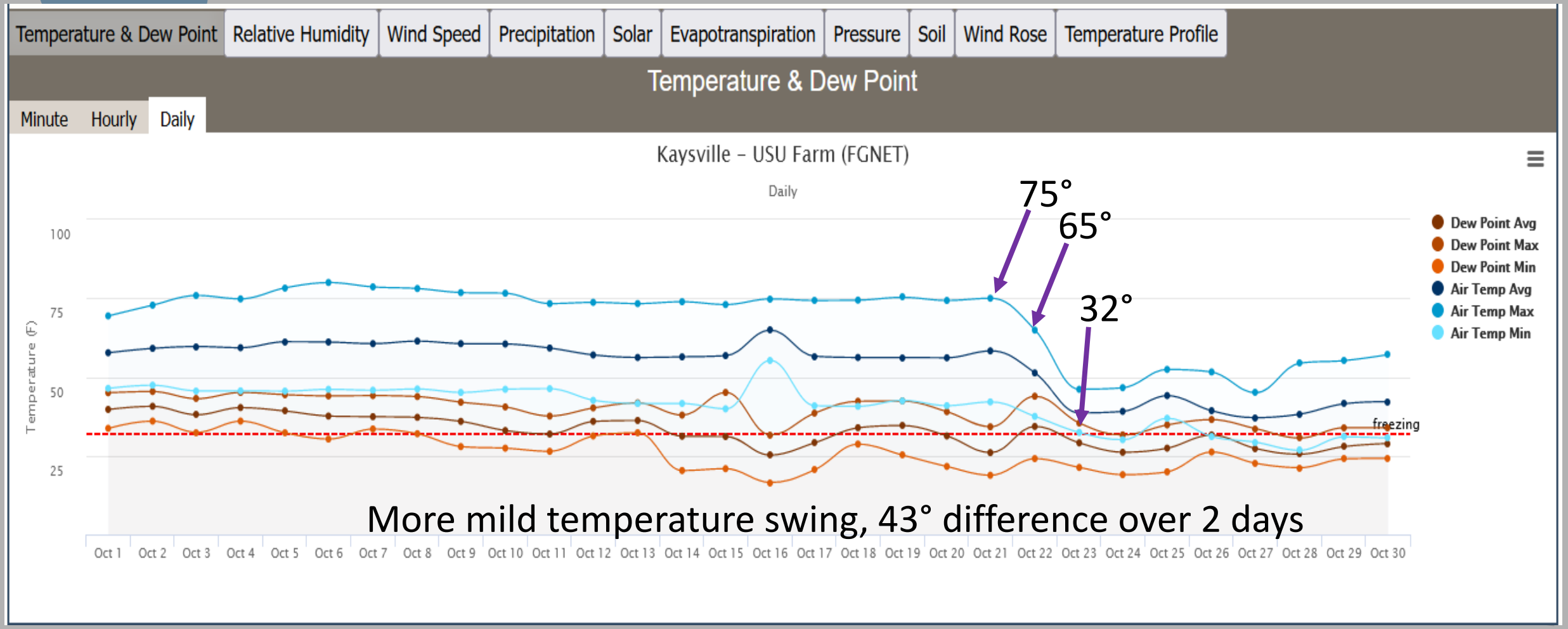
- Preventing fall damage
- Avoid:
  - Late season fertilization (after July 1st)
  - Late season pruning (after July 1st)
  - Drought stress
  - Overcropping trees
  - Planting marginally hardy cultivars/varieties/rootstocks
- Do:
  - Manage trees to promote health and vigor
  - Control insects and diseases

OCTOBER 2019



43° difference overnight, 52° difference from 10/26 to 10/30

OCTOBER 2022



More mild temperature swing, 43° difference over 2 days

Photo: Luke Milliron, UC Dept. of Agriculture and Natural Resources

WALNUT

Photos: W. Shane, Michigan State University

Photo: Brian Smith, University of Wisconsin

PEACH & APPLE

Photos: G. Sundin and N. Rothwell, Michigan State University

One-year-old peach limbs in cross section showing low to moderate browning (left) and significant browning (right) in the xylem tissues due to mid-winter low temperature.

WINTER DAMAGE

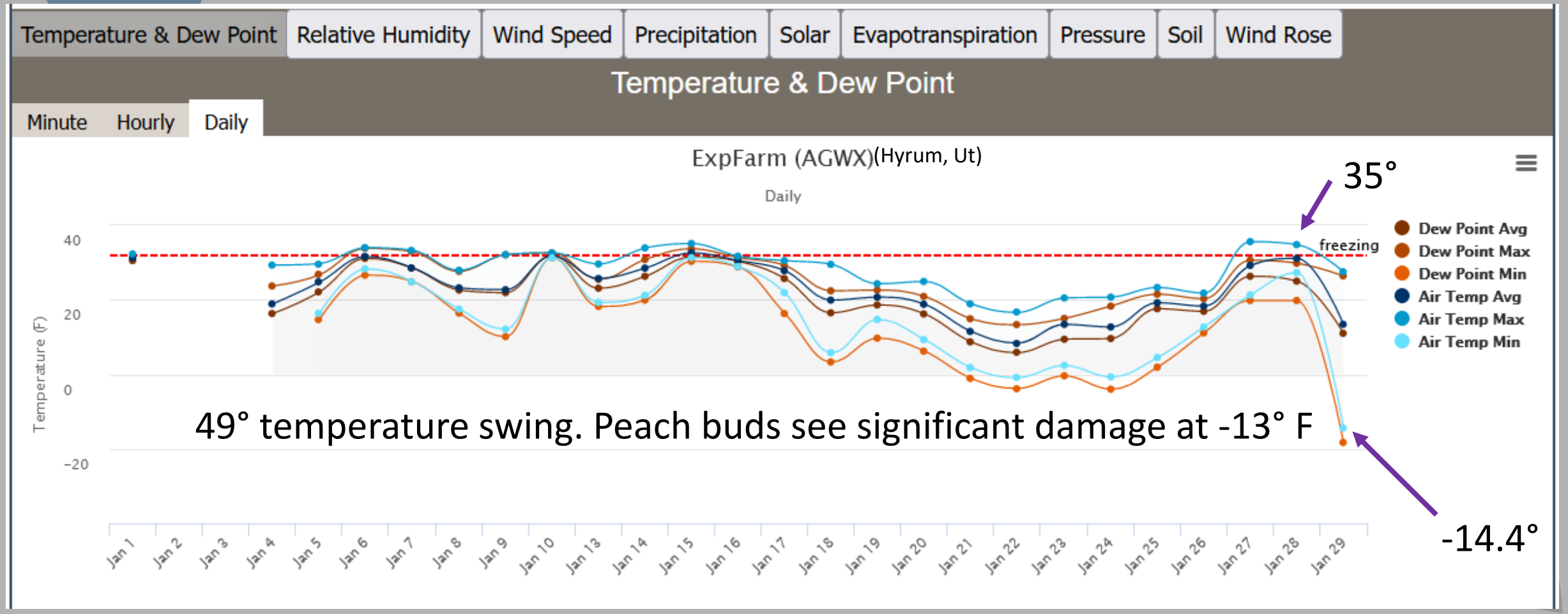
Endo-dormancy

- Damage occurs due to extreme low temperatures
- Temperature drops so low that ice is formed in cells where it typically isn't formed
- Younger wood more susceptible
- Results in damage to branches and trunk
- Whole tree death
- Brambles – cane death

SUNSCALD

- Occurs when light is reflected off of the snow
- Warms the trunk of the tree during the day
- Protective mechanisms reverse in the xylem and phloem
- Freezes at night causing trunk splitting/cracking
- Trunk wraps, whitewashing 1:1 latex paint:water

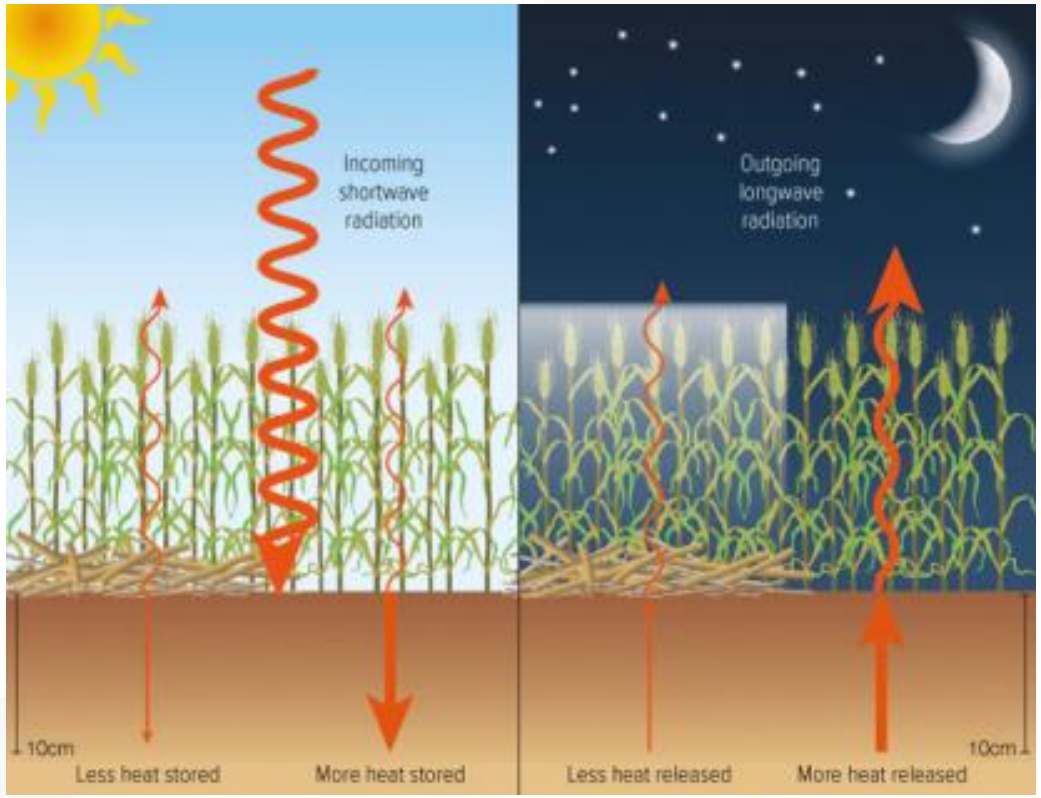
JANUARY 2023

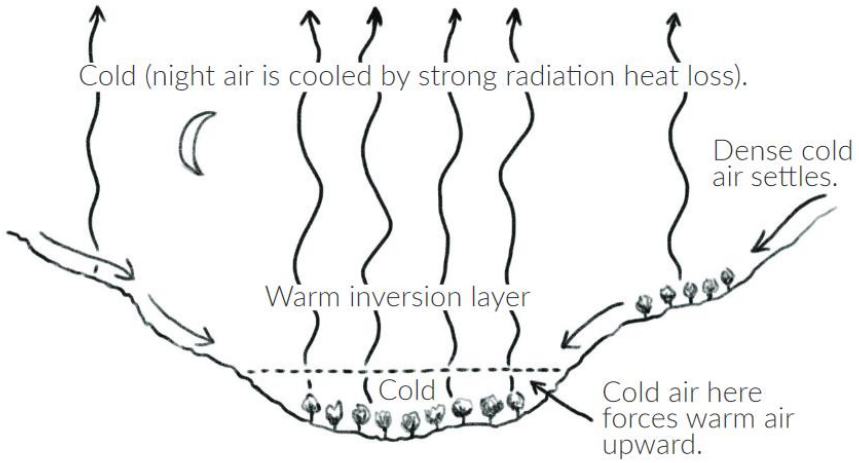


SPRING DAMAGE

Eco-dormancy

- Damage occurs due to fluctuations in temperature
- Growth has begun and plant tissues are not as hardy
- Critical temperatures are for plant exposure for 30 minutes
- Type of freeze can play into this





TWO TYPES OF FREEZES:

Advective

Occur when cold (and often) dry air blow into a region.

Usually windy.

Difficult to manage.

Radiative

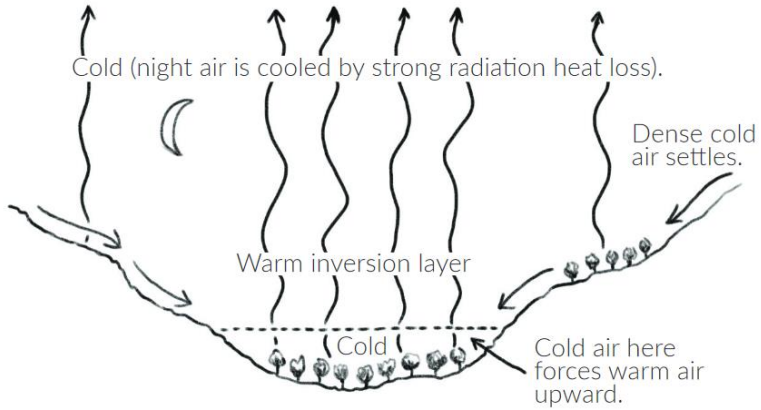
Occur when clear, calm conditions occur which allow heat to escape out into space.

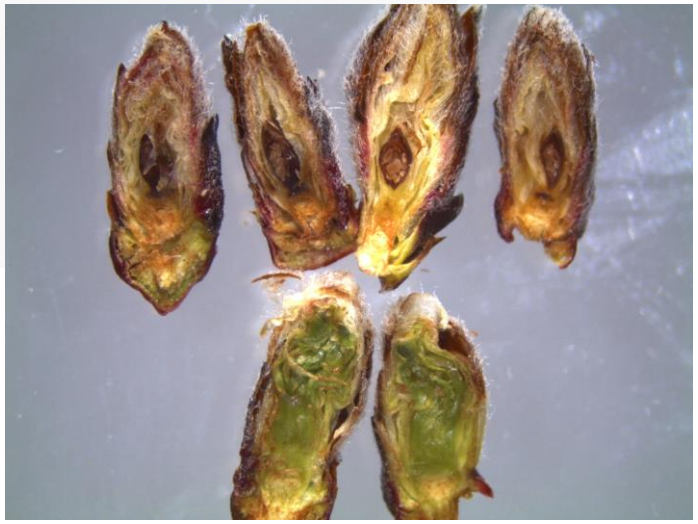
Frequently coupled with inversion.

Management is possible to an extent

COLD PROTECTION IN SPRING

- Wind machines/helicopters
- Orchard heaters
- Covering individual trees
- Freezing water
- Plastic mulches
  - May raise temperature by a few degrees **if** not covered with snow





SPRING DAMAGE

Eco-dormancy

- Damage occurs on buds, leaves, and fruit
  - Fruit loss (bud damage)
  - Russeting
  - Frost rings
  - Buttoning (can be genotype specific – 'Loring' relatives more prone)
  - Malformed or marred leaves and fruit
- The more open the buds are the more susceptible they are to cold injury
- Critical temperatures vary for fruit types and bloom stage (30 min.)

Critical Temperatures for Frost Damage on Fruit Trees

Marion Murray, IPM Project Leader

The following table, developed by Washington State University, lists Fahrenheit temperatures for each stage of development at which 10% and 90% bud kill occurs after 30 minutes exposure. The percentage bud kill which causes crop reduction will vary with each crop. For example, to have a full crop of cherries requires well over 50% bud survival in most years, while apples, pears, and peaches may only need 10-15% bud survival.

APPLE

	Silver Tip	Green Tip	Half-Inch Green	Tight Cluster	First Pink (Pink)	Full Pink (Open Cluster)	First Bloom (King Bloom)	Full Bloom and Post-bloom
10%	15	18	23	27	28	28	28	28
90%	2	10	15	21	24	25	25	25

PEAR

	Swollen Bud (Scale Separation)	Bud Burst (Blossom Buds Exposed)	Green Cluster (Tight Cluster)	White Bud (First White, Popcorn)	Full White	First Bloom (King Blossom)	Full Bloom	Petal Fall (Post-bloom)
10%	15	20	24	25	26	27	28	28
90%	0	6	15	19	22	23	24	24

APRICOT







	First Swell (Bud Swell)	Tip Separation (Swollen Bud)	First White	First Bloom	Full Bloom	In the Shuck (Petal Fall)	Shuck Split (Post-bloom)
10%	15	20	24	25	27	27	28
90%	---	0	14	19	22	24	25

CHERRY







SWEET	Swollen Bud (First Swell)	Bud Burst (Green Tip)	Tight Cluster	White Bud (First White, Popcorn)	First Bloom	Full Bloom	Post-bloom
10%	17	25	26	27	28	28	28
90%	5	14	17	24	25	25	25
TART							
10%	15	26	26	28	28	28	
90%	0	22	24	24	24	25	

PEACH NECTARINE







	Swollen Bud (First Swell)	Calyx Green	Quarter-Inch Green (Calyx Red)	Pink (First Pink)	First Bloom	Full Bloom	Post-bloom
10%	18	21	23	25	26	27	28
90%	1	5	9	15	21	24	25

PLUM	Swollen Bud	Side White	Green Tip	Tight Cluster	First White	First Bloom	Full Bloom	Post-bloom
10%	14	17	20	24	26	27	28	28
90%	0	3	7	16	22	23	23	23

TAKE AWAYS

- Take good care of your trees
- Prevent stress when possible
- Avoid late season fertilization and pruning
- Utilize resources to warm environment around plants when possible
- Sometimes it is beyond our control…

Questions?

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