Irrigation, IPM, Paint and More: Tactics for Greater Resilience in Iowa Apple Orchards

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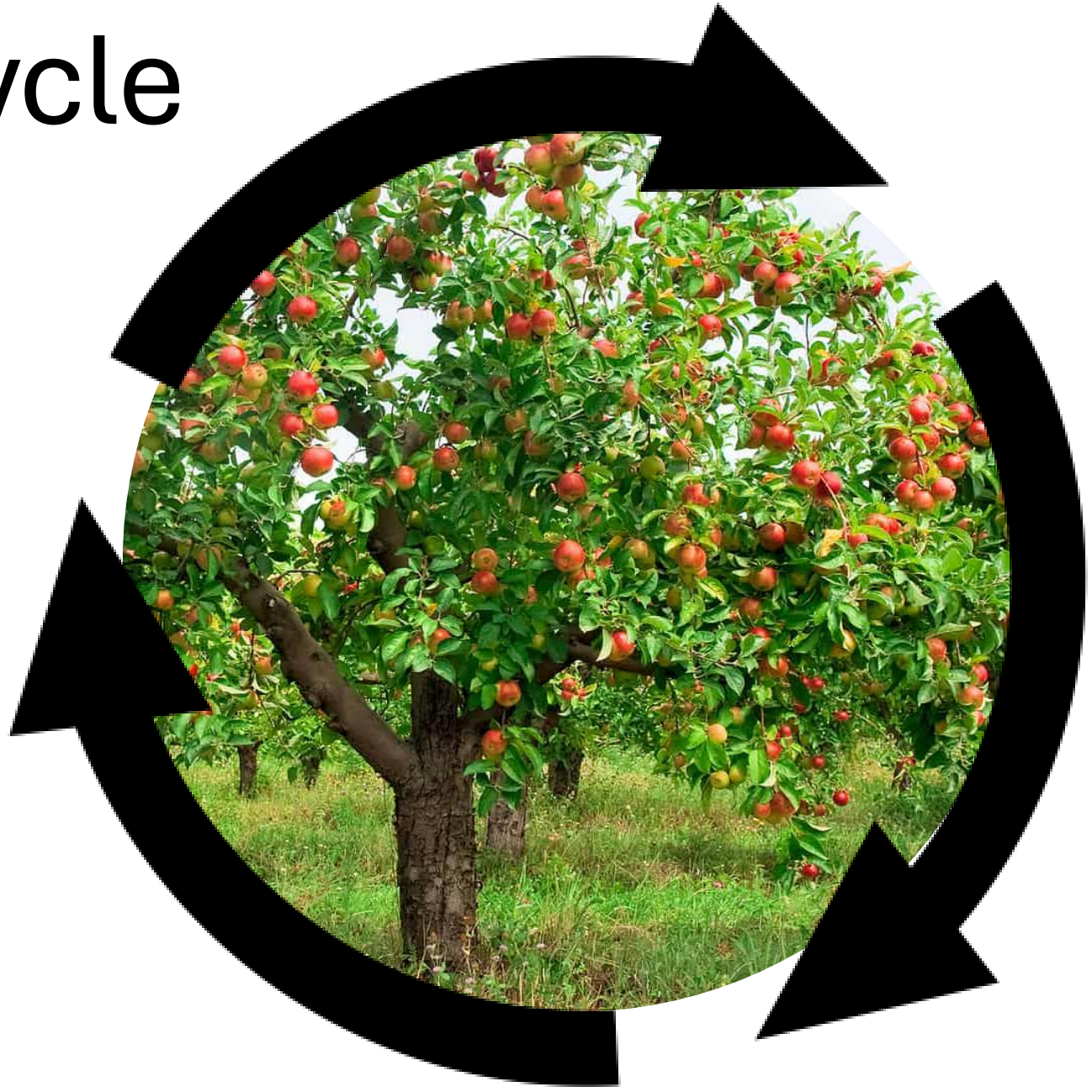
Talk Outline

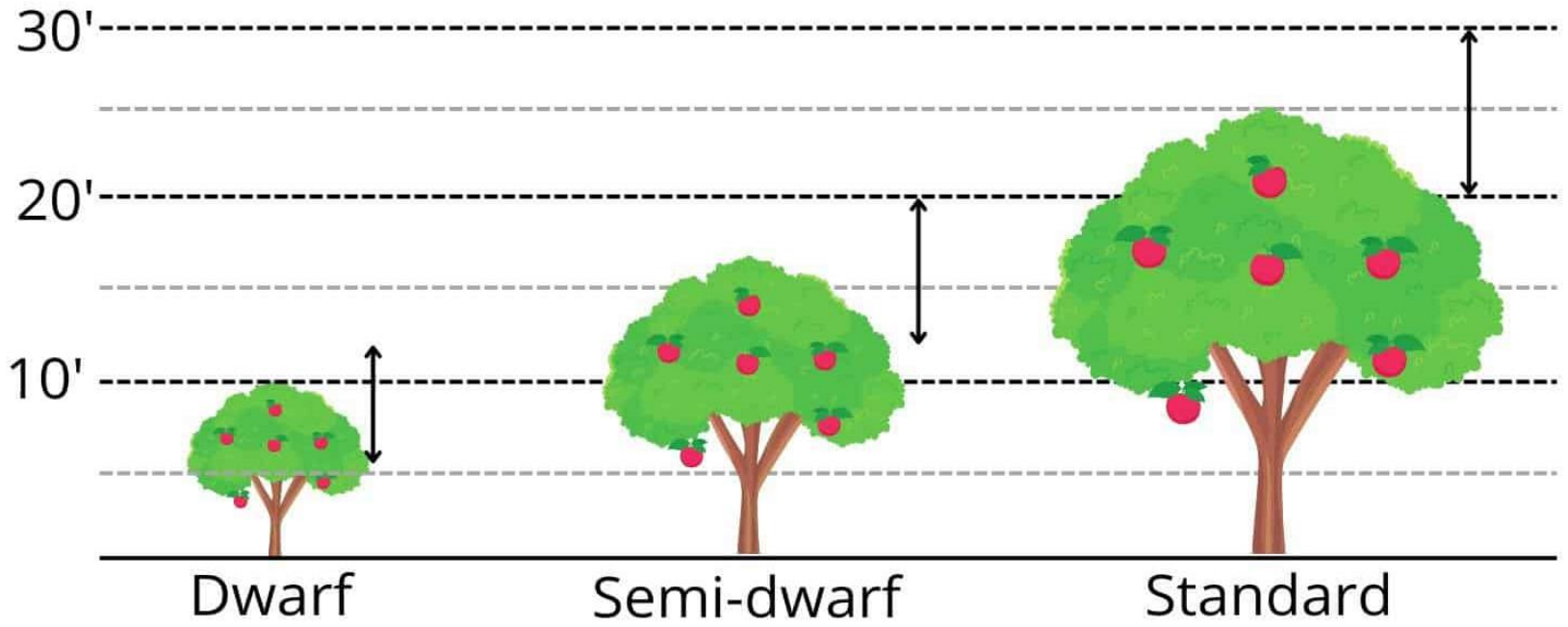
1. Orchard life cycle

2. Weather Dynamics and Apple Trees

3. Management for Resilience

Orchard Life Cycle

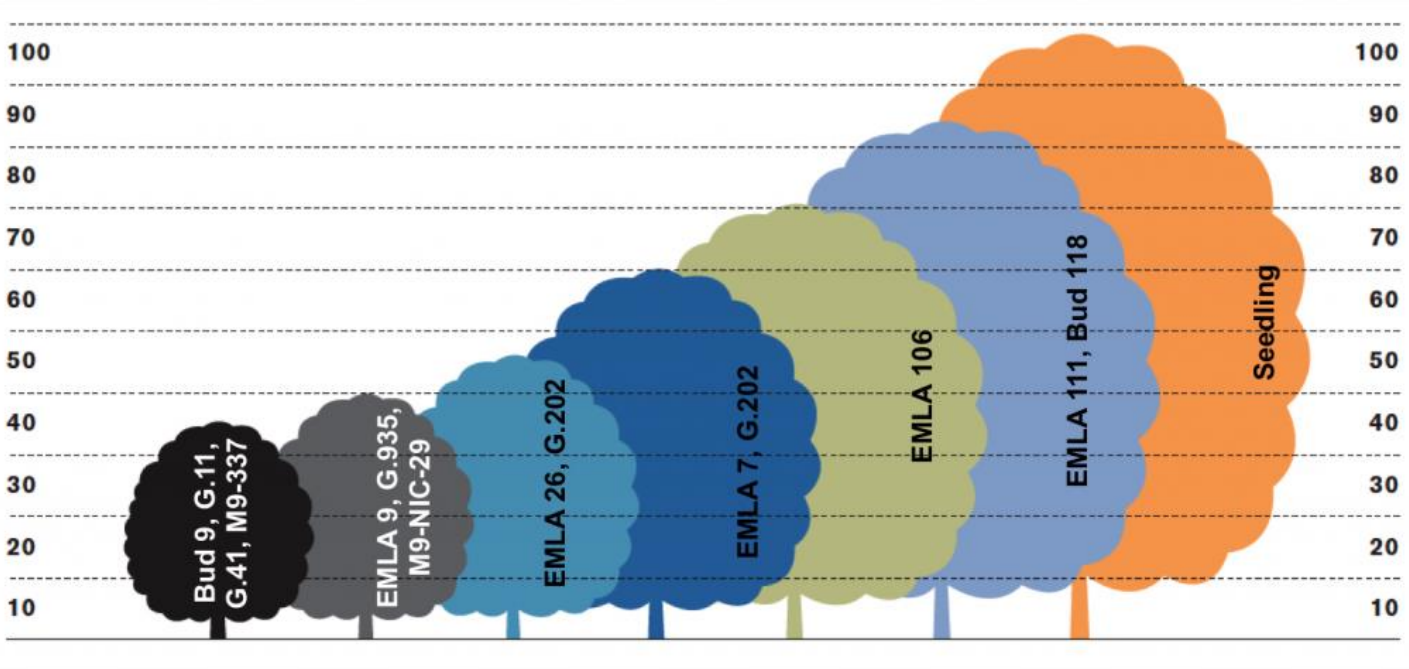




Smaller tree → earlier fruit
→ shorter lifespan
(15-20 years)

Larger tree → later fruit
→ longer lifespan
(30-60+ years)

Rootstock influence

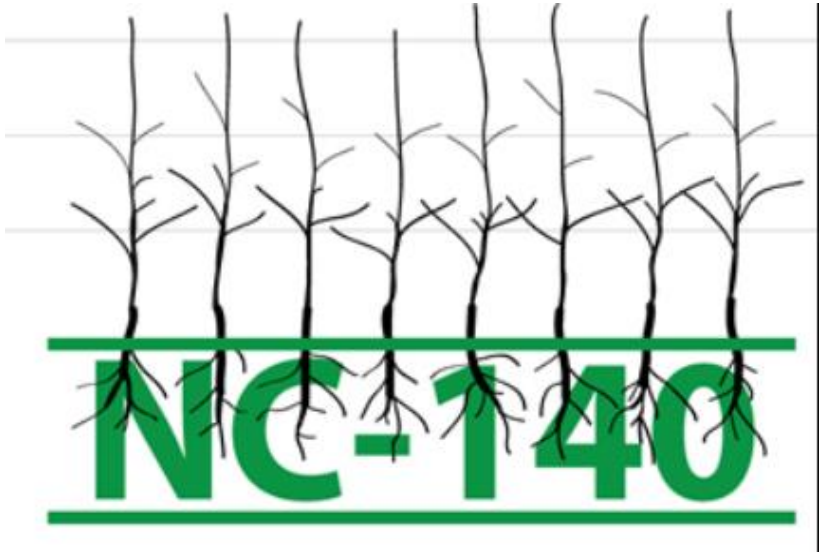


- ✓ Size
- ✓ Bearing time
- ✓ Nutrient/H20 uptake/efficiency
- ✓ Cold tolerance
- ✓ Pest/pathogen resistance
- ✓ Graft union strength (B.9)

Image credit: WSU

NC-140 Regional Research Project

- ✓ **Fruit tree performance**
- ✓ **Develop/acquire genetically-improved rootstocks**
- ✓ **Resilience to biotic/abiotic stressors**
- ✓ **Accelerate adoption**
- ✓ **Disseminate information**



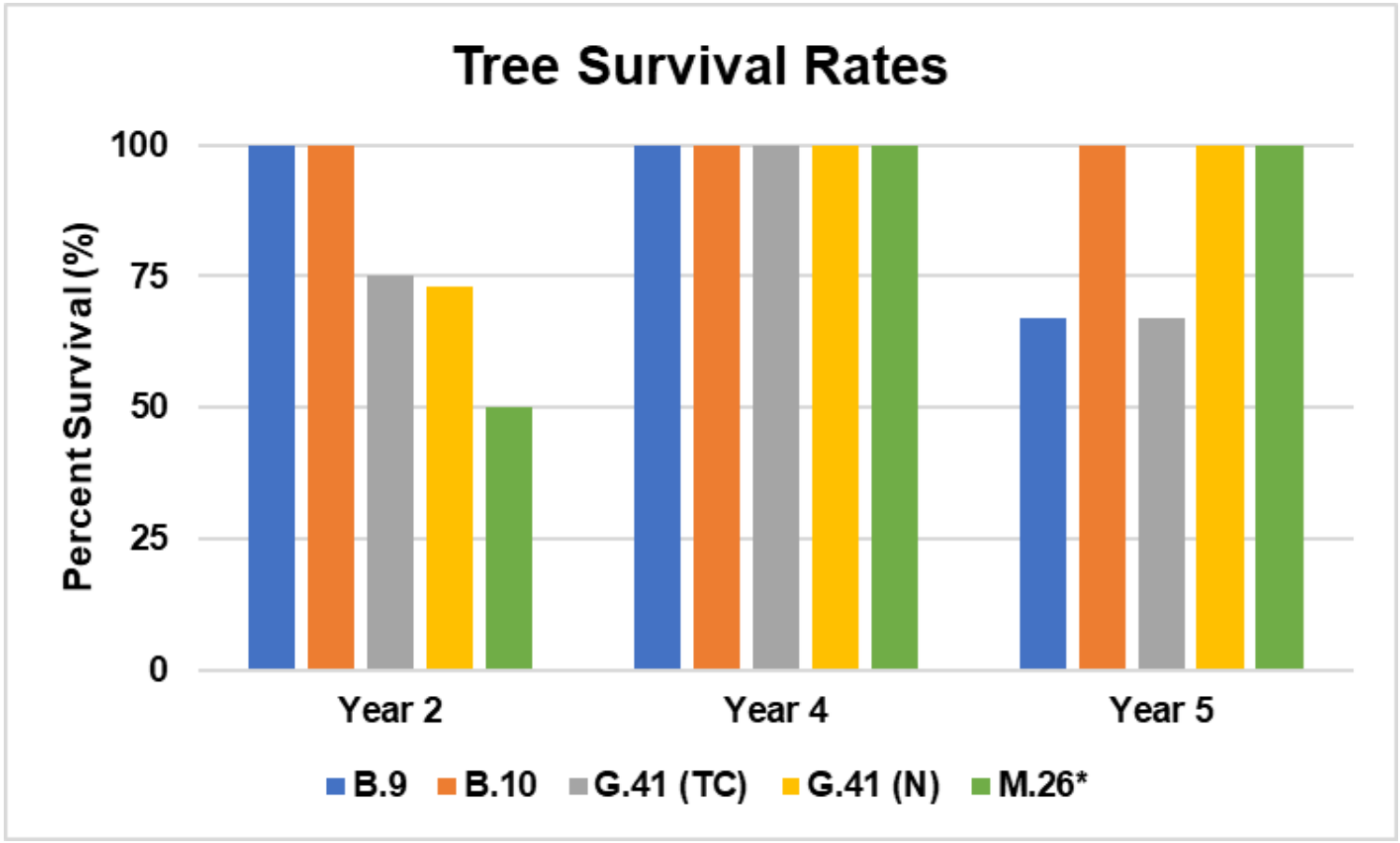
2010 Honeycrisp Trial

Spacing: 4 ft X 14 ft

Training and Support: Tall Spindle

Rootstocks: B.9, B.10, B.7-3-150, B.7-20-21, B.67-5-32, B.64-194, B.70-6-8, B.70-20-20, B.71-7-22, G.11, G.41 N, G.41 TC, G.202 N, G.202 TC, G.935 N, G.935 TC, CG.2034, CG.3001, CG.4003, CG.4004, CG.4013, CG.4214, CG.4814, CG.5087, CG.5222, PiAu 51-11, PiAu-9-90, Supporter 3, M.26 EMLA, M.9 Pajam2, M.9 NAKBT337

2010 Honeycrisp Trial



N = nursery (stool bed propagation)

TC = tissue culture propagation

* = ‘industry standard’

2010 Honeycrisp Trial ‘Summary’

- **Year 2: high winds caused union breakage (lower survival rates for G.41 [dwarfing], M.26 [semi-dwarfing])**
- **Year 4: drought and persistent cold temps (good survival rates)**
- **Year 5: another year or record low temps (lower survival rates for B.9 [dwarfing], G.41 [TC/dwarfing]) – accumulation of ‘stressors’ over years**

Orchard longevity vs. consumer preference longevity (~20 years)

Red Delicious

Honeycrisp

Red Delicious

Most popular in US in 1940’s

Red Delicious fell out of favor (shifts to Gala, Fuji, HC; Gala overtook US sales in 2018)

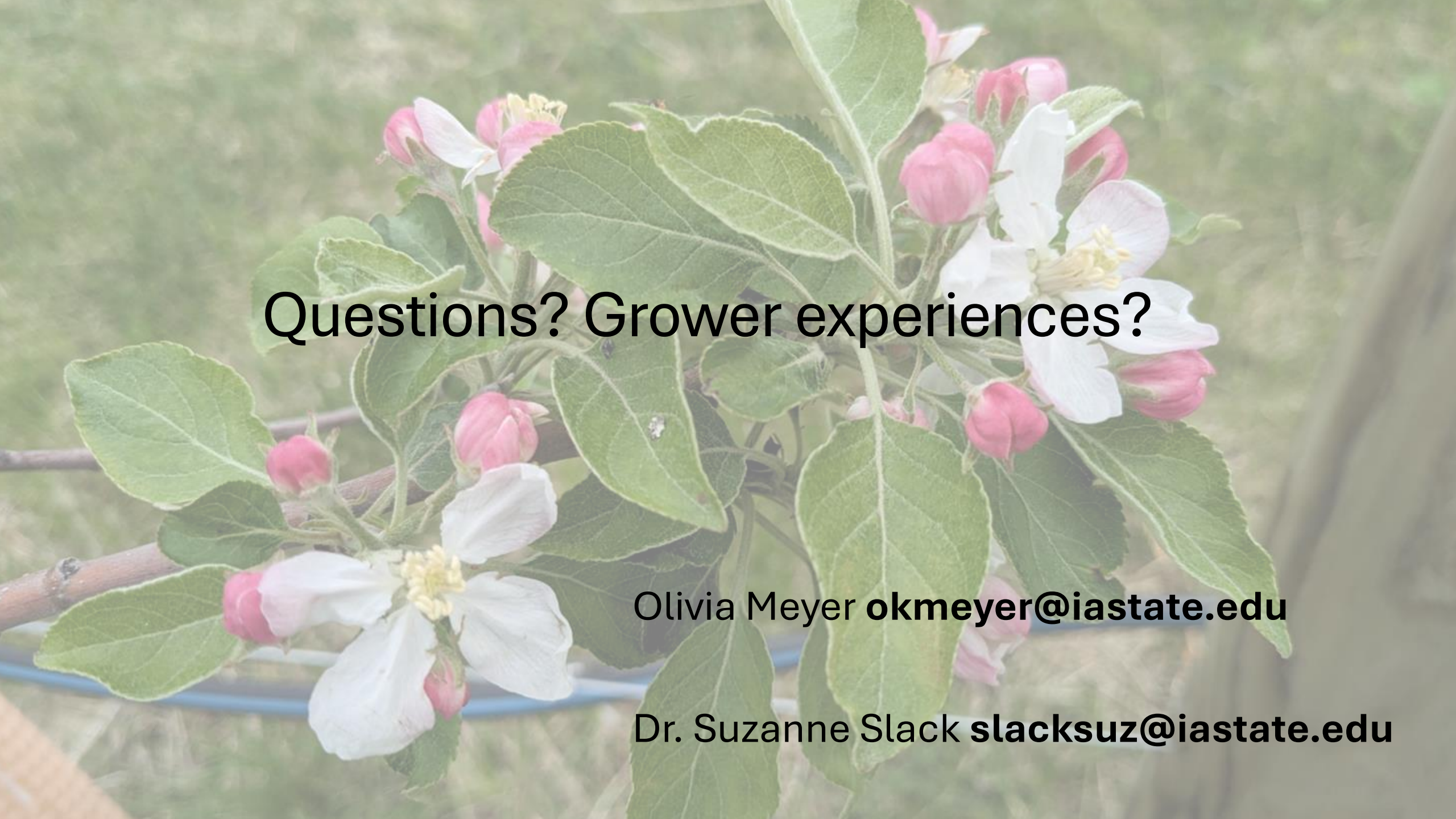
1990’s government bailout (Washington, largest in history for apple industry)

Honeycrisp

High consumer preference

Developed in MN (1960's) to tolerate cold temps

Management heavy (bitter pit, high sensitivity to chilling post-harvest)



Questions? Grower experiences?

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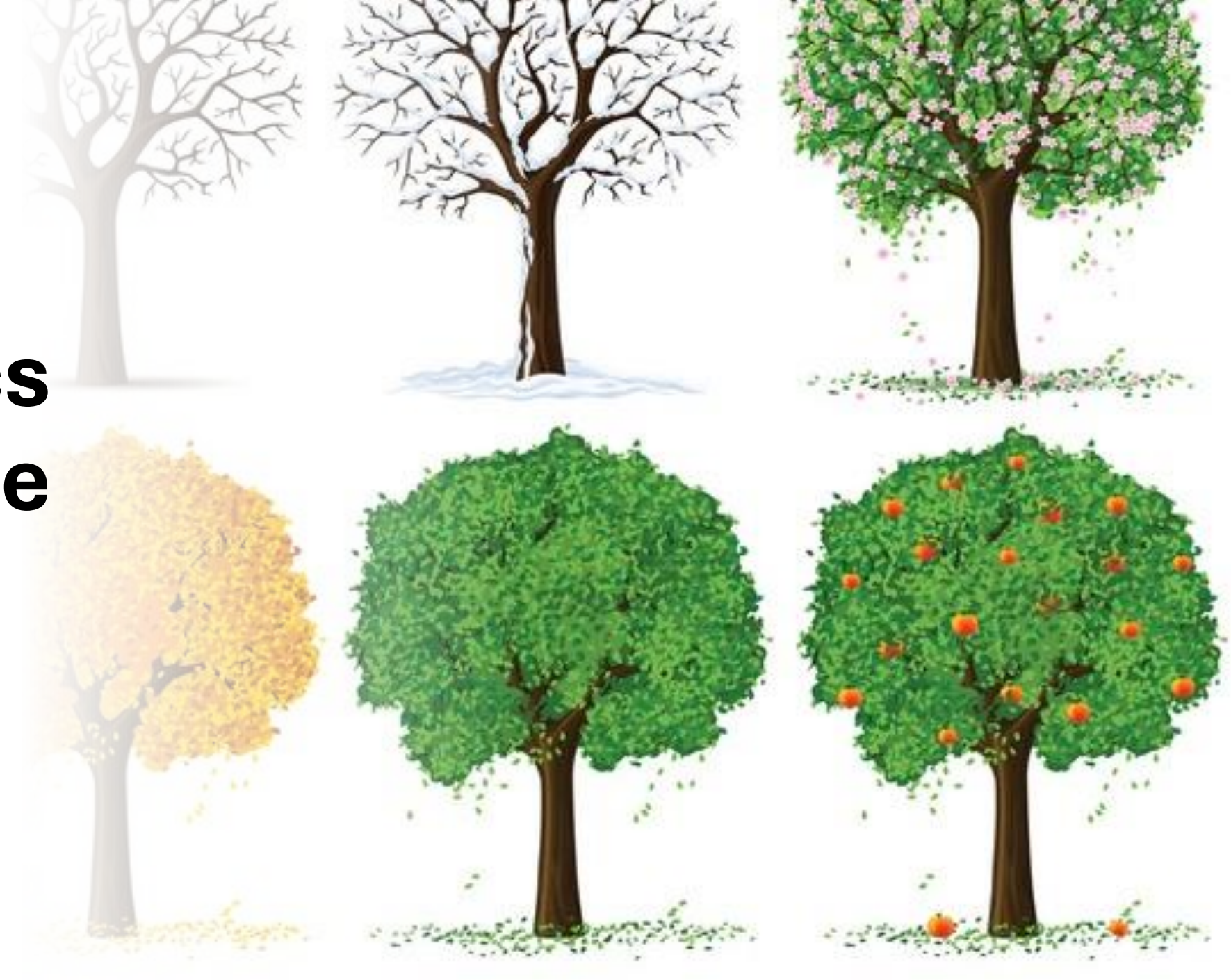
Dr. Suzanne Slack **slacksuz@iastate.edu**

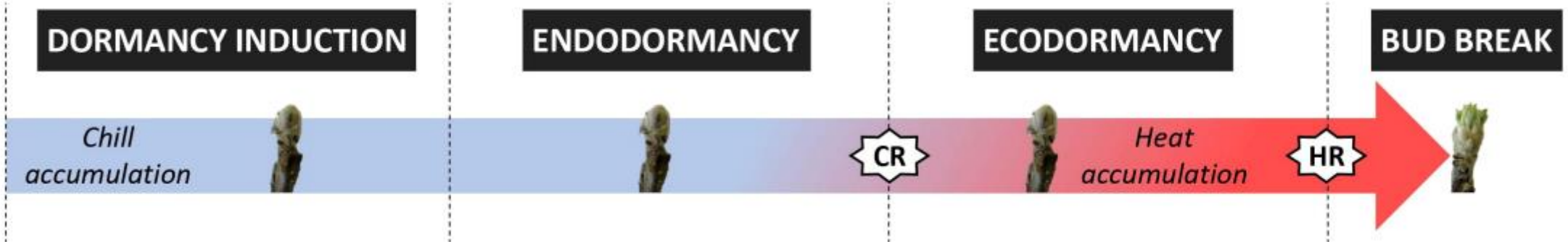
Weather Dynamics and Apple Trees



Dormancy

Physiological survival mechanisms – trees stop growth and remain inactive during winter to protect tissues

Chilling requirements (overcome dormancy): 700/800-1000+ (variable between cultivars—some as low as 450 but cold hardiness issue)



Chilling hours aren’t met before spring?

Uneven vegetative development

Bud abortion

Delayed/extended flowering period

Poor fruit set

Reductions in yield

Cold temp range

Lower bound temperatures for chilling requirements are dependent on models

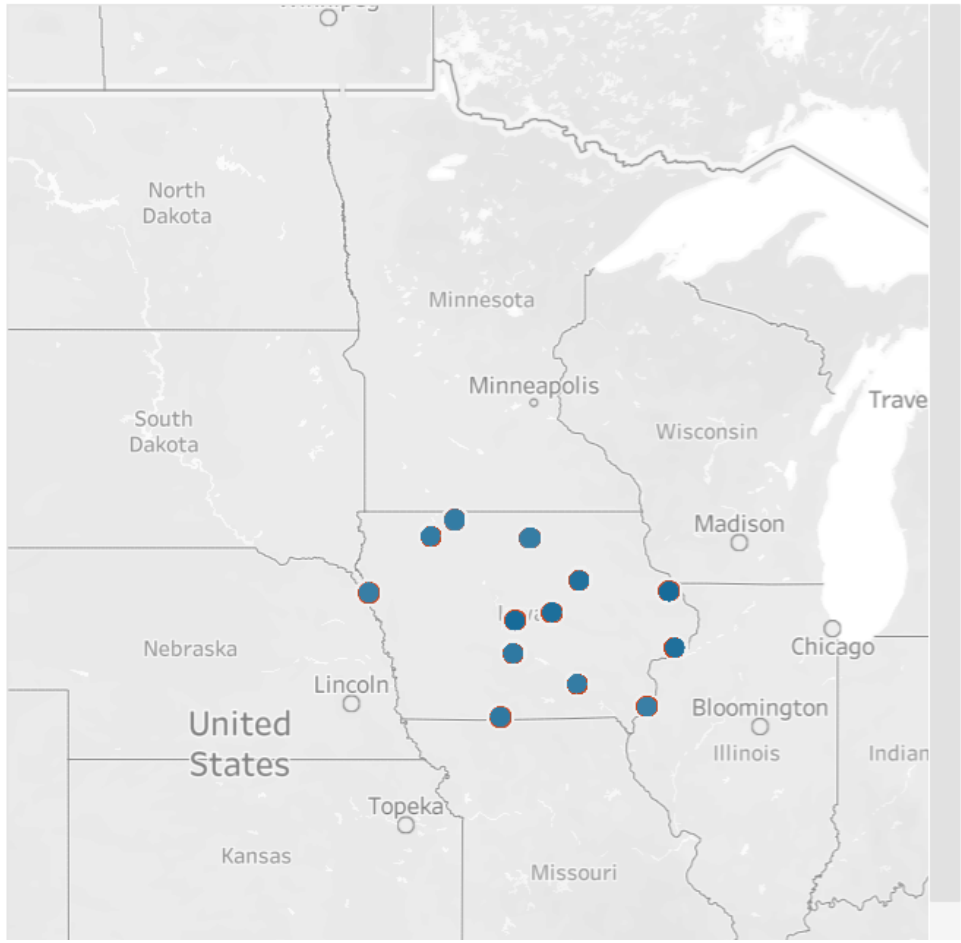
Anything lower than the lower bound temperature doesn’t contribute to accumulation of chilling (ergo not considered for ‘hours’)

Map of Chilling Hour Accumulation

Click on station dot to see accumulation

Chilling Hour Accumula...

0 744



First, select state(s).

IA

Then, select lower-bound and upper-bound temperatures and

Lower-Bound Temperature (°F)

Must be less than Upper-Bound Temper...

32

Upper-Bound Temperature (°F)

Must be greater than Lower-Bound Tem...

45

Start Date

Must be on or after July 1st in a July 1st ...

7/1/2024

End Date

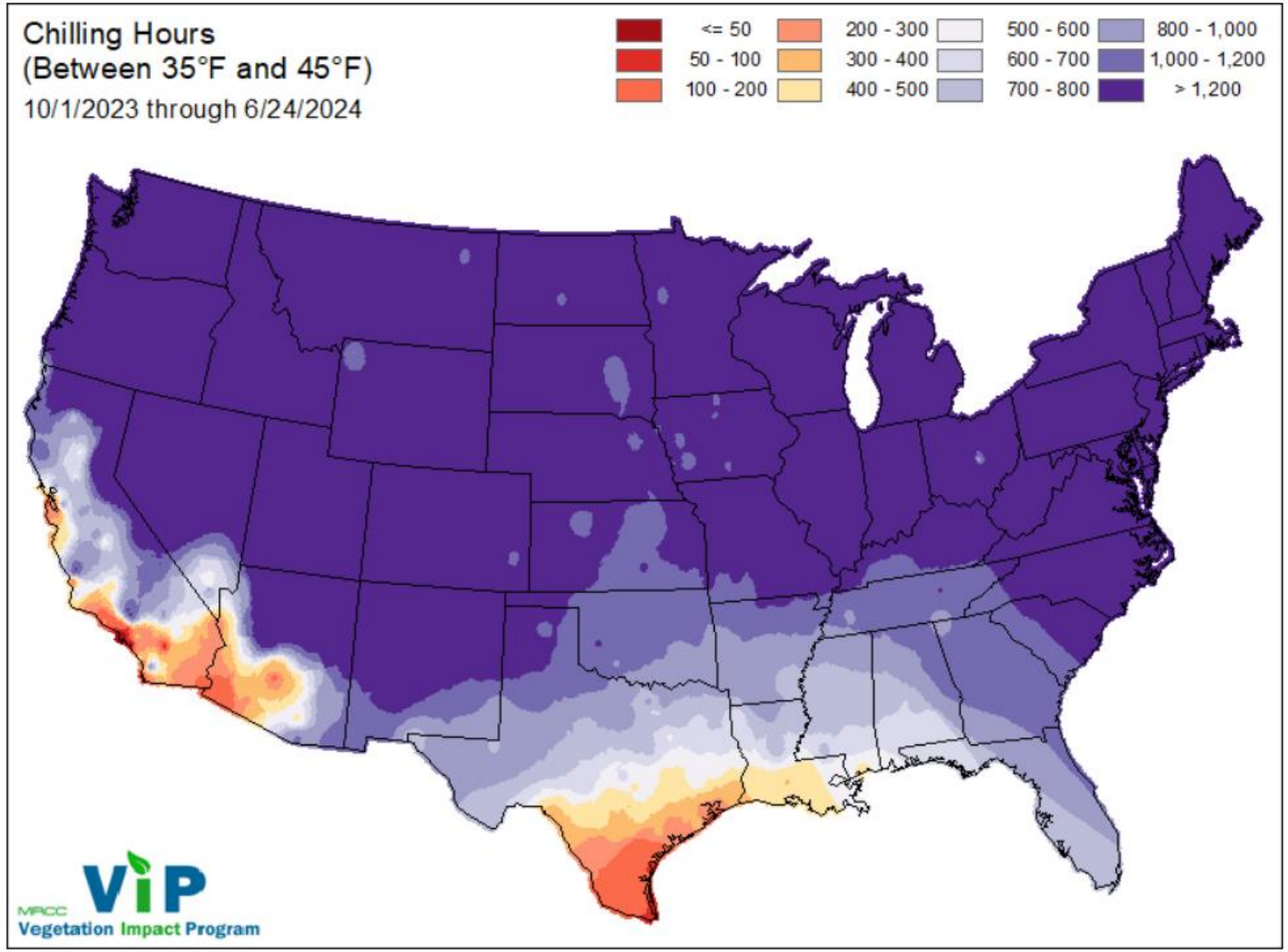
Must be on or before the next June 30th ...

1/21/2025

MRCC

USDA Climate Hubs
U.S. DEPARTMENT OF AGRICULTURE

NOAA


Chilling Hours
(Between 35°F and 45°F)
10/1/2023 through 6/24/2024
<= 50
50 - 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 600
600 - 700
700 - 800
800 - 1,000
1,000 - 1,200
> 1,200
MPCC
ViP
Vegetation Impact Program

Frost

Formation of ice crystals on surfaces when surface temps drop below 32 F (air temp can be above 32 F)

Freeze

Air temps drop below 32 F (can occur without visible frost on surfaces)

Winter

- Prolonged freezes can cause tissue damage, particularly in less cold-hardy cultivars
- Freeze damage to dormant trees is typically minimal unless temps drop significantly below hardiness threshold

Spring

- Frost and freeze events during bud break, flowering, or early fruit set:
  - Bud/blossom damage
  - Reduced fruit set/yield
  - Visible damage (water-soaked, black tissue after thawing)

Armistice Day Freeze (11/11/1940)

Strong winds + sharp temperature drop = tree injuries/deaths
(winter storm after warmer temps)

1941 crop was 15% of 1940 crop

Dwindled economic importance in Iowa…

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**

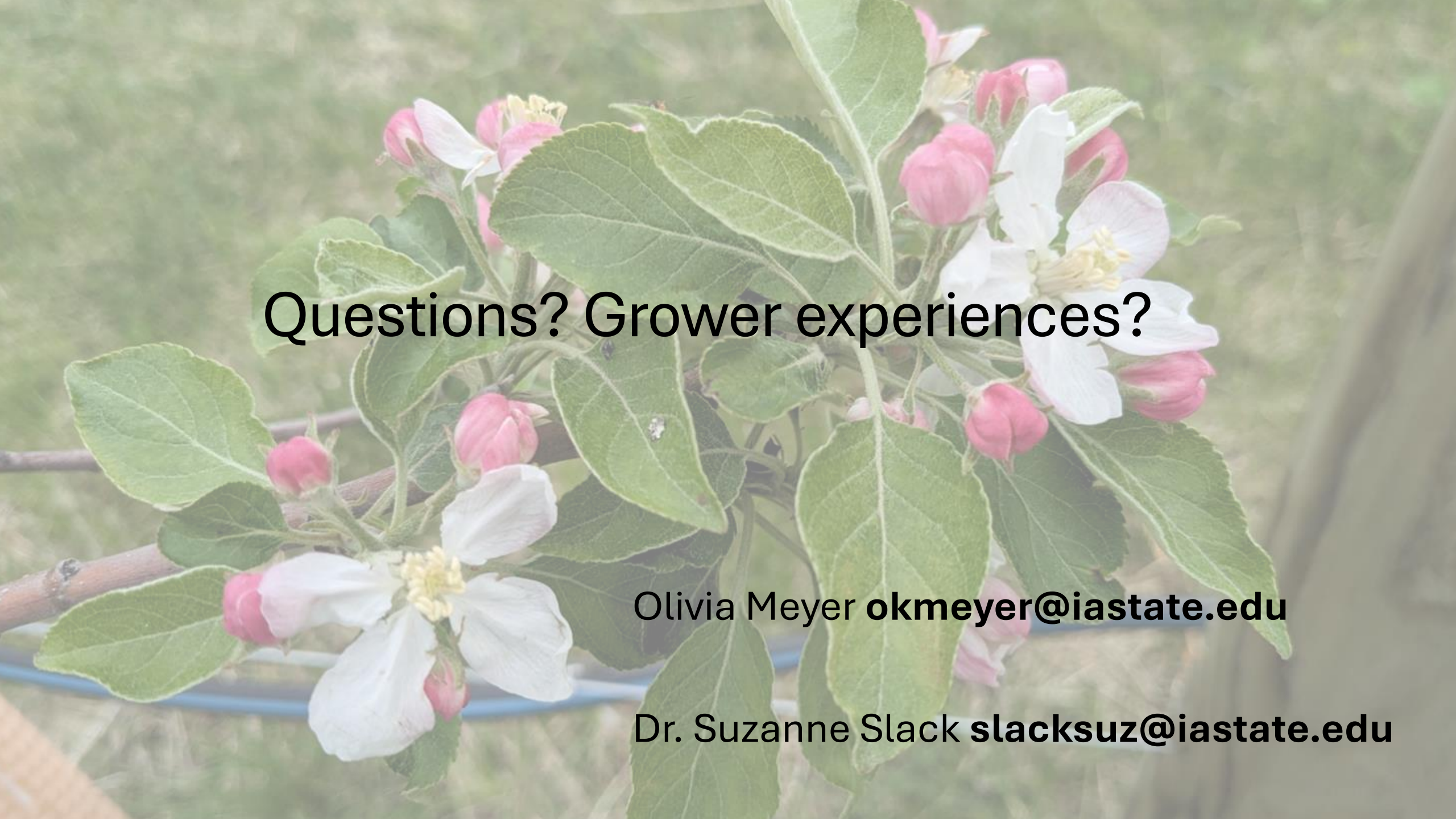
Image credit: Michigan State

Deacclimation and reacclimation

Deacclimation – loss of cold hardiness (temps rise)

Reacclimation – regain cold hardiness (temps lower)

- Challenges in orchards:
  - Increase risk of frost damage
  - Bark cracking/tissue damage



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Management for Resilience

Winter Damage: Sunscald and Cracking

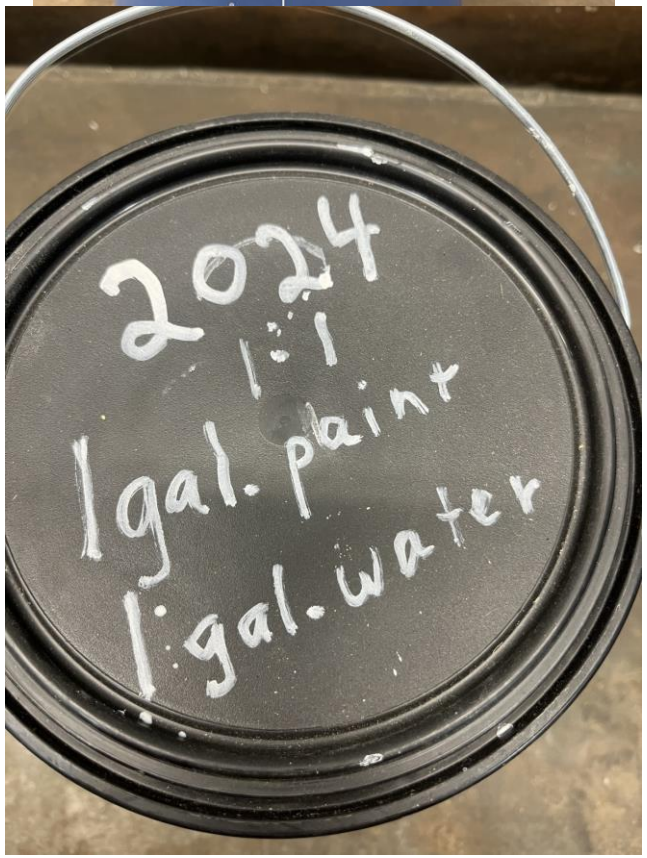
Sun scald

- Elongated areas of dead bark (south, southwest side of trees) – cracked, peeling, exposed wood
- Recently planted, young, thin bark = more susceptible
- During winter, sudden temp changes
  - Tissues warm up in response to direct sunlight (bark deacclimates)
  - Attempt to reacclimate when sun goes down, temps get cold
  - Results in injury

Management

- Latex paint
- Tree may seal or callus over damaged area over time (several years)
  - Avoid callus development, remove dead/loose bark (eliminate hiding spots for insects)
- Avoid ‘wound dressing’ or paint if already cracked
  - Make issue worse
  - Trap moisture/pathogens
  - Influence healing time (slow)
- Maintain tree health and vigor (proper irrigation)


INTERIOR
LUCITE
FLAT
WALL & CEILING PAINT
GOOD COVERAGE & HIDE
WASHABLE & UNIFORM FINISH
COMMERCIAL QUALITY
15 YEAR WARRANTY


2024
1:1
1gal. paint
1:gal. water


MAGNUM
PROJECT PAINTER PLUS
TRUEAIRLESS


POWERRUSH
GENERAC
GP3300i
GENERAC GP3300i

Winter Damage: Rodents

Rodent damage

- Susceptibility to injury, other pests
- Lose moisture
- Chew through tissue layers, disrupt flow of nutrients and water to shoots and roots
- Girdling (partial have chance at recovery, full likely to die)
- Bridge graft to save?

Management

- Latex paint
- Guards (potential for gaps, girdling, material and wood contact issues)
- If mulching, don’t put at the base of the tree (avoid contact)
- Baits/traps
- Maintain clean orchard floor


FARM & RANCH
WITH
BROMADIOLONE
HAWK
All-Weather
BAIT CHUNX
KILLS RATS, MICE & MEADOW VOLES
CAUTION
W10442

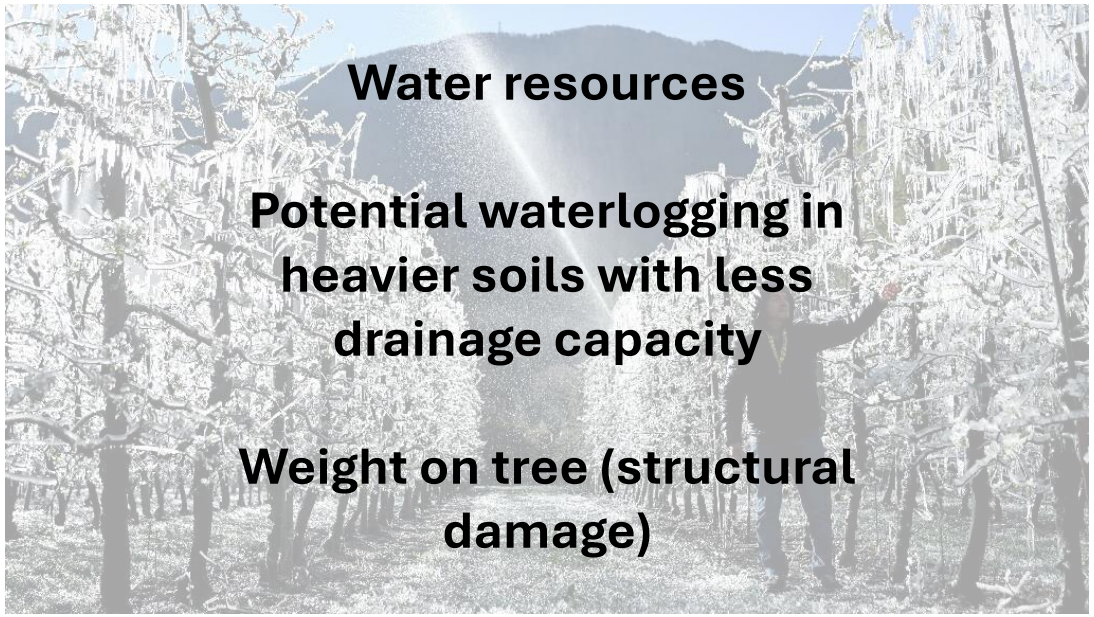
Frost Protection Tech Options

Sprinkler Irrigation

Wind Machines

Frost Protection Tech Options

Sprinkler Irrigation

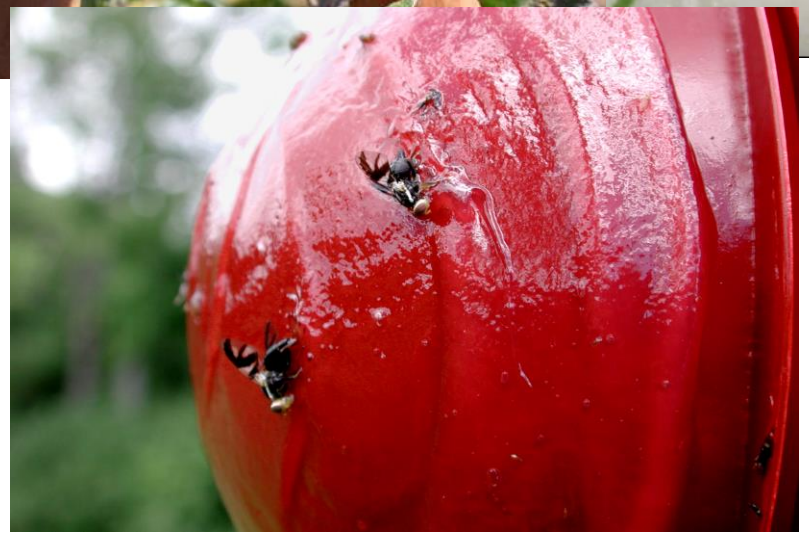


Wind Machines

Viruses in Orchards

- Systemic infection
- Spread through vectors, mechanical, infected stock
- Chronic issues, symptoms may not be obvious right away – infection necessitates removal of entire tree/orchard block
- No chemical treatments/sprays – preventative (not curative) management
  - Quarantine measures
  - Sanitation
  - Certified virus-free stock

IPM Practices



Hail netting
Soil testing
Rotate modes of action
Mating disruption
Products like Bt (biologicals)
Resistant cultivars
Maintaining orchard floor

Intercropping

→Risk to pollinators

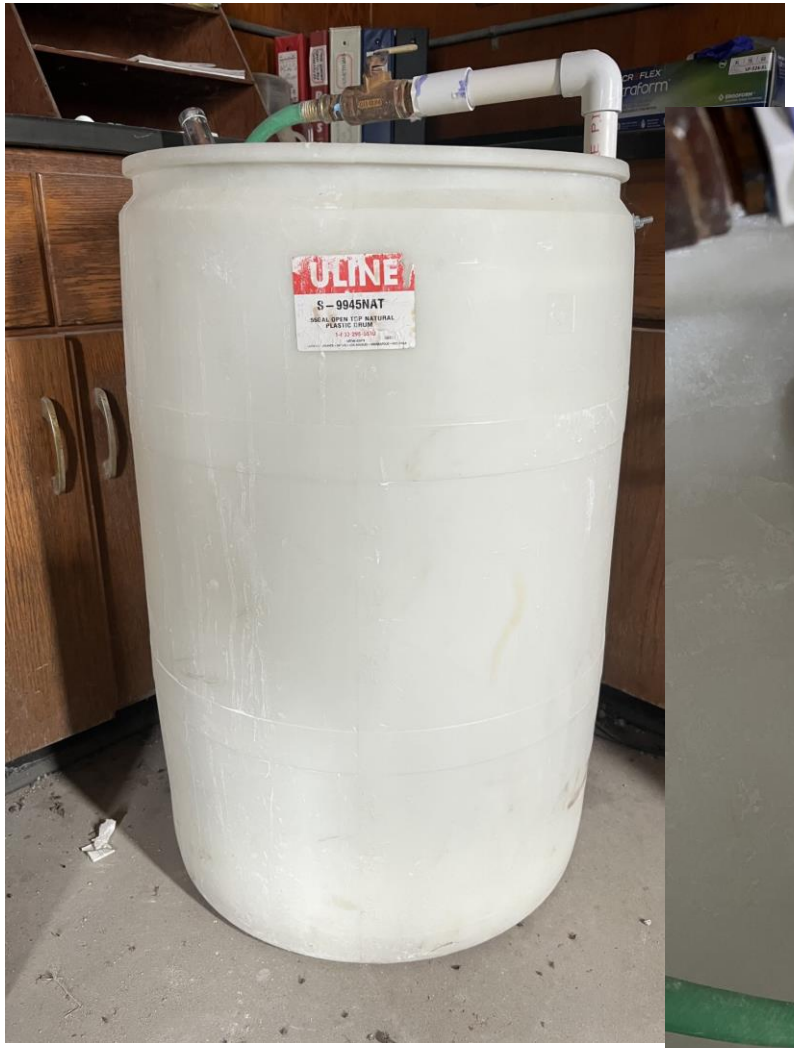
→Rodent/pest habitat

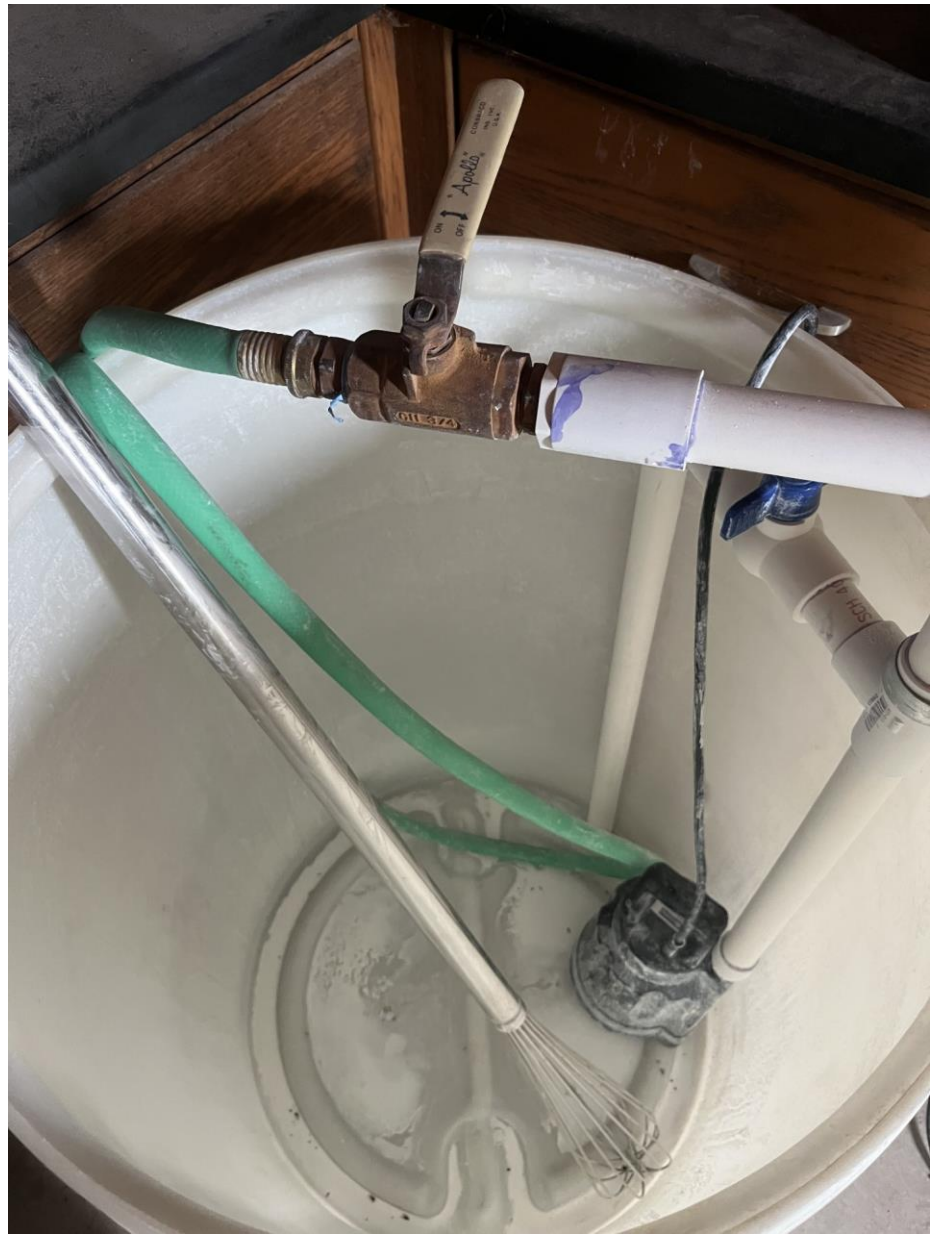
→Additional labor

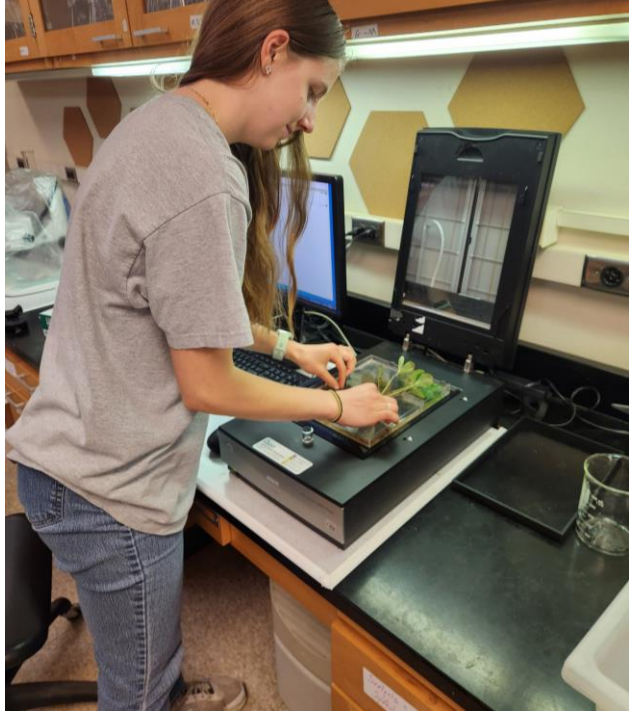
→Bio-predator numbers

Kaolin Clay

Pros	**‘Cons’iderations**
Physical barrier/irritant (chewing insects and fungal spores)	Frequent reapplication (labor and costs associated with)
Non-toxic and environmentally friendly (IPM compatible)	Residue on fruit
Reduce risk of sunburn (reflective)	Not ‘broad spectrum’, limited efficacy with heavy infestations

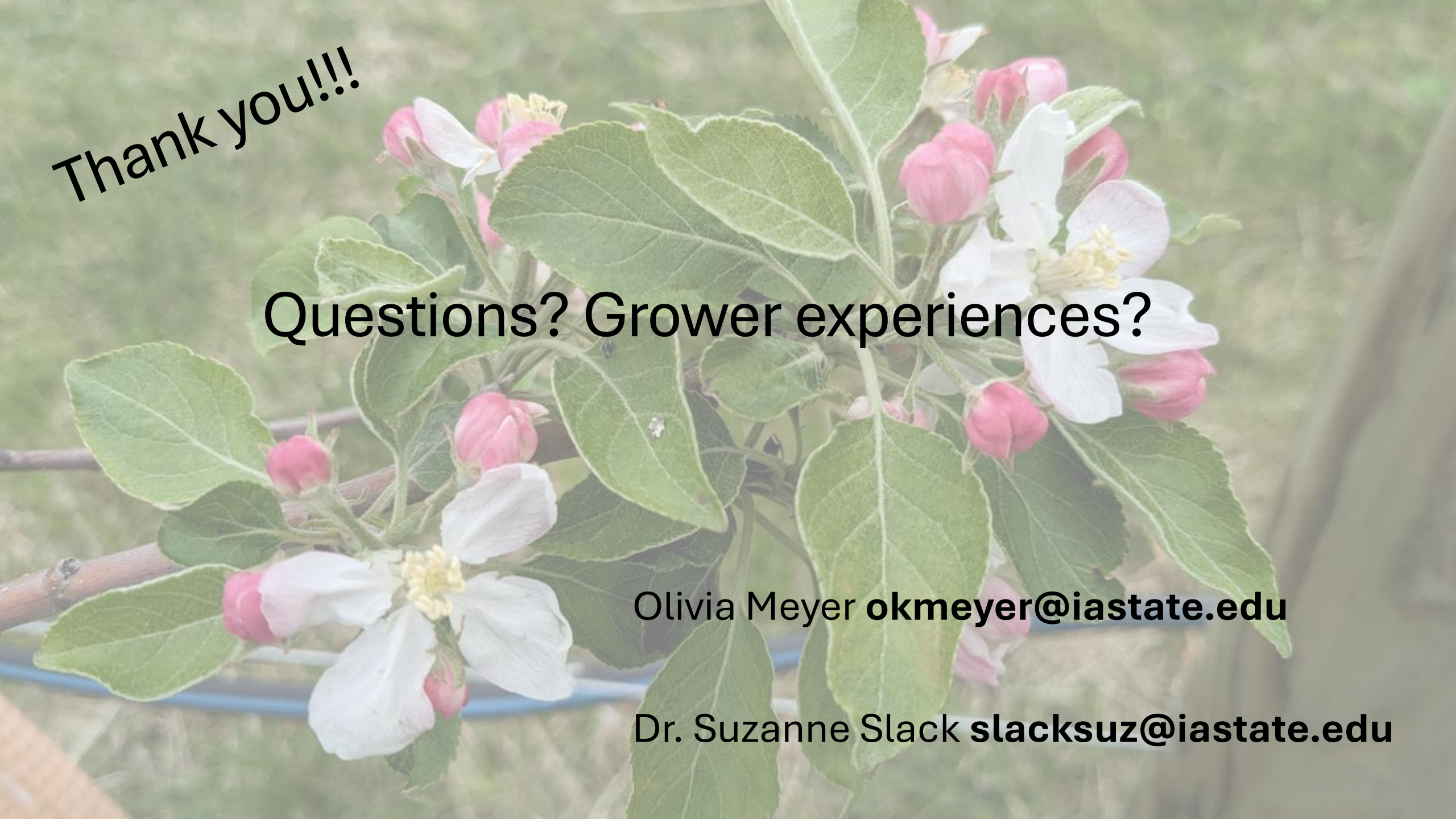

ULINE
S-9945NAT
55GAL OPEN TOP NATURAL
PLASTIC DRUM





Integrated Fruit Health Research Group at Iowa State University

Dr. Xiaochen Yuan
Dr. Suzanne Slack
Olivia Meyer
Brooke Dietsch



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