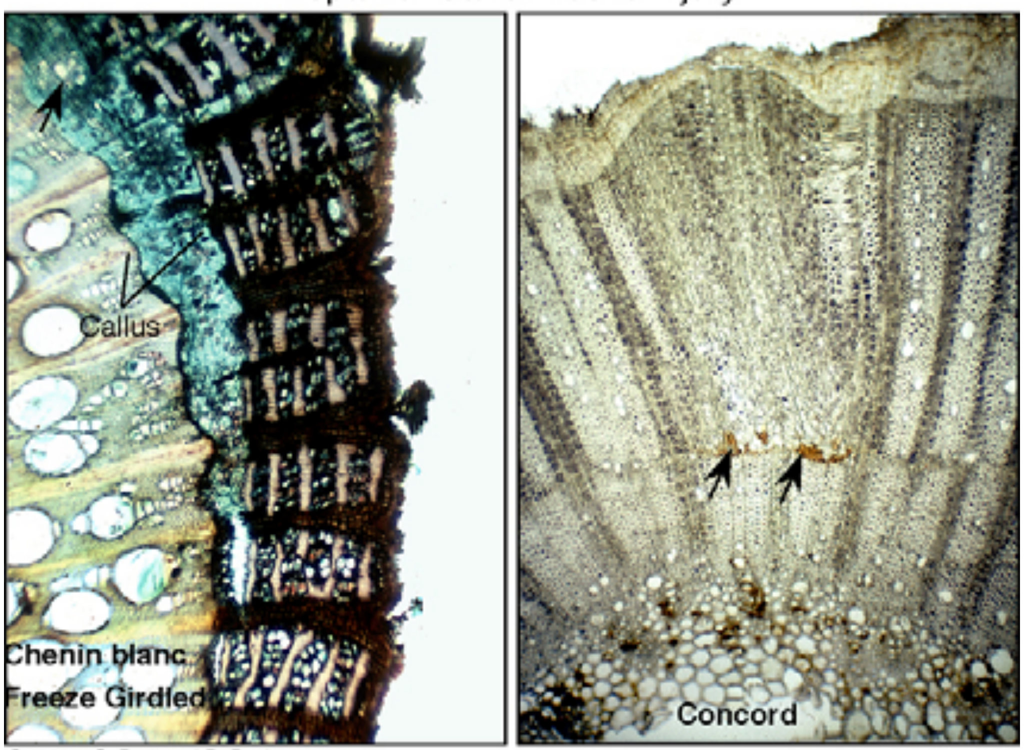
Repair following freeze events…

- Cells are compartmentalized and have unique functions- freeze disrupts organized processes
- Dead cells and tissues **are not** capable of repair
- Specific cell types in adjacent tissues can become meristematic
- Cambium activity is dependent upon signals from growing shoots
- Differentiation, reorganization and replacement takes **time**

Repair of Cane Freeze Injury



Courtesy C. Pratt and R. Pool

Goffinet, 2004

Thank you for your attentio

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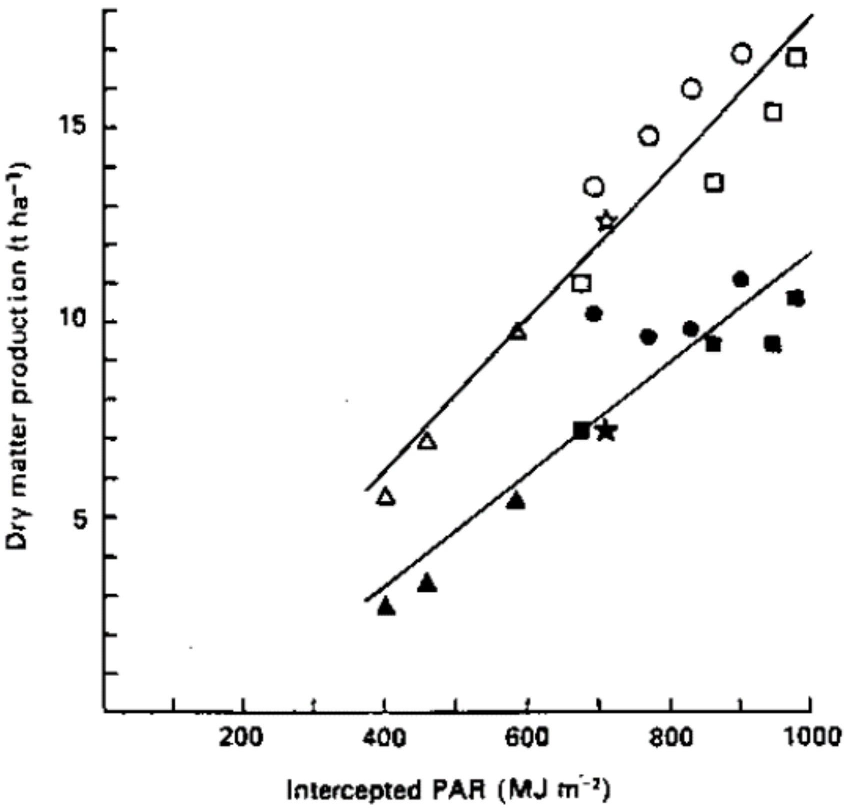
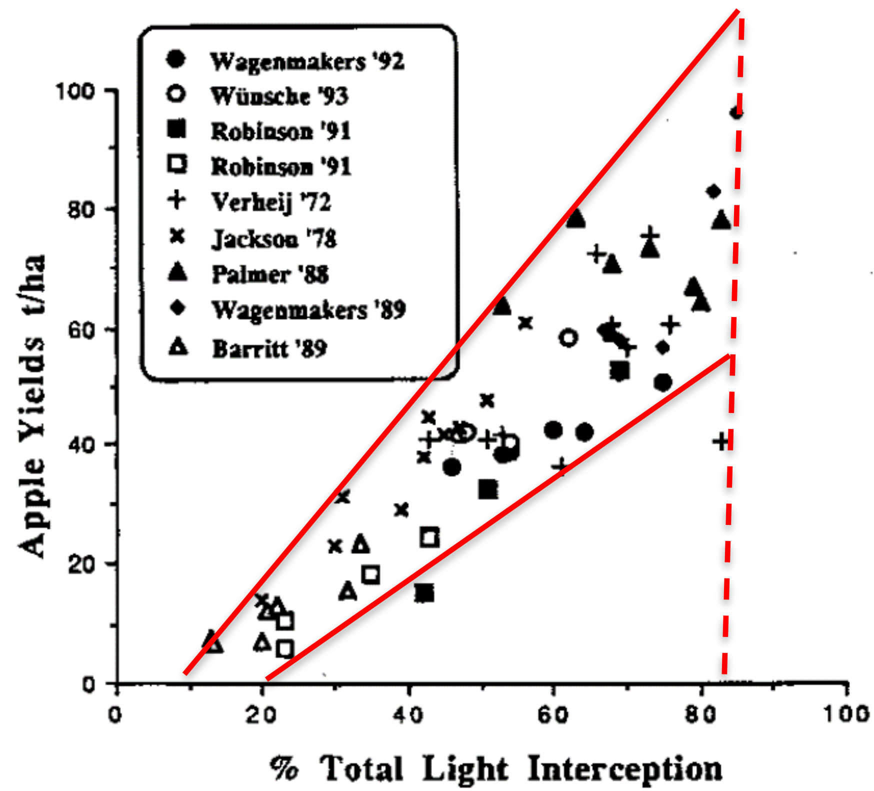
Dane Klindt (Commercial collaborator, Dufur, OR)
Dr. David Gibeaut, Amboise Sarret (MS) and Laura Hillmann (PhD candidate)
(Experimental data)
Janet Turner (Technical support)
Oregon Sweet Cherry Commission &
Washington Tree Fruit Research Commission
(Project funding)

The basis for modern orchard production is the relationship between light and yield

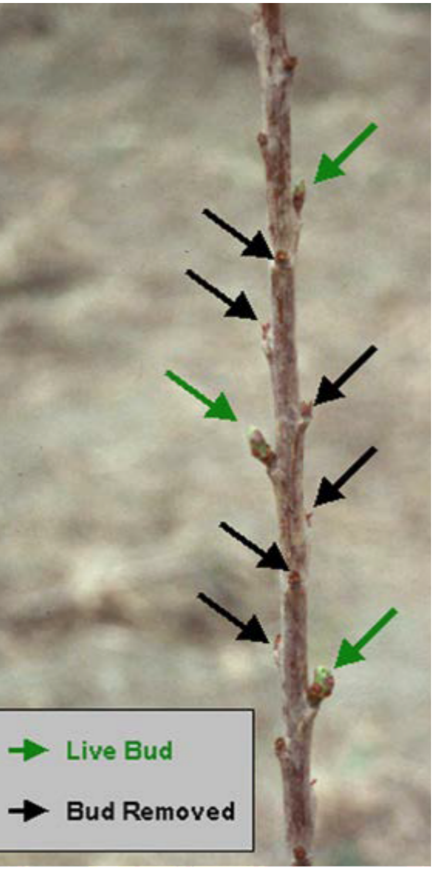




Lakso, 1994

Early yield and return on investment are directly related to tree density, fruiting units and light interception

Branch Initiation Techniques: Future Fruiting Units



Bud Removal

Notching, girdling

PGRs

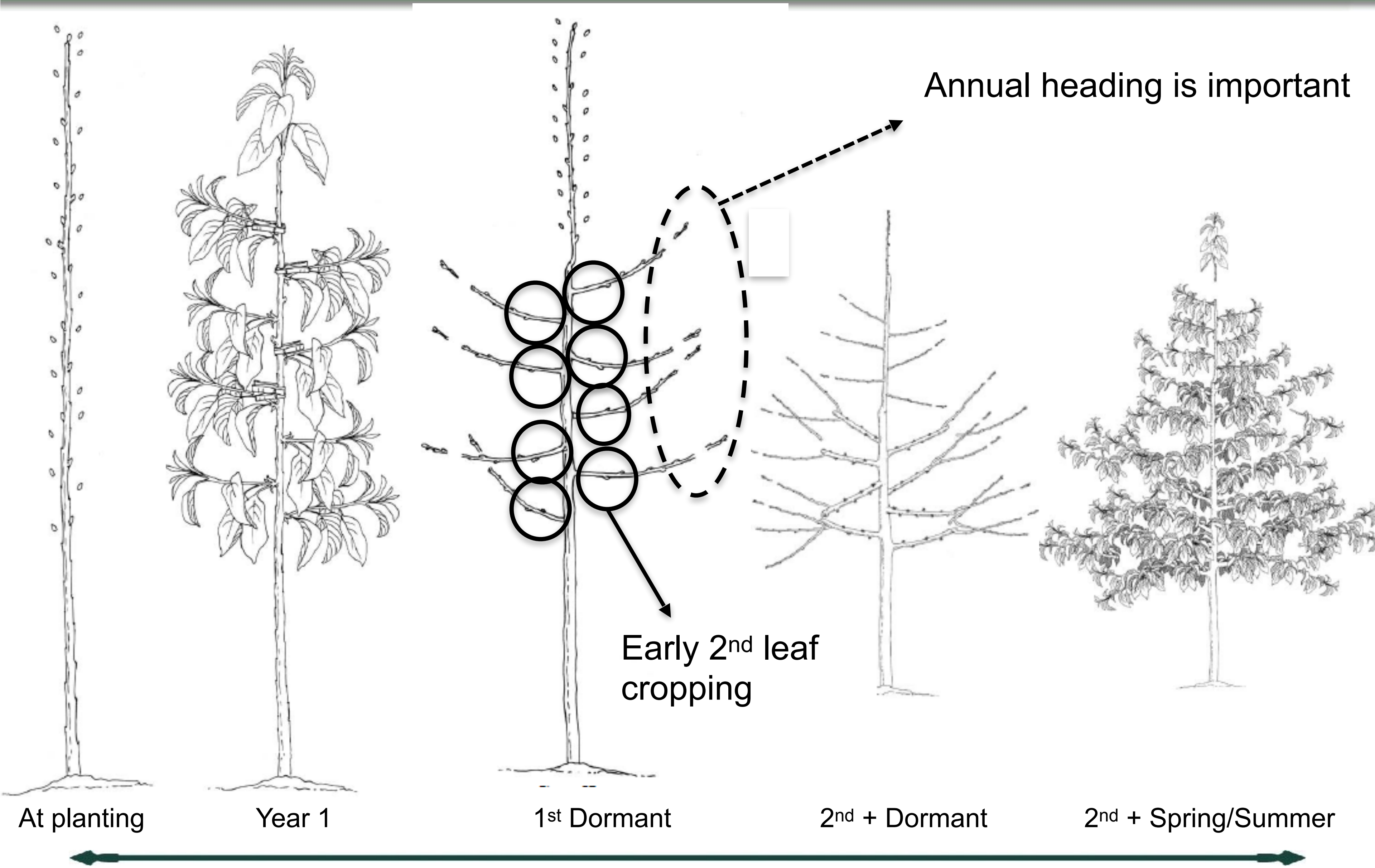
GA+BA

(or) BA

Limb flattening w/ toothpicks, clothespins, etc.

Slide G. Lang and T. Einhorn

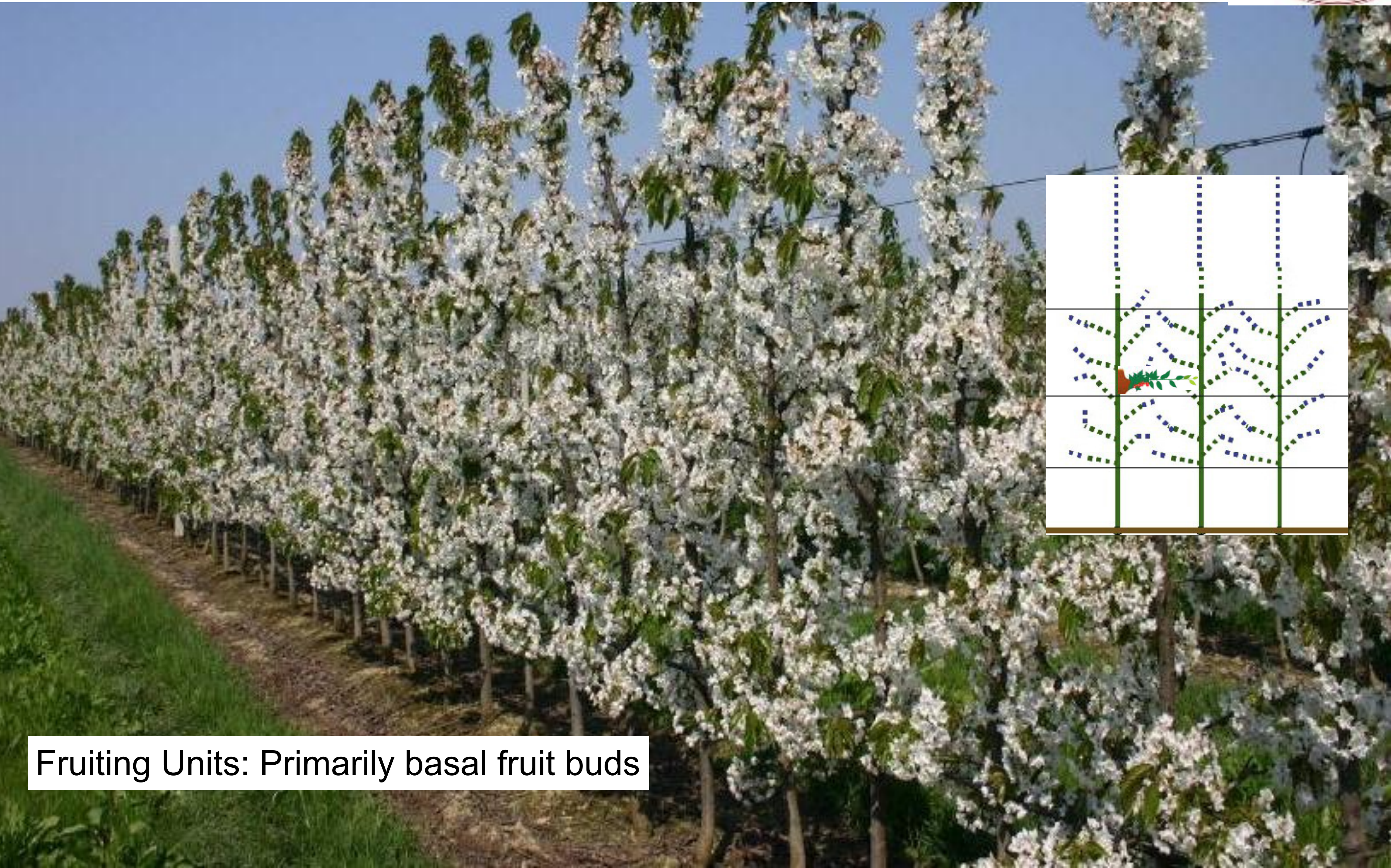
Tall Spindle – Sweet Cherry



Long et al., 2015 PNW 667

SSA: High density sweet cherry

Stefano Musacchi, WSU



Fruiting Units: Primarily basal fruit buds

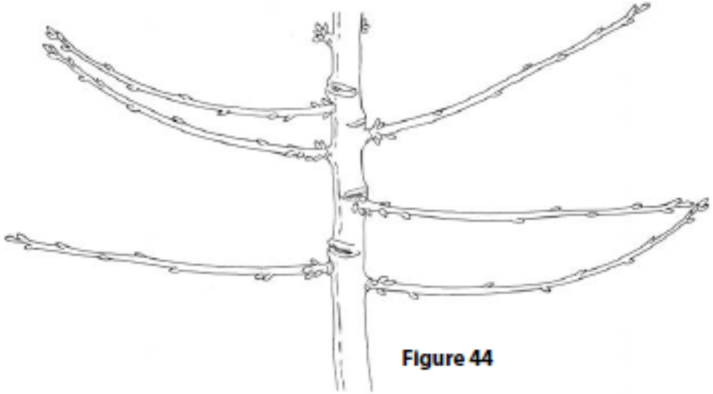


Figure 44

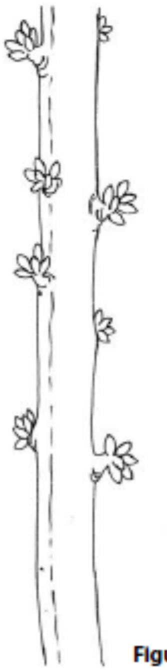


Figure 45

Figure 44 illustrates the type of desired lateral shoot activation and growth at the end of first year. Figure 45 illustrates a tree with no bud activation.

Knowledge of cultivar fruiting habit is important for SSA!

Apical Dominance

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Scoring

Forcing lateral branches to initiate (disrupting auxin flow) from specific locations is ideally performed at green tip

Apical Dominance Release- Proleptic shoot development

McArtney and Obermiller, 2015

- BA, GA_{4+7},GA_7, BA + GA_{4+7} can all branch 1-year-old, and to a lesser extent, 2-year-old wood of apple and sweet cherry trees in the orchard
- Branching of 2-year-old wood requires high concentrations in combination with scoring
- GA alone can branch sweet cherry trees as readily as BA but requires [2,000-5,000 ppm]

Apical Dominance Release- Proleptic shoot development

- 5,000 ppm GA/BA + Latex paint in a 3:1 mix- bud swell/ green tip
- 250 to 500 ppm GA/BA (nonbearing trees) for sprays at shoot emergence timing
- Surfactants necessary but two-year-old wood typically requires some type of bark injury to facilitate penetration

Issues Around Fruit Set:

Too few or too many fruit

AVG

– Ethylene plays a role in fruit senescence and abscission

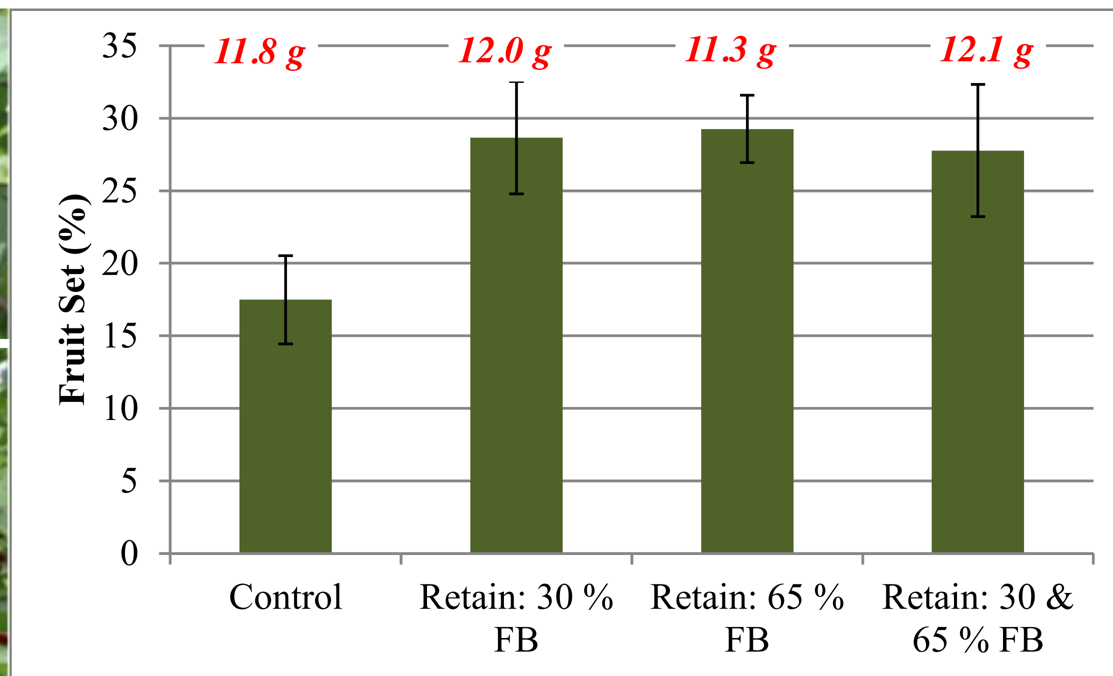
- Use for apple to delay physiological maturity and harvest
- Use for sweet cherry 'Regina' to lengthen ovule viability and improve fruit set
- Use for pear to reduce fruit drop and improve fruit set

‘Regina’ Sweet Cherry

AVG

Treatment	Yield (lbs/tree)	Projected based on actual tree density (tons/a)	
Control	51.9 b	6.3	
ReTain (1 pouch/a)	69.2 a	8.4	**+33%**
P>F	*0.022*		

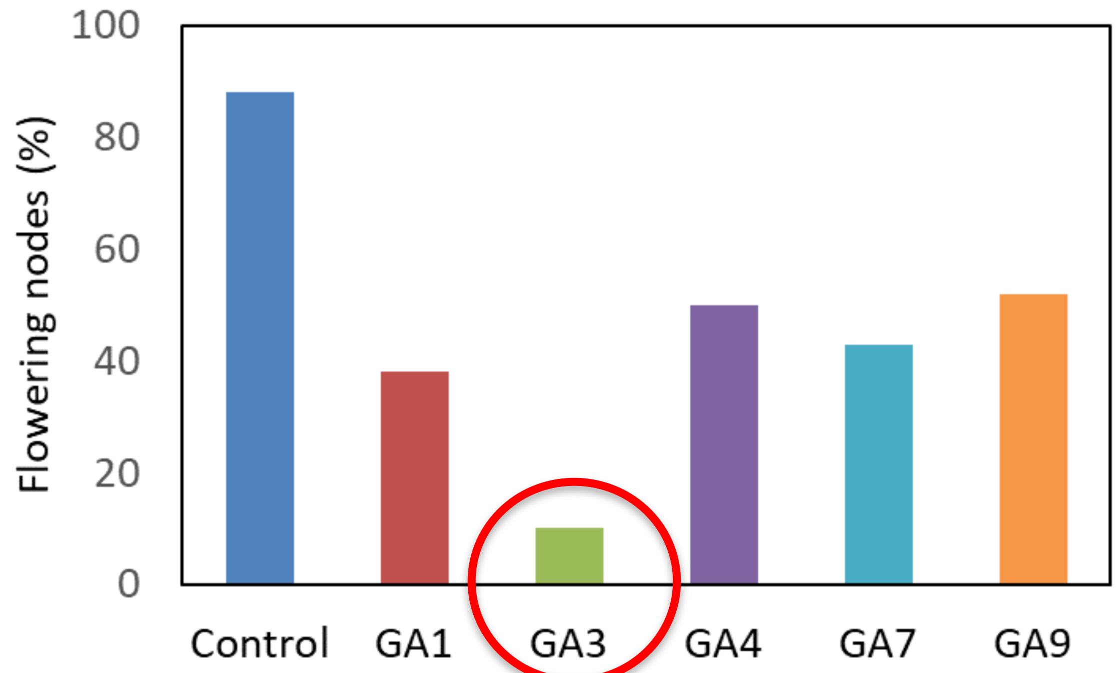
4 reps (RCBD), n=19



The Effect of GA on Flowering

- All GAs affect return bloom
  - GA_3 produced greatest response for sour cherry

- Challenges
  - Coverage
  - Poor penetration

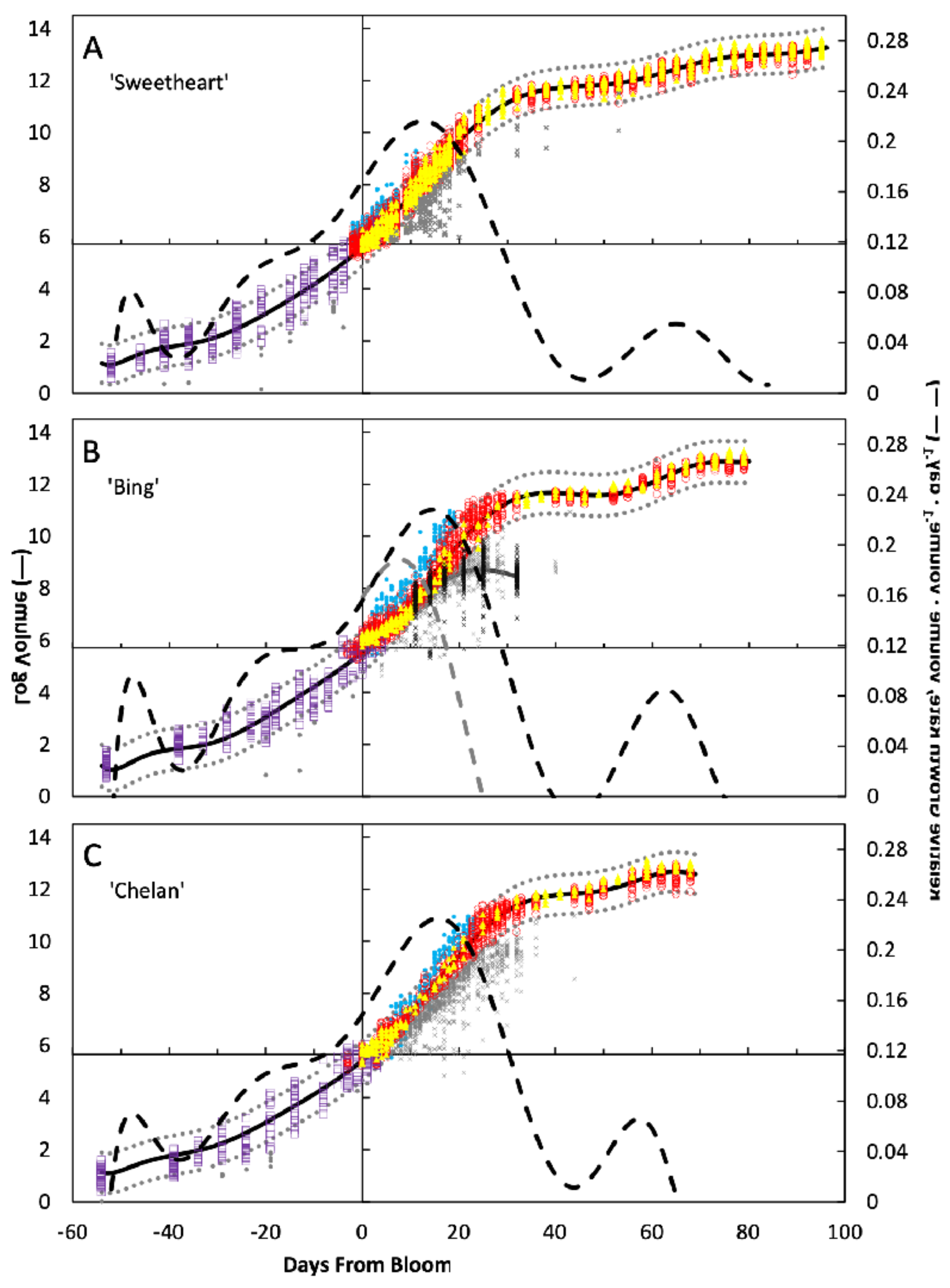


Data reproduced from Retamales et al., 2014

Cherry Growth & Development

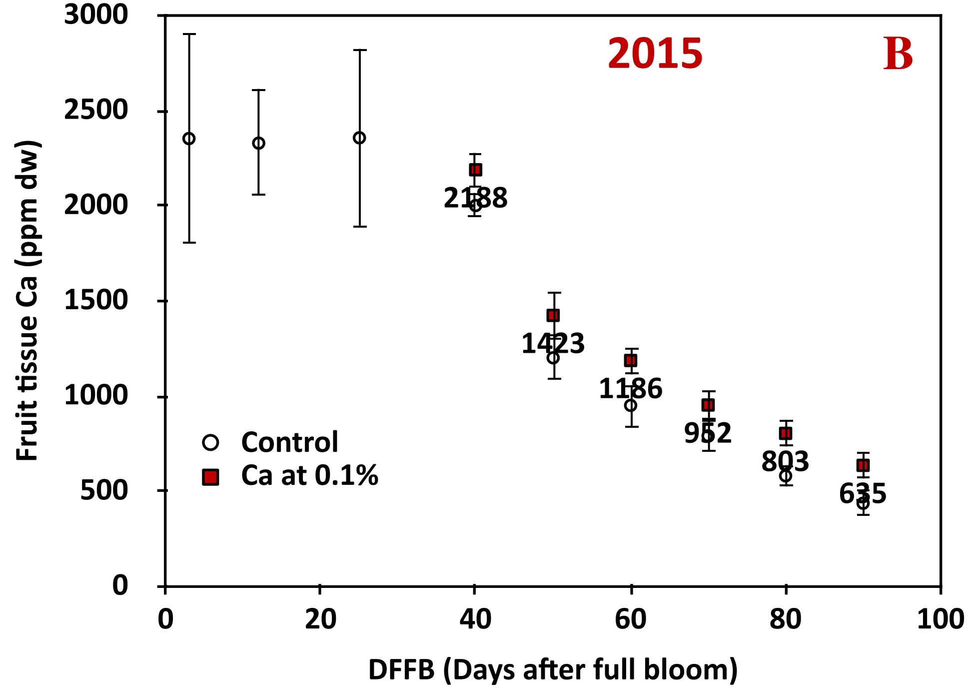
- Pre-anthesis data anchored curve and provided insights into developmental variability

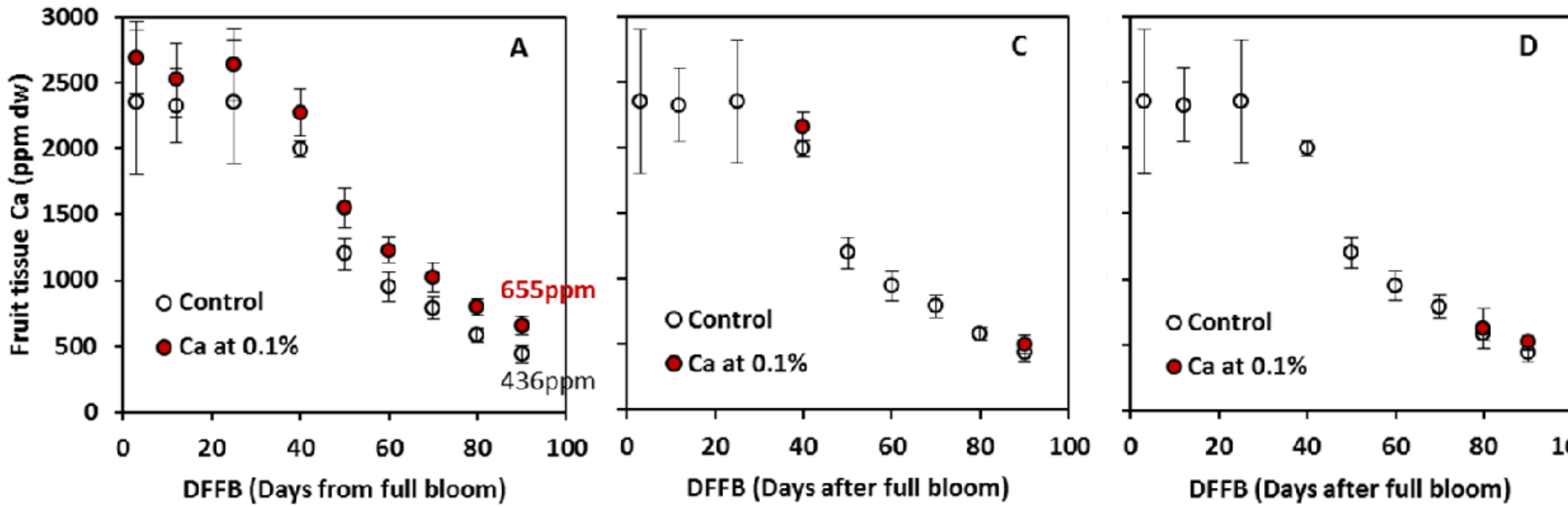
- Prior to 2nd sigmoid, insignificant growth differences among disparate cultivars
    - early- ‘Chelan’
    - mid- ‘Bing’
    - late- ‘Sweetheart’



Ca optimum frequency and timing

- **Frequency** [$CaCl_2/Ca(NO_3)_2$]
  - (A) 9 times: fb - 1wb
  - **(B) 6 times: ph - 1wbh, weekly intervals**
  - (C) 2 times: ph & 1wbh
  - (D) 2 times: 2wbh & 1wbh
- **Timing**
  - **Frequent applications are more important than exact spray timing**





Ca^{2+} 0.1% (6x) improve shipping quality after 3 weeks

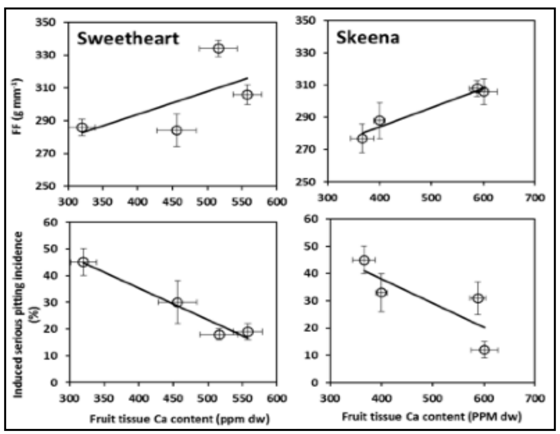
- All Ca sources increased shipping quality.
- At the same Ca concentration, chelated were more efficacious than other sources.

2014

	Pitting (%)	Decay (%)	Pedicel Browning (%)	Fruit skin darkening (L*)	Fruit firmness (g mm^{-1})	SSC	TA (%)
				Lapins			
Control	13.5a	8.7a	22.3a	29.9b	288c	16.5b	0.48c
$CaCl_2$ (0.4%) at 0.15% Ca	11.0ab	3.6b	15.5b	29.0b	296b	17.8a	0.52b
$Ca(NO_3)_2$ (0.6%) at 0.15% Ca	10.6ab	4.0b	13.9b	30.3b	291b	17.6a	0.53b
"6% CALCIUM" at 0.07% Ca	9.8b	2.8b	11.7b	30.6b	303b	17.5a	0.55ab
"Cal-8" at 0.2% Ca	8.9b	1.6b	6.5c	32.1a	318a	17.3ab	0.56a
"Chelate Ca" at 0.05% Ca	7.7b	2.1b	9.9c	31.8a	322a	17.2ab	0.57a
				Skeena			
Control	5.6a	5.5a	5.5a	29.0a	335a	18.8a	0.66a
"6% CALCIUM" at 0.07% Ca	4.9a	2.2b	2.2b	29.4a	327a	18.5a	0.69a

2015

	Natural pitting (%)	Splitting (%)	Decay (%)	Pedicel browning (%)	Fruit skin darkening (L*)	Fruit firmness (g mm^{-1})	SSC (%)	TA (%)
				Lapins				
Control	15.8a	0	5.2a	33.3a	30.5b	388b	20.3b	0.68b
$CaCl_2$	8.5b	0	1.3b	23.1b	31.5a	406a	21.5ab	0.71b
$Ca(NO_3)_2$	9.1b	0	2.1b	19.8b	30.9a	411a	21.3ab	0.73b
Ca citrate	8.3b	0	1.8b	21.5b	31.6a	409a	21.8ab	0.76ab
$Ca(OH)_2$+OA	6.6b	0	1.6b	18.6b	31.2a	416a	22.3a	0.78a
Chelate Ca	7.5b	0	2.2b	18.9b	30.9a	413a	21.5ab	0.79a
				Skeena				
Control	5.8a	6.3a	4.8a	10.0a	30.2a	422a	22.3a	0.78a
$Ca(NO_3)_2$	5.5a	3.2b	1.3b	6.6b	31.0a	436a	22.7a	0.80a



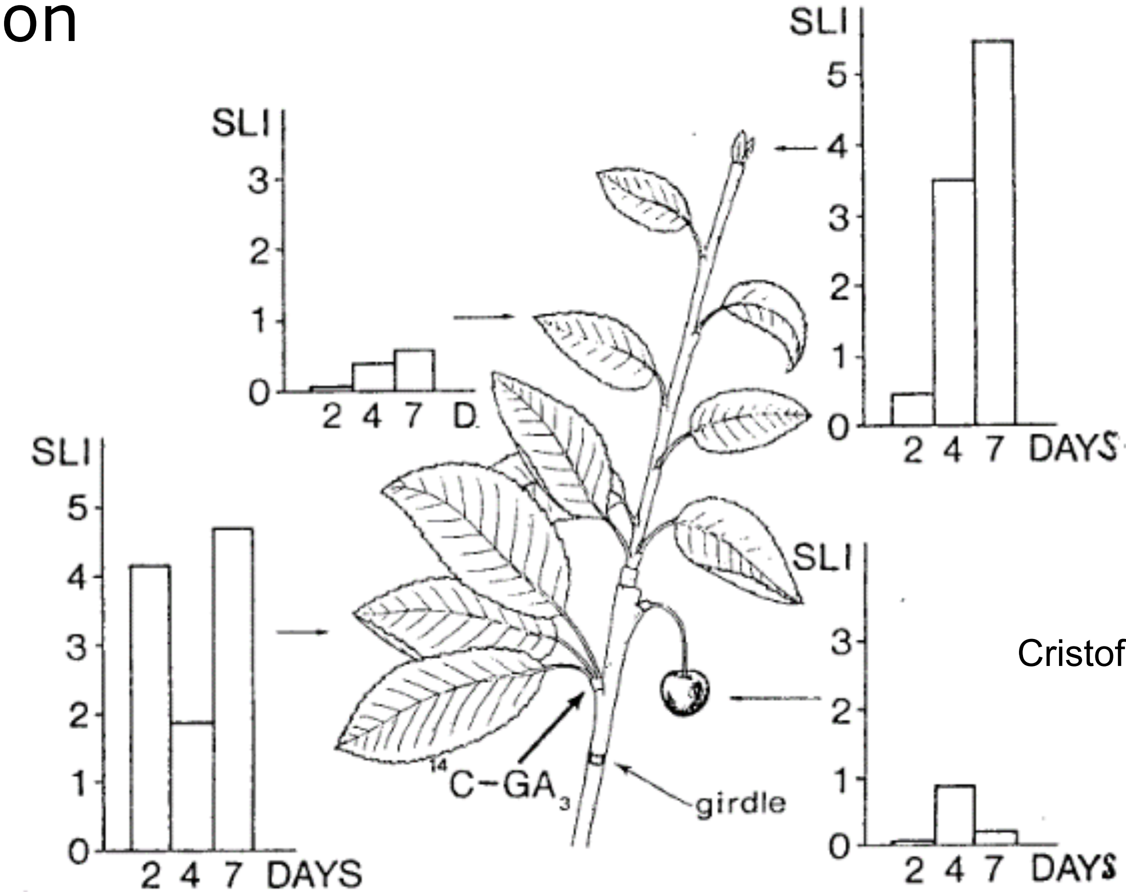
Data Wang and Einhorn, 2017, Acta Hort.

Apogee & Kudos (P-Ca)

- P-Ca inhibits the last enzymatic rxn which forms active GA from inactive GA
- P-Ca (Apogee) **is** presently labeled for use with cherry, Kudos registration (apple, pear, sweet cherry)
- Timing: When newly emerged shoots are < 1 inch, 125 to 250 ppm depending on tree vigor
- Multiple applications may be necessary…***Second application for pear in PNW ~60 d after first***
- Additional evaluation (cultivars and locations) is required

GA

- GA translocation is acropetal via **phloem** and xylem
- Sink strength (shoots stronger than fruit) alters translocation



Cristoferi and Filiti, 1983

- Potential for GA and P-Ca combination to limit extension growth (P-Ca) thereby improving allocation of GA to fruit (M. Whiting [WSU])

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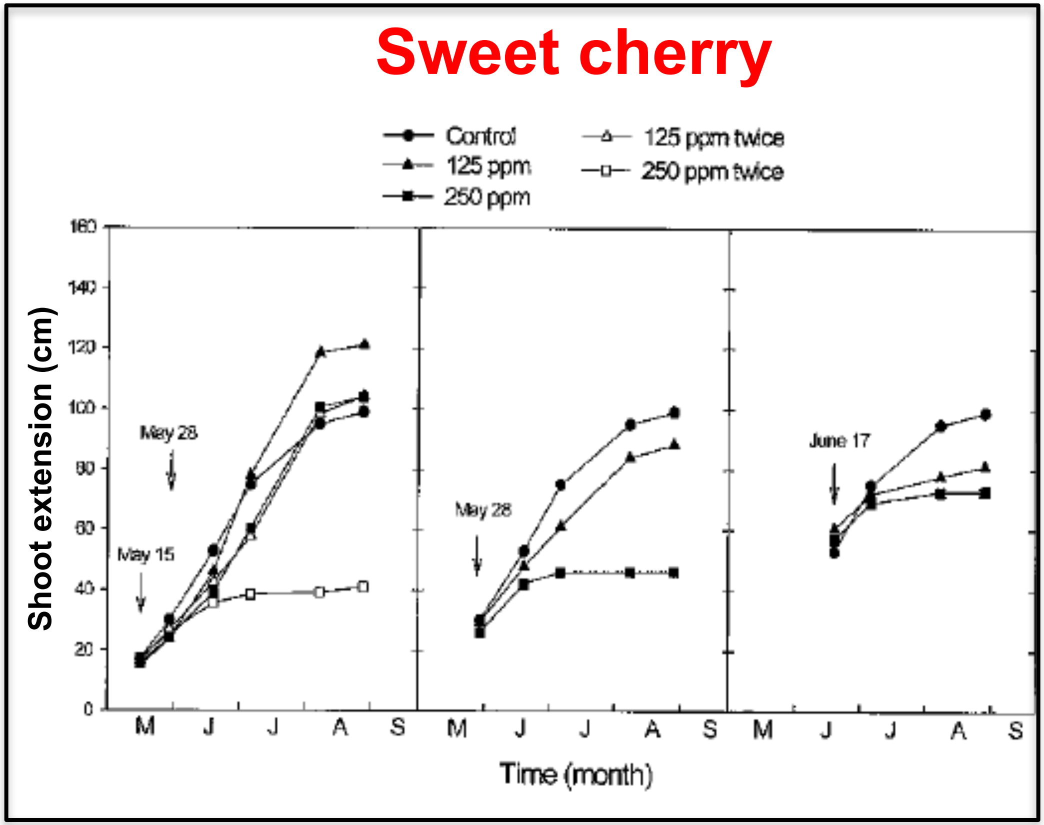
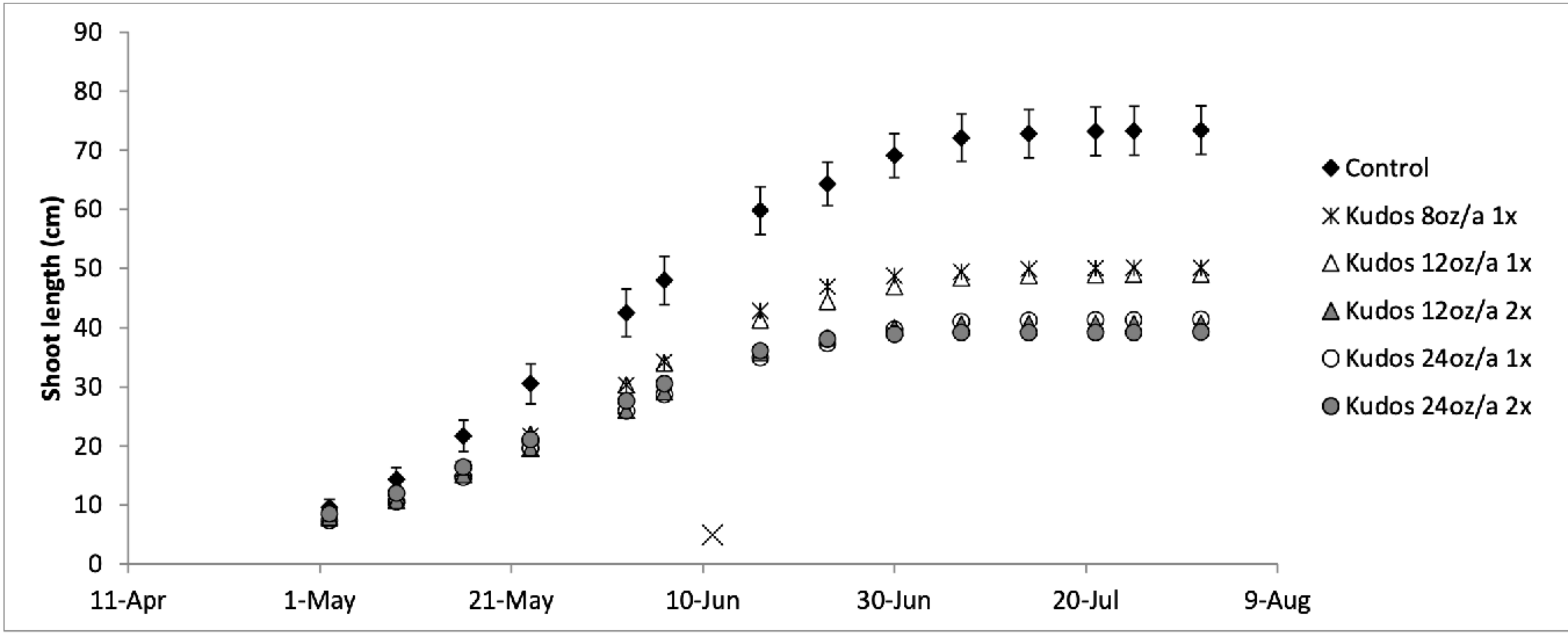
Prohexadione-calcium

- Inhibits GA production
  - GA increases cell growth
  - GA promotes internode elongation
  - P-Ca used in apple, sweet cherry and pear
  - P-Ca doesn't appear to affect floral bud initiation of stonefruit
  - Reduced shoot growth depends on:
    - pH of solution
    - Cultivar
    - Time of application
    - Coverage



Guak et al., 2005

Effect of Kudos Rate and Timing on 'Lapins' Sweet Cherry Shoot Growth



- First application, 30-Apr; Second application, 12-June
- 12 oz (250 ppm) applied 2x was the most efficacious treatment