HORTICULTURE AND LANDSCAPE ARCHITECTURE
COLORADO STATE UNIVERSITY

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December 8, 2021

Orchard & Environmental Factors Affecting Peach Productivity & Harvest Quality

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Cold damage of floral tissues is the biggest single limitation to profitability of the Colorado tree-fruit industry

April 14, 2020
T_{min}=-5.9°C

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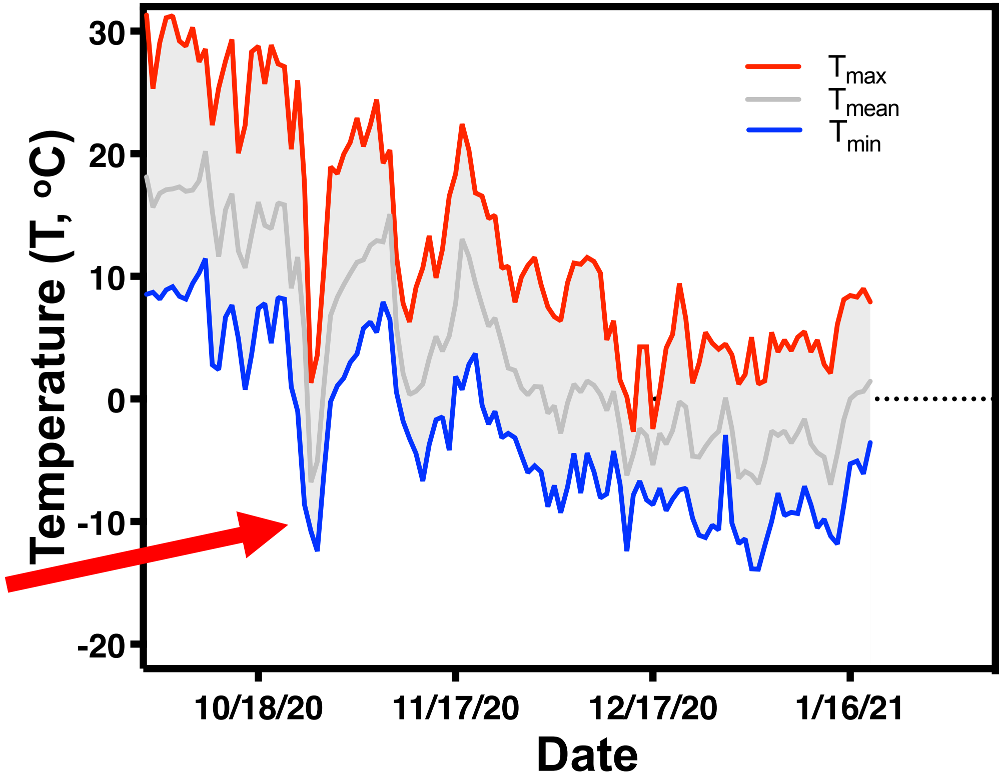
Cold damage during fall 2020



10/26/2020: -10.6°C (13°F)

10/27/2020: -12.4°C (9.7°F)

*windy nights and no inversion

Range of Tissue Damage

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- Trees didn't receive adequate chilling before the frost
- Cambial and xylem damage
- Potential disease (e.g. Cytospora or bacterial canker) vulnerability

*These shoots looked similar from the outside

Differential Thermal Analysis (DTA)

Reliable and efficient tool to determine lethal temperatures of peach floral buds

- Monitors difference in temperature between a sample and a reference thermoelectric module (TEM)
- For each TEM a voltage signal that corresponds to the temperature at which super cooled water in the bud tissue freezes is being send to an output directly to an Excel spreadsheet through a data logger

Minas & Sterle. 2020. Acta Hortic. 1281, 385-392

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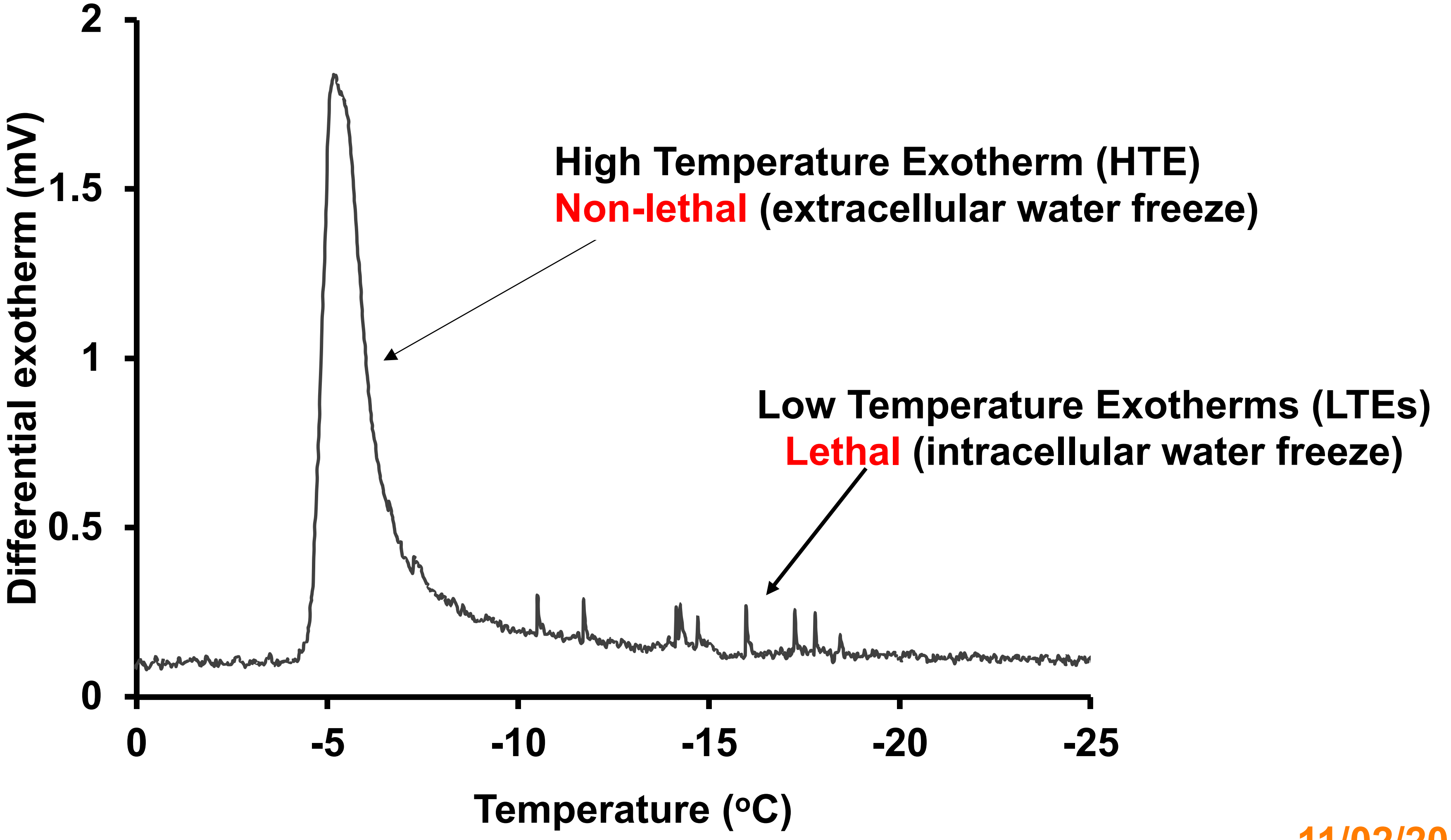
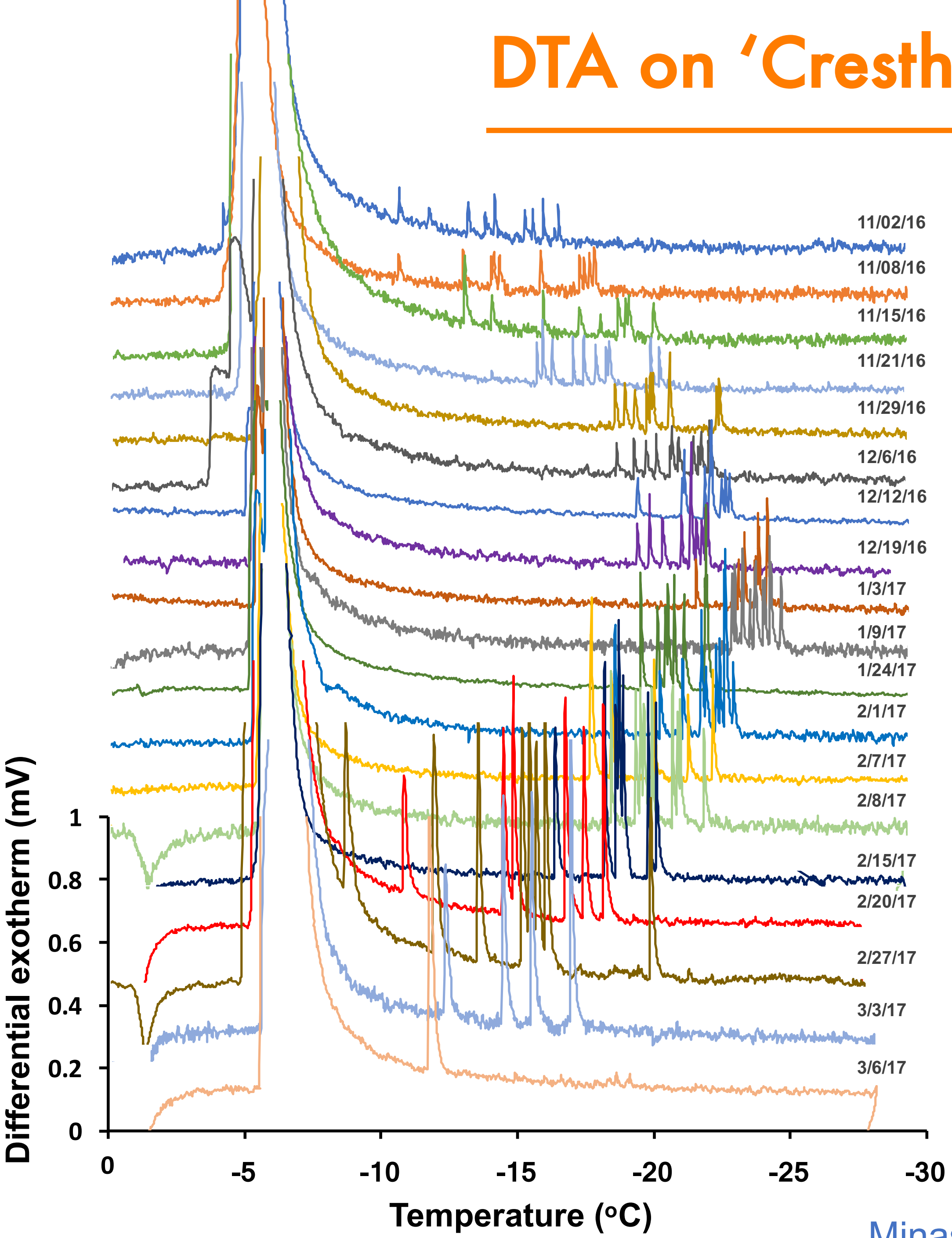
DTA on ‘Redhaven’ peach dormant floral buds



Minas & Sterle. 2020. Acta Hortic. 1281, 385-392

11/02/2016

DTA on 'Cresthaven' floral buds



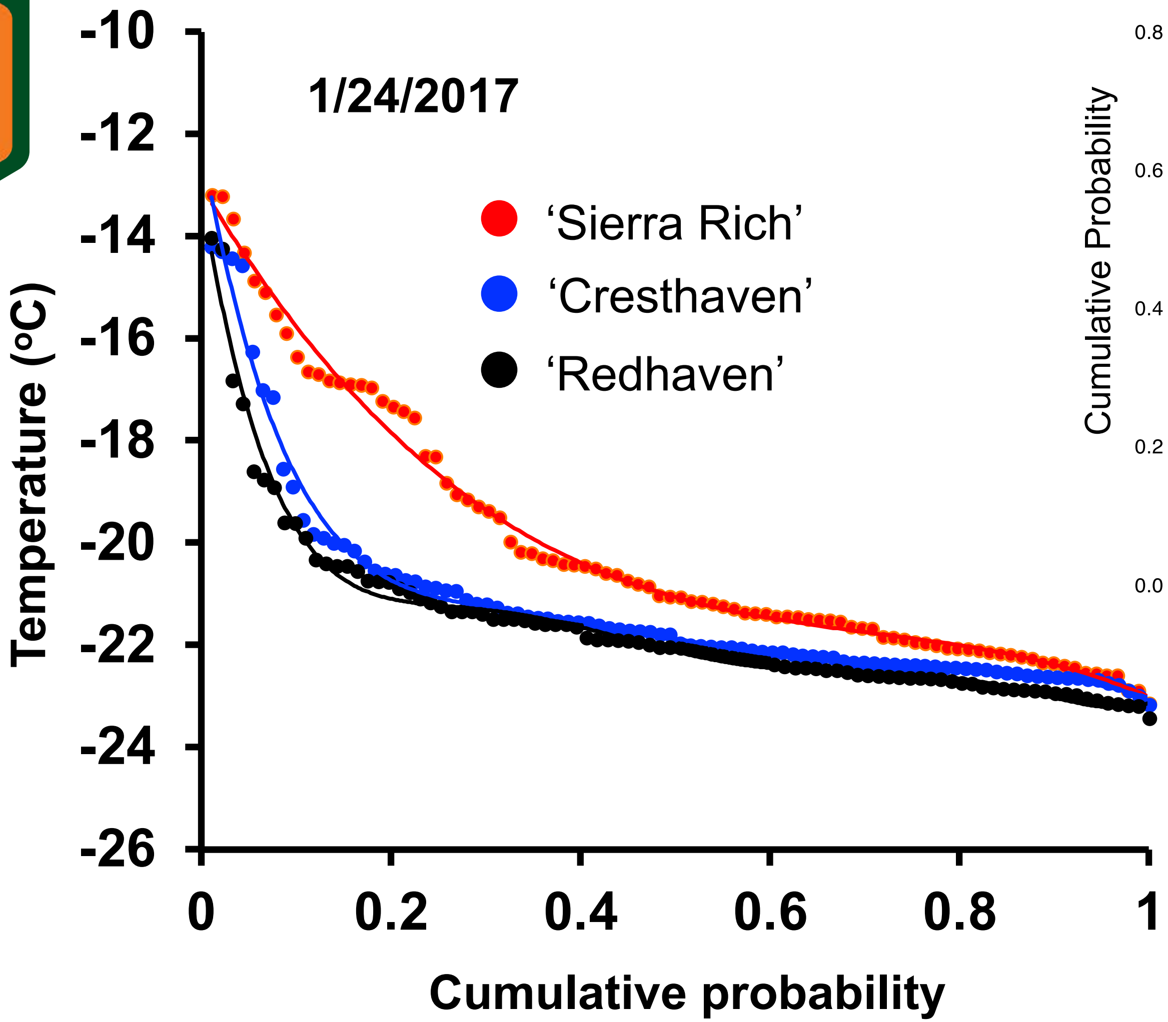
Acclimation: the gradual increase of cold hardiness
(Fall – Dec 6th, 2016)

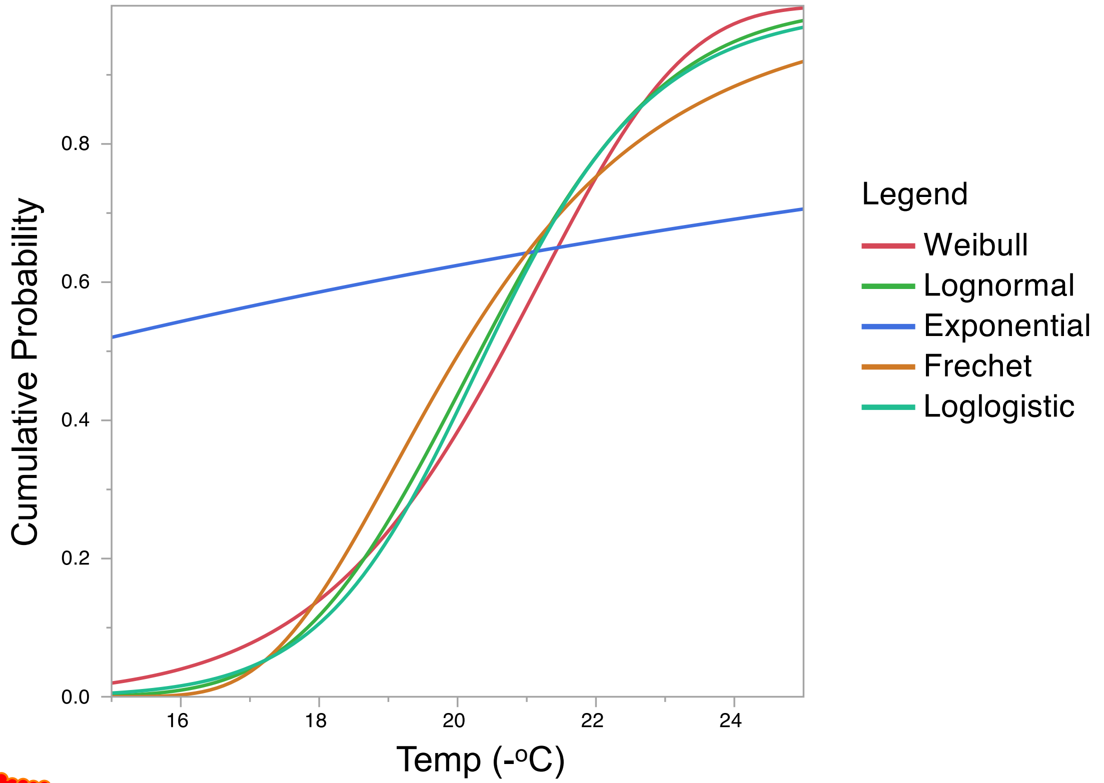
Maximum Hardiness
(Dec 12th - Feb 1st, 2017)

De-acclimation: the decrease of cold hardiness towards bud break
(Feb 7nd - March 6rd, 2017)

Minas & Sterle. 2020. Acta Hortic. 1281, 385-392

Statistical analysis to determine critical temperatures for floral bud kill





Lethal Temperatures (LT, °C)

	'Sierra Rich'	'Cresthaven'	'Redhaven'
LT_{10}	-16.4	-19.6	-19.9
LT_{50}	-21.1	-22.0	-22.1
LT_{90}	-22.4	-22.6	-23.0

Minas & Sterle. 2020. Acta Hortic. 1281, 385-392.

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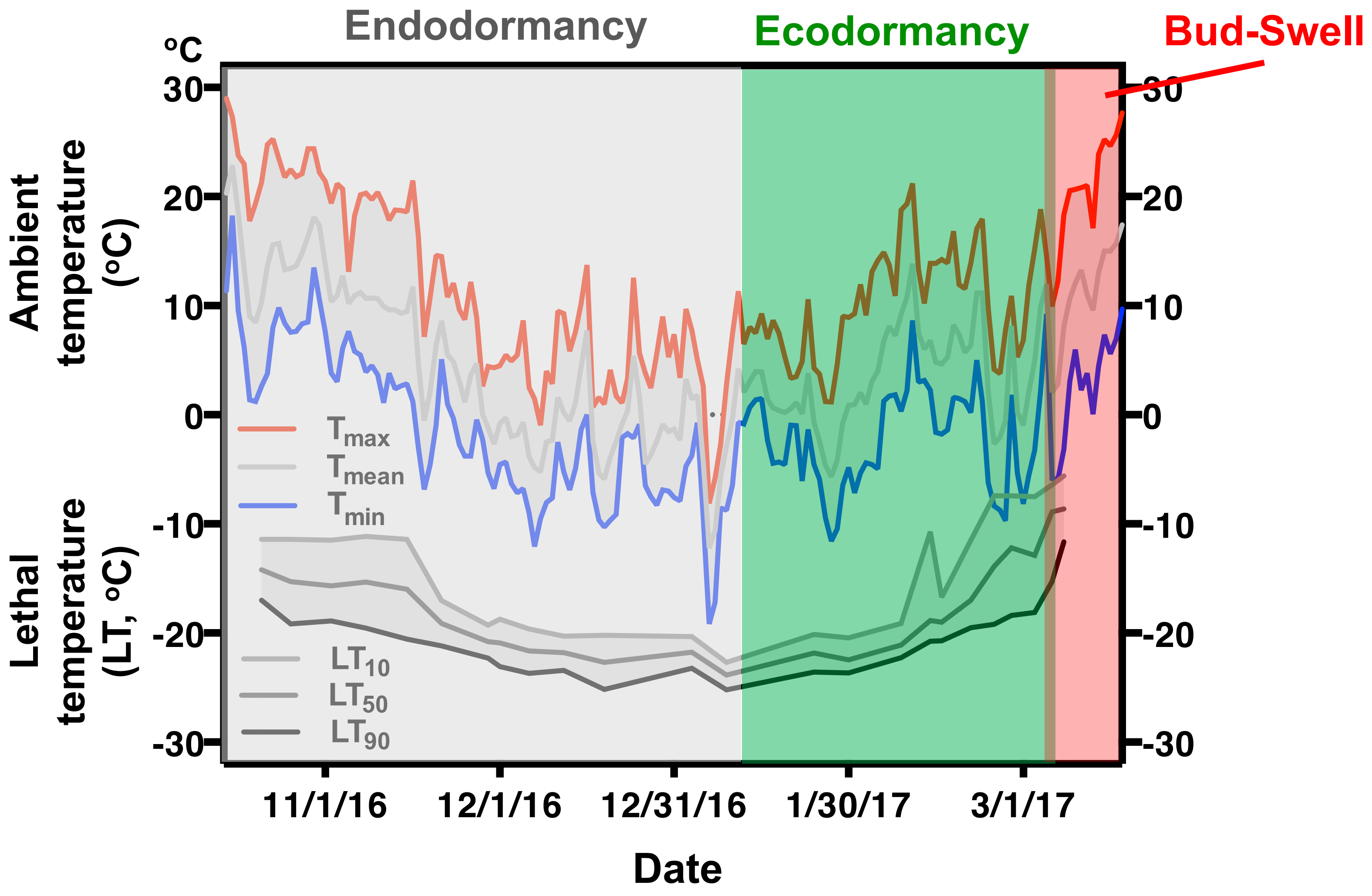
‘Redhaven’ peach floral bud cold hardiness



Seasonal patterns of temperature and cold hardiness (expressed as lethal temperature, LT) for ‘Redhaven’ peach floral buds

Dormancy phases as described by Lang, 1987. HortScience 22, 817–820

Peach bud cold hardiness monitoring updates

http://minas.agsci.colostate.edu/tree-fruit-information/cold-hardiness/

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Cold Hardiness

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Peach Floral Bud Cold Hardiness Updates

Cold hardiness update 2020-21 | Chilling hours/portions | Cold hardiness updates 2019-20 | 2018-19 Updates | 2017-18 Updates | 2016-17 Updates | Critical Phenological Temperatures

Peach floral bud cold hardiness update #21 02_03_21

Data from the last dormant seasons (2016-2021) on peach cold hardiness, chilling accumulation & critical phenological temperatures

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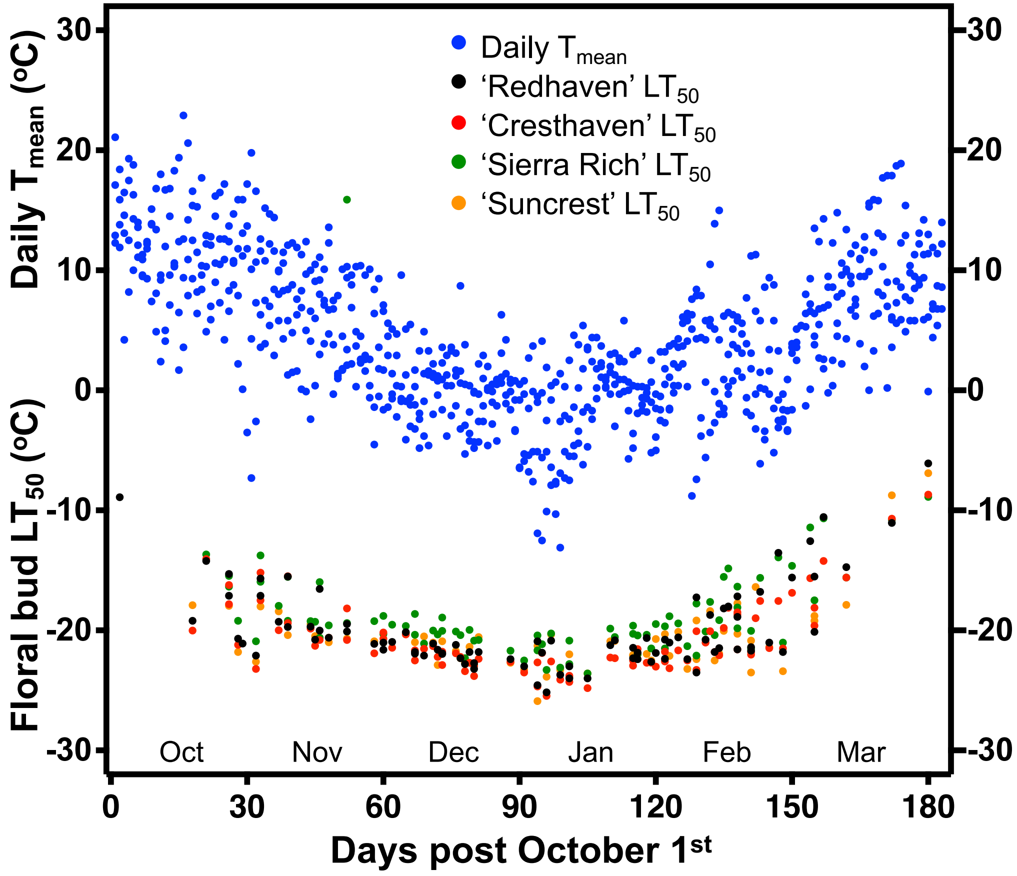
Can we develop accurate cold hardiness prediction models based on thermal and weather data?

- DTA (LT) and weather data collected over 4 dormant seasons (2016-20)
  - ~6000 lethal events per cultivar
  - 80 time points per cultivar (each comprised of 75 LTs)
- Models were validated by randomly selected data in a ratio of 2:1 for training data to validation data
- Standard least squares with an iterative approach to compared models with different variables
- Favored models which had low error in validation with the least number of variables
- Frost control methods can only raise temps to 1-2 ^{o}C (need low error in H_c prediction)



Sterle et al., 2021. *Submitted to Environmental & Experimental Botany.*

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Different models for the different phases of dormancy

Endo- and ecodormancy models were created using data from predictor variables that were separated by place-holder at a point of chill satisfaction

- $T_{min,1-4}$ (recent climate history)
- Photoperiod (seasonal progression)
- Interaction: ($T_{min,1-4}$ and photoperiod)

- $T_{max,1-4}$ (recent climate history)
- GDD >0 (GDD_0, seasonal progression)
- Date post October 1st (seasonal progr.)
- Interaction : (GDD>0 x $T_{max,1-4}$)

Endodormancy

Ecodormancy

Full bloom

DPO_{EDB}

October

Chill Satisfaction

(700 chilling hours @ 0-7 °C)

April

DPO_{EDB}, days past October that EDB was reached
EBD, endodormancy barrier
Chill Satisfaction = EDB

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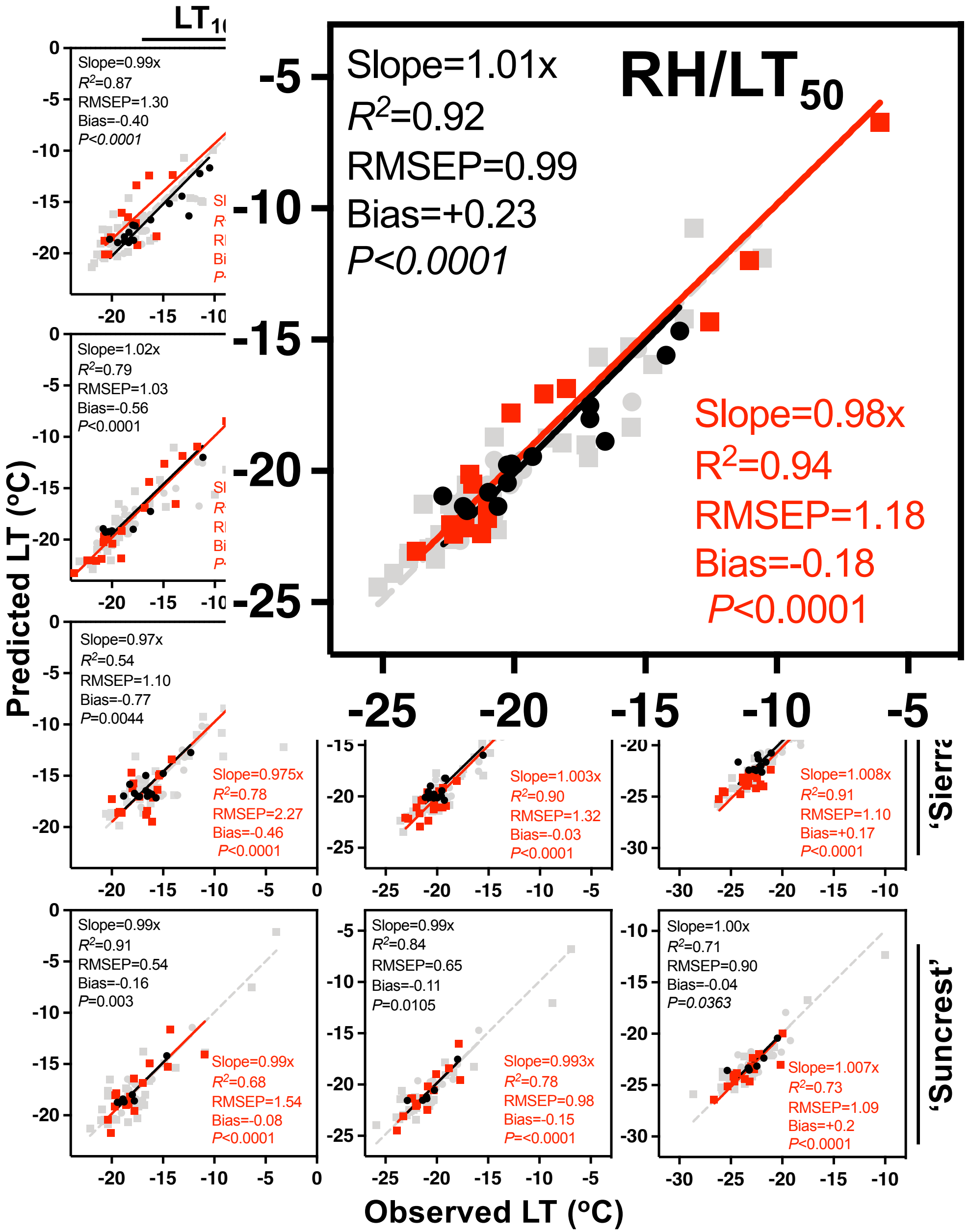
Model prediction performance



- LT_{50} + LT_{90} are predicted very accurately
- RMSEP= error (°C)
  - Low error
- Endodormancy black
- Ecodormancy red

Sterle et al., 2021. *Submitted to Environmental & Experimental Botany*

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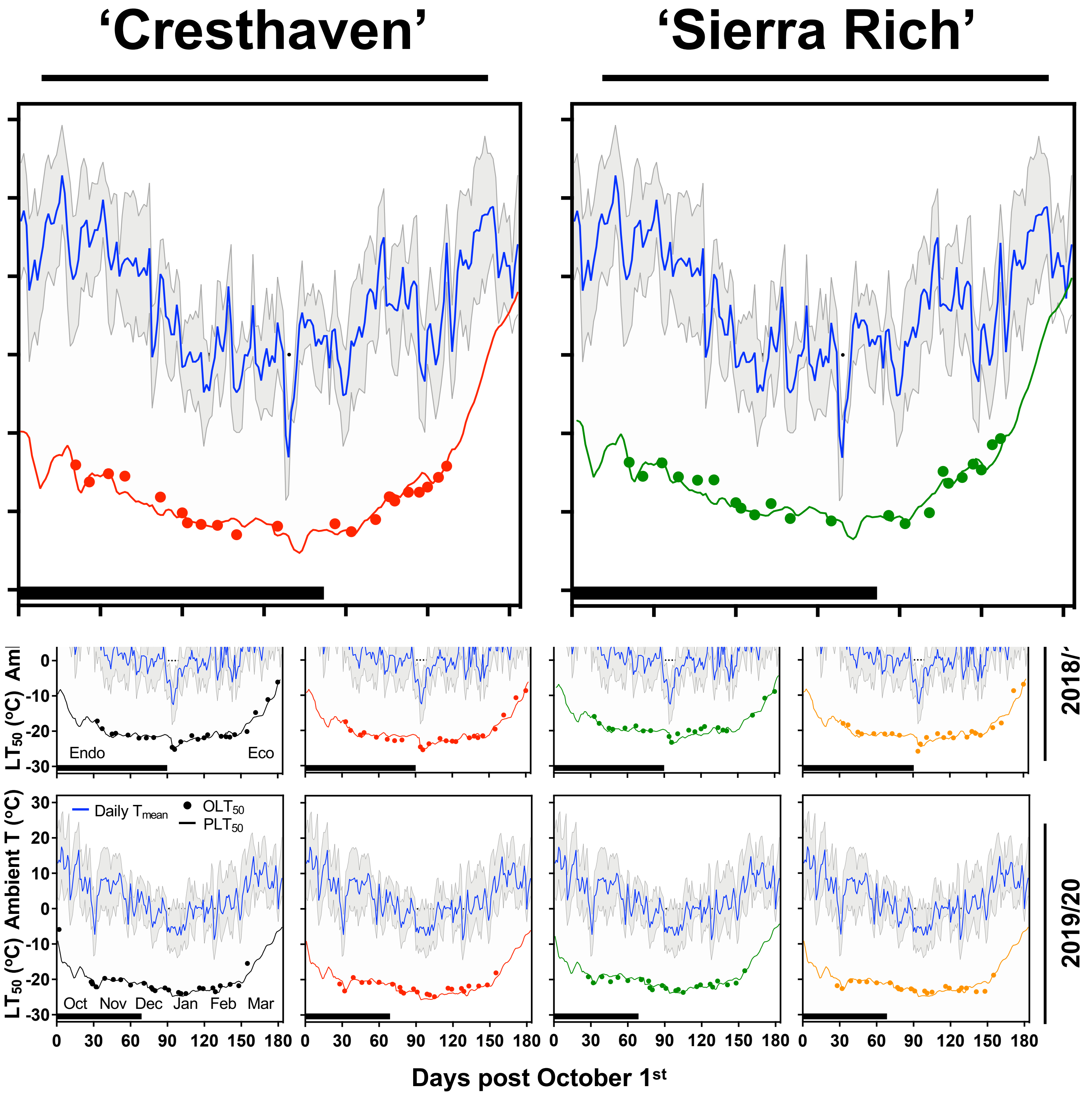
Seasonal Prediction Curves



Sterle et al., 2021. *Submitted to Environmental & Experimental Botany*

Cold Hardy Cultivars Evaluation Trial

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We are using DTA to acquire large data sets in order to fully characterize the seasonal changes in hardiness across 13 peach cultivars that:

1. Cover different harvest times
2. Defend against hardiness using multiple hardiness strategies (ie. delayed bloom, earlier acclimation, or mid-winter hardiness)

California Bred Cultivars | Michigan Bred Cultivars

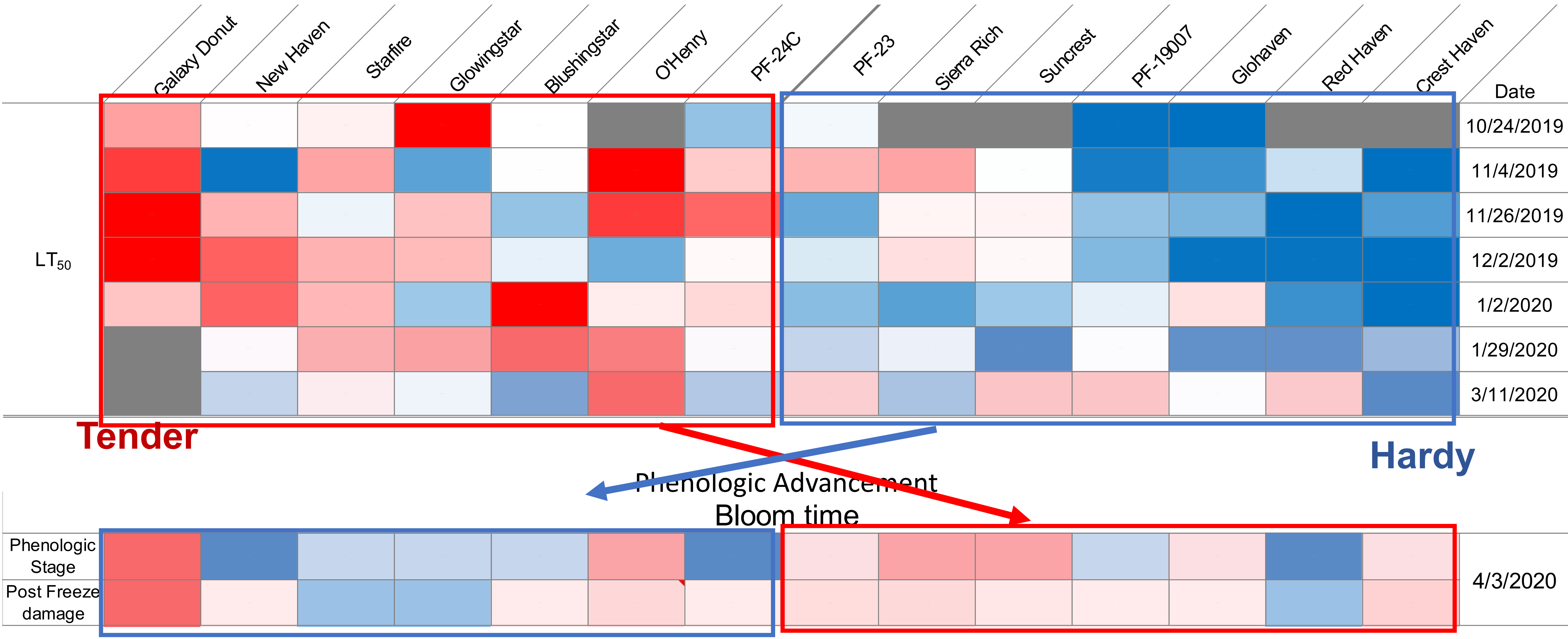
Notice variety of sizes and colors

Sterle & Minas, 2021. XII Orchard Systems Symposium

Dormant Season 2019-20 Cold Hardiness Data (LT_{50})

	Galaxy Donut	New Haven	Starfire	Glowingstar	Blushingstar	O'Henry	PF-24C	PF-23	Sierra Rich	Suncrest	PF-19007	Glohaven	Red Haven	Crest Haven	Date
LT_{50}	-19.0	-20.1	-20.0	-17.1	-20.1	NA	-20.7	-20.2	NA	NA	-21.4	-21.5	NA	NA	10/24/2019
	-21.3	-23.0	-21.7	-22.7	-22.0	-21.1	-21.8	-21.7	-21.7	-22.0	-23.0	-22.8	-22.2	-23.0	11/4/2019
	-18.4	-19.5	-20.1	-19.6	-20.4	-18.8	-19.1	-20.6	-20.0	-20.0	-20.5	-20.5	-21.0	-20.7	11/26/2019
	-18.2	-19.2	-20.1	-20.2	-21.0	-21.3	-20.8	-21.0	-20.6	-20.8	-21.2	-21.6	-21.6	-21.6	12/2/2019
	-20.7	-19.6	-20.6	-22.2	-18.4	-21.2	-21.0	-22.4	-22.8	-22.2	-21.6	-21.1	-23.1	-23.6	1/2/2020
	NA	-21.4	-20.8	-20.6	-20.1	-20.3	-21.5	-21.9	-21.6	-22.8	-21.5	-22.7	-22.7	-22.2	1/29/2020
	NA	-10.8	-9.0	-10.5	-11.4	1.9	-11.0	-6.5	-11.0	-5.7	-5.7	-10.3	-6.1	-11.7	3/11/2020

Dormant Season 2019-20 Cold Hardiness Data (LT_{50})



Red and blue underlines indicate different “hardiness strategies”

- Some CVs that were less hardy mid-winter were more-hardy pre-bloom (delayed phenology)

Dormant Season 2020-21 Cold Hardiness Data (LT_{50})

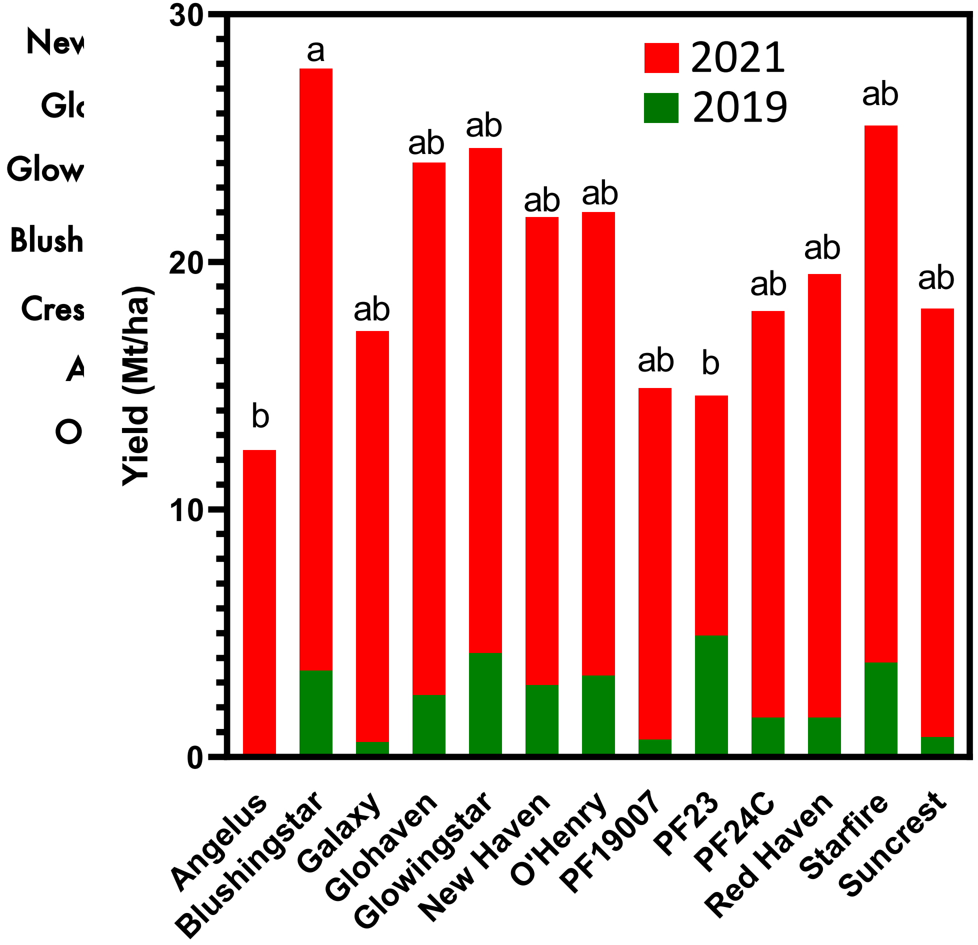
	Galaxy Donut	New Haven	Starfire	Glowingstar	Blushingstar	O'Henry	PF-24C	PF-23	Suncrest	PF-19007	Glohaven	Red Haven	Crest Haven	Date
Floral bud	-13.0	-12.6	-13.8	-10.8	-12.8	-12.3	-12.1	-13.4	-15.3	-12.2	-13.7	-13.6	-11.0	10/23/2020
	-16.6	-14.5	-14.9		-16.0	-16.3	-14.5	-18.6	-18.3	-16.4	-17.8	-16.5	-13.9	10/28/2020
		-17.9	-18.6	-17.5	-18.5	-16.9	-16.6	-19.4	-18.4	-18.5	-19.0	-18.1	-19.2	11/11/2020
	-18.2	-19.8	-20.5	-19.7	-20.1	-20.4	-20.5	-21.7	-21.3	-21.3	-21.4	-21.4	-19.8	12/8/2020
	-19.0	-18.8	-19.9	-17.7	-18.6	-19.0	-20.6	-21.0	-21.5	-21.0	-20.4	-20.6	-21.9	12/29/2020
	-19.9	-20.2	-21.0	-20.3	-20.7	-19.9	-21.2	-21.0	-22.5	-20.8	-20.9	-22.1	-21.3	1/21/2021
	-19.3	-20.5	-21.4	-22.2	-19.9	-21.4	-22.6	-20.4	-20.1	-20.2	-21.8	-22.2	-22.5	2/23/2021
	-17.9	-18.4	-19.3	-18.1	-18.4	-18.6	-19.4	-19.5	-20.1	-19.1	-19.6	-20.0	-19.3	Average

Tender | **Hardy**

	Galaxy Donut	New Haven	Starfire	Glowingstar	Blushingstar	O'Henry	PF-24C	PF-23	Suncrest	PF-19007	Glohaven	Red Haven	Crest Haven	
Bloom date	8-Apr	14-Apr	10-Apr	10-Apr	10-Apr	9-Apr	9-Apr	9-Apr	8-Apr	10-Apr	9-Apr	9-Apr	10-Apr	Bloom date
Mid shoot Damage	0%	20%	14%	45%	18%	52%	25%	38%	15%	48%	32%	27%	50%	Mid shoot Damage

Peach Cultivar Hardiness Summary

- In both dormant seasons there was consistent but different hardiness strategies across cultivars (best question is when hardy?)
  - Galaxy Donut has most tender buds, most hardy shoots
  - In 2020 fall freeze, the cultivars which didn't acclimate due to lack of prior freeze had the most woody-damage in general ('O'Henry', 'Glowingstar', 'PF-19007', 'Cresthaven')
  - Newhaven reached full bloom 4 days after any other cultivar decreasing risk of spring frost, but otherwise one of the most tender yellow peach CVs in mid-winter
- When averaging hardiness in the most critical dates (early fall and spring season) these cultivars performed best: 'Newhaven', 'Glohaven', 'Glowingstar', 'Blushingstar', and 'Cresthaven'
- 'Blushingstar' had highest cum. yield - PF23 and Angelus lowest



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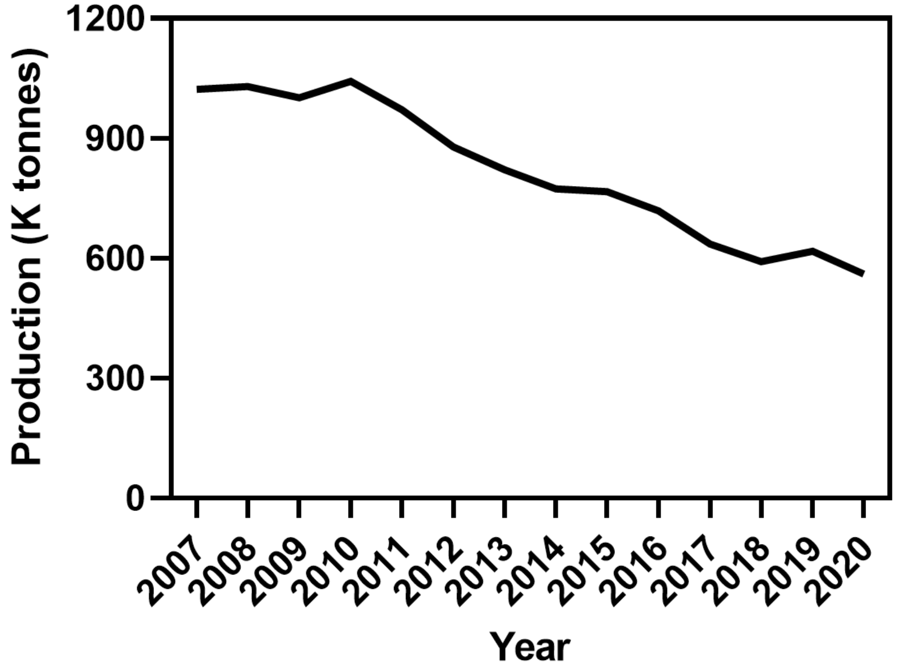
Peach per capita use in USA reduced between 2007 – 2020

- Consumption is falling
- 1.3 kg/capita in 2020

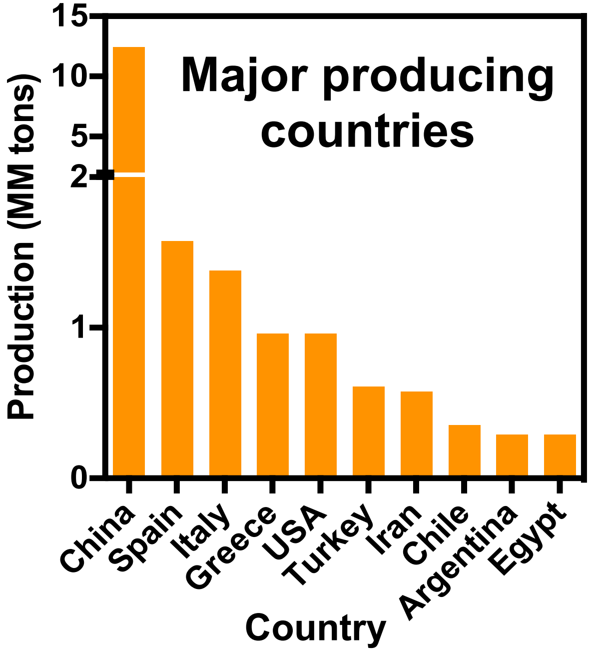
Peach and nectarine production distribution per utilization in US

- Production is falling
- Poor peach quality
- Labor costs increasing

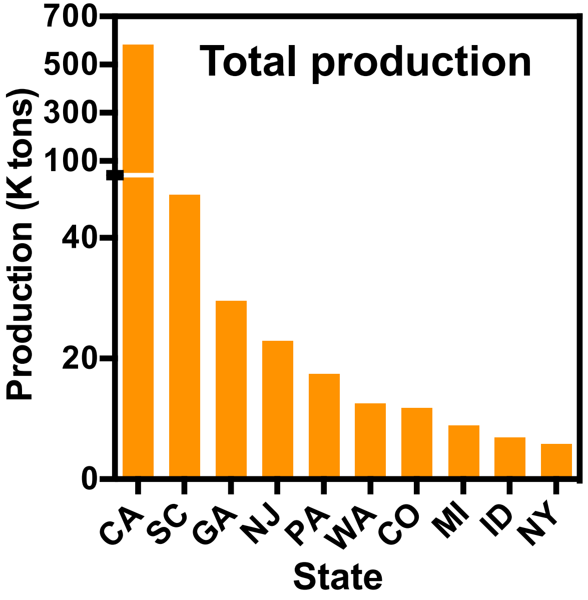


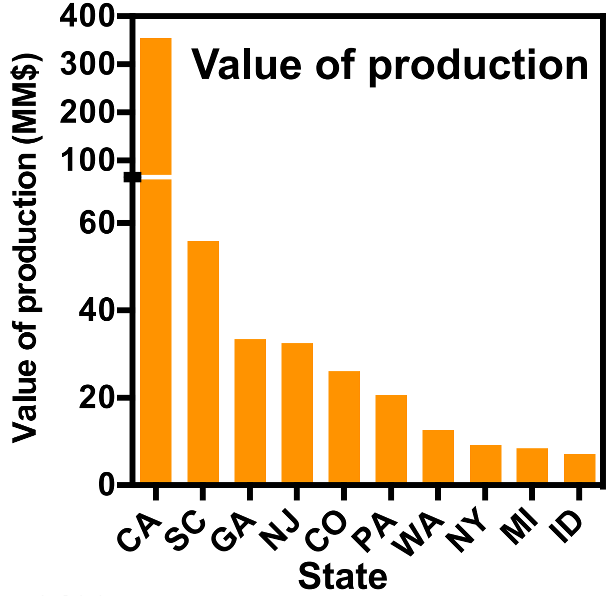
(USDA-NASS, 2017; 2019)

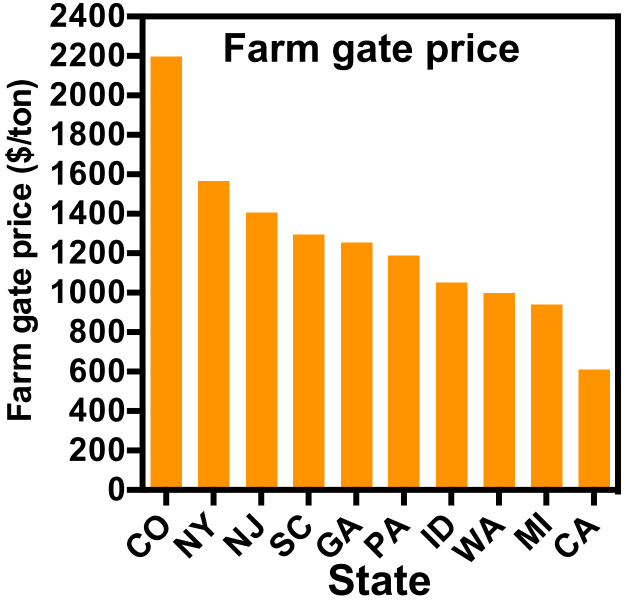
Peach & nectarine production in the world and US



Major producing states in USA*







- National ‘farm gate’ avg. price = $1.2/kg
- Colorado ‘farm gate’ avg. price = $2.2/kg
    - $1 difference = ~$15 million (*quality premium*)

***Average values of 2014-17**

Source: FAO, 2019; USDA-NASS, 2019

Chilling injury (CI) symptoms due to prolonged storage make consumers stay away of peaches?

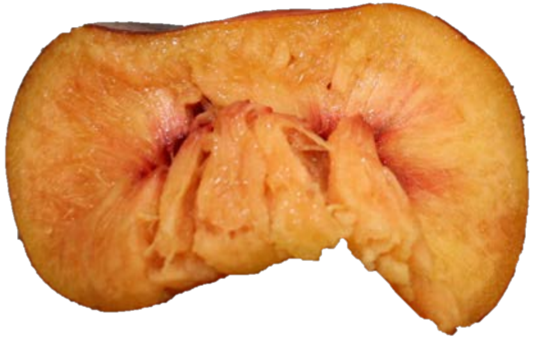
Appear following 3+ weeks of storage (0°C) plus 2+ days at shelf life (20°C)

Healthy

Flesh bleeding

Internal appearance of 'Zee Lady' peaches following storage of 4 weeks at 0°C plus 2 days at 20°C

Flesh browning



Flesh mealiness

(Minas and Crisosto, 2013)

Etiology of cold storage disorders of peach fruit

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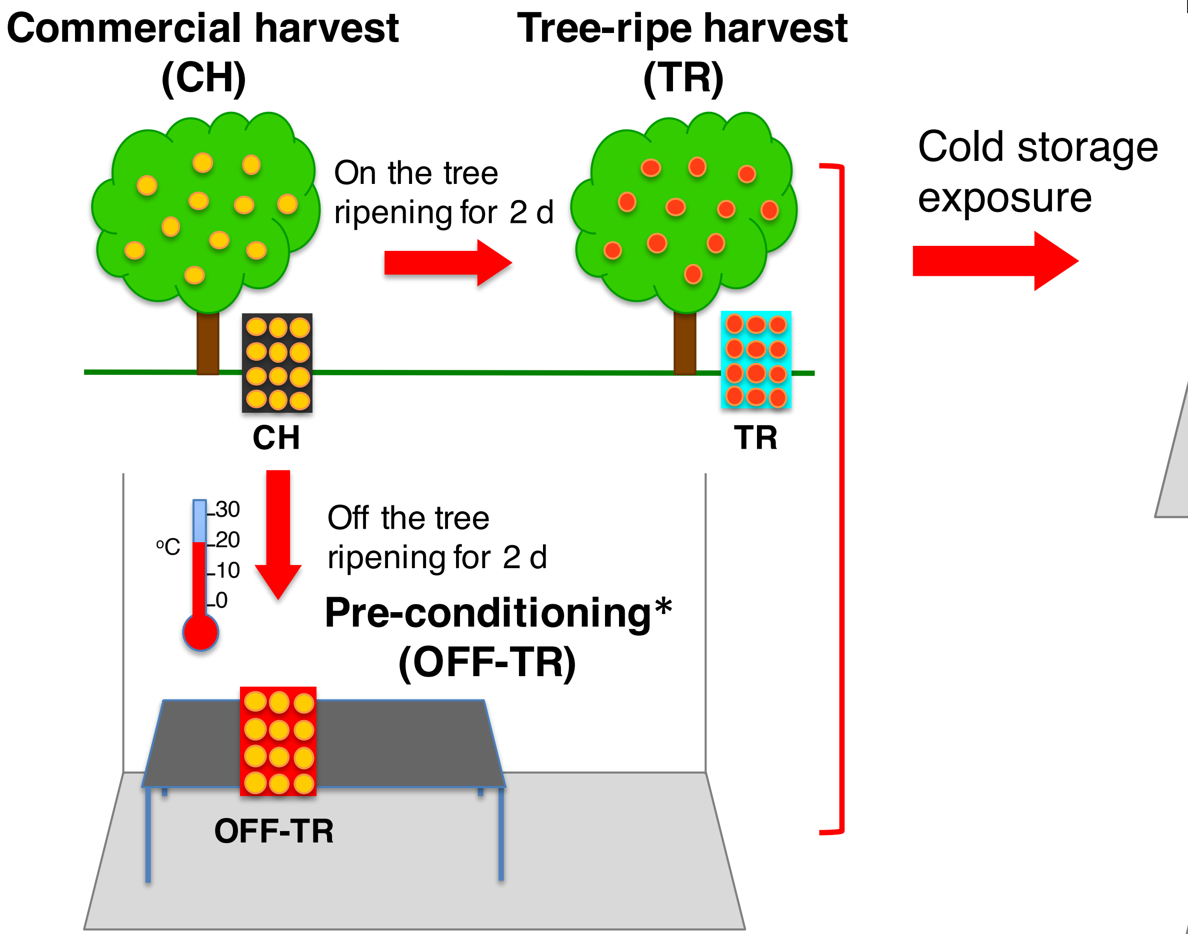
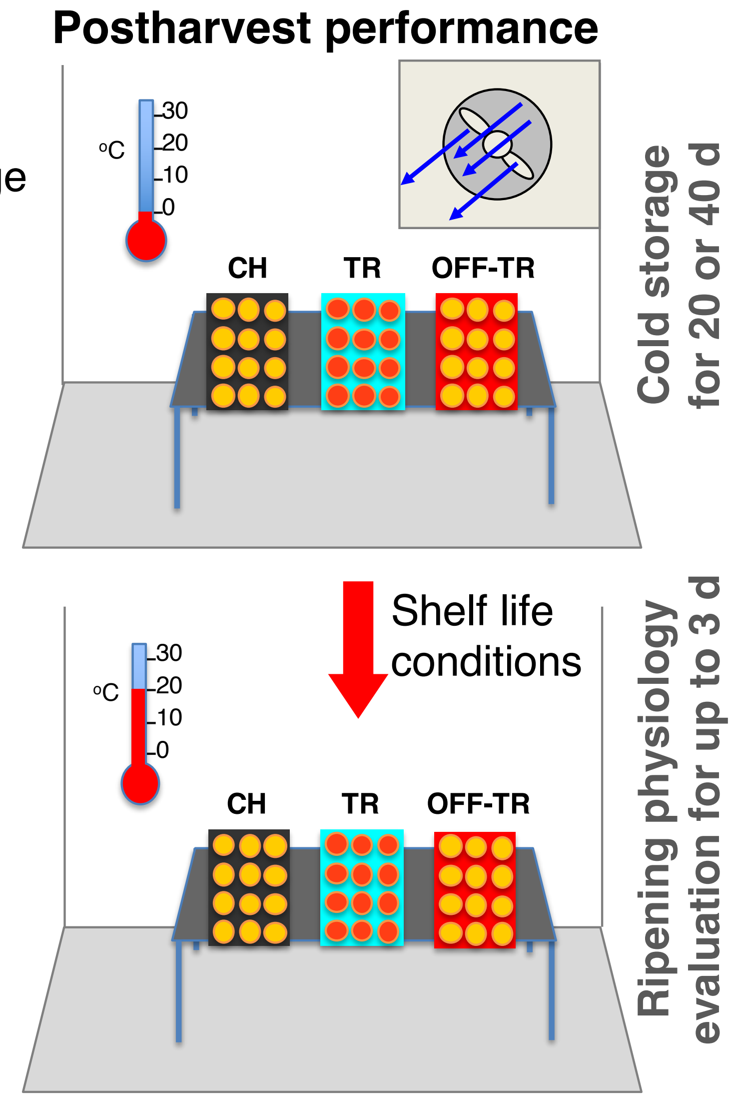
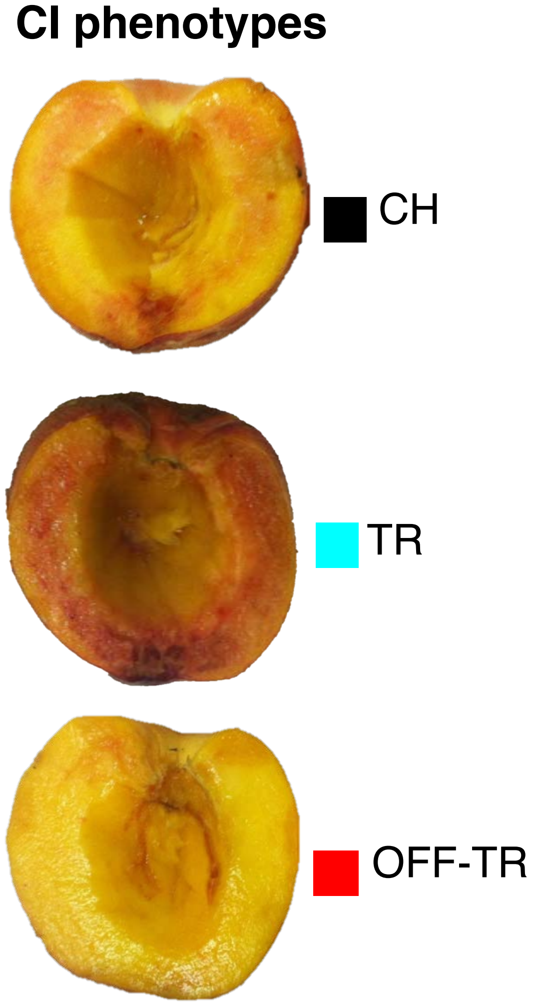
Simulated conditions of CI priming (maturity) and suppression (pre-conditioning) provided distinct CI phenotypes. OFF-TR were CI-free, however, TR and CH exhibit severe and moderate CI, respectively.

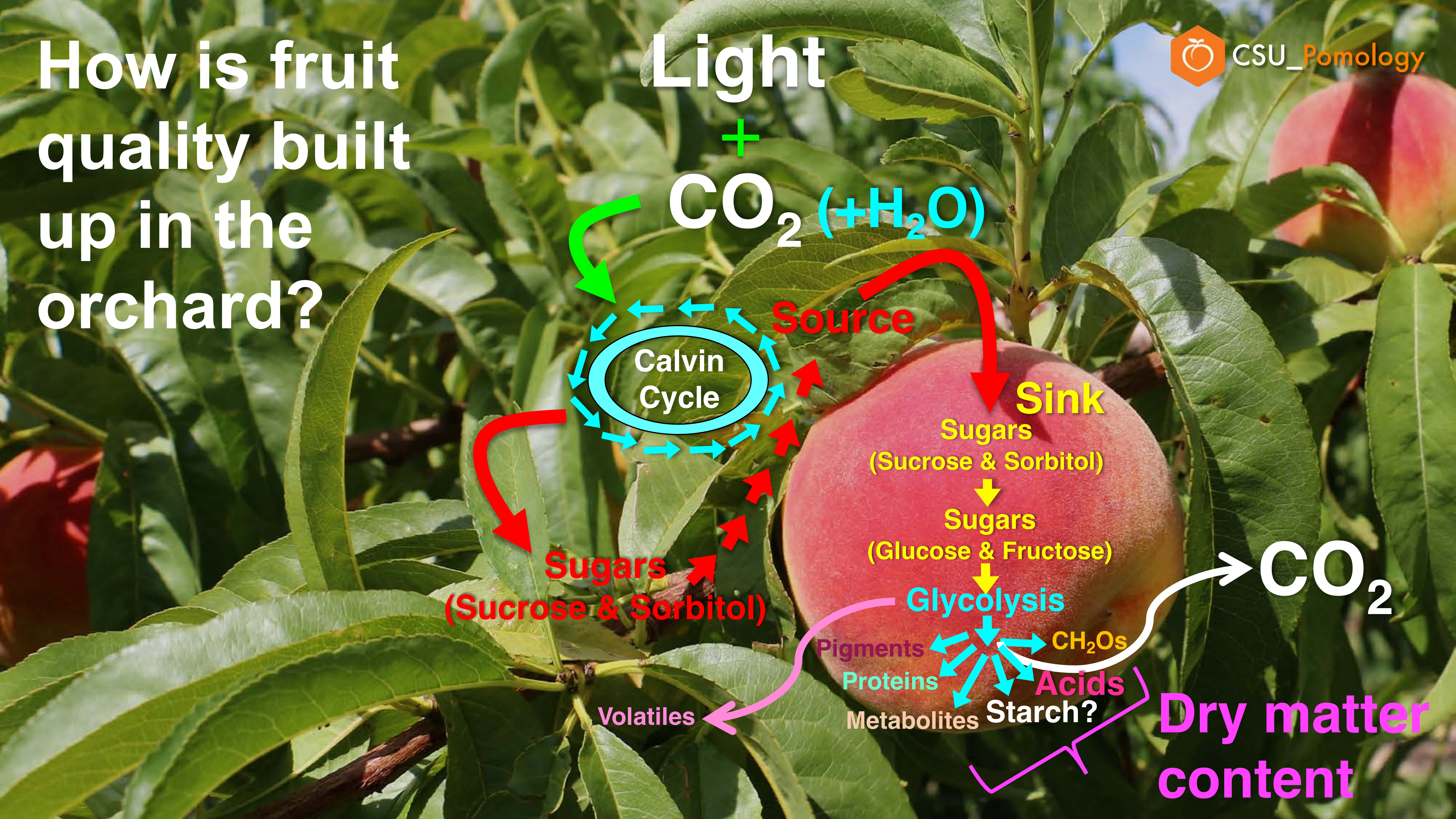






*Adopted by Crisosto et al., 2004. HortTech. 14, 99–104

Tanou, Minas et al., 2017. Scientific Reports 7, 11358


How is fruit quality built up in the orchard?
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Light
+
CO_2 $(+H_2O)$
Calvin Cycle
Source
Sugars
(Sucrose & Sorbitol)
Sink
Sugars
(Sucrose & Sorbitol)
Sugars
(Glucose & Fructose)
Glycolysis
Pigments
CH_2Os
Proteins
Acids
Metabolites
Starch?
Volatiles
CO_2
Dry matter content

Pre-harvest factors affecting peach fruit quality

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Crop Load

Crop load/thinning method/thinning time
Baugher et al. (1991)
Berman and DeJong (1996)
Drogoudi et al. (2009)
Grossman and DeJong (1995)
Grossman and DeJong (1995)
Inglese et al. (2002)
Marini et al. (2002)
Schupp and Baugher (2011)

Fruit canopy position

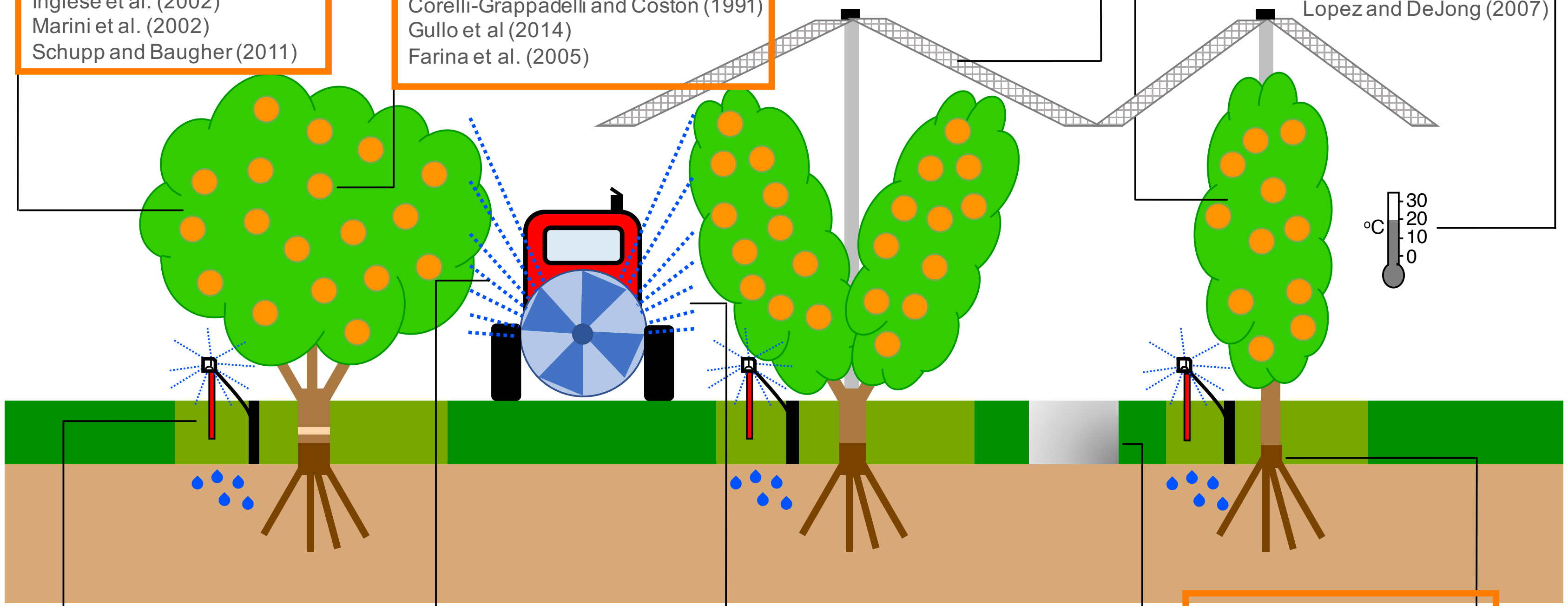
Fruit position in the canopy
Corelli-Grappadelli and Coston (1991)
Gullo et al (2014)
Farina et al. (2005)

Light manipulation/ photo-selective nets
Bastias and Correli-Grappadelli (2012)
George et al. (1996)
Marini et al. (1991)
Shahak et al. (2004)

Training systems

Canopy architecture
Dejong et al. (1994)
Dejong et al. (1999)
Caruso et al. (1999a)
Caruso et al. (1999b)
Farina et al. (2005)
Gullo et al. (2014)
Robinson et al. (2006)

Growing climate
Johnson et al. (2015)
Karagiannis et al. (2016)
Lopez and DeJong (2007)



Irrigation method/RDI
Alcobendas et al. (2012)
Bryla et al. (2005)
Crisosto et al. (1994)
Faci et al. (2014)
Lopez et al. (2011)
Rahmati et al. (2015)

Mineral nutrition/ foliar sprays
Crisosto et al. (2000)
Daane et al. (1995)
Manganaris et al. (2005)
Sotiropoulos et al. (2010)
Val and Fernández (2011)

Plant growth regulators
Belding and Lokaj (2002)
Cline (2006)

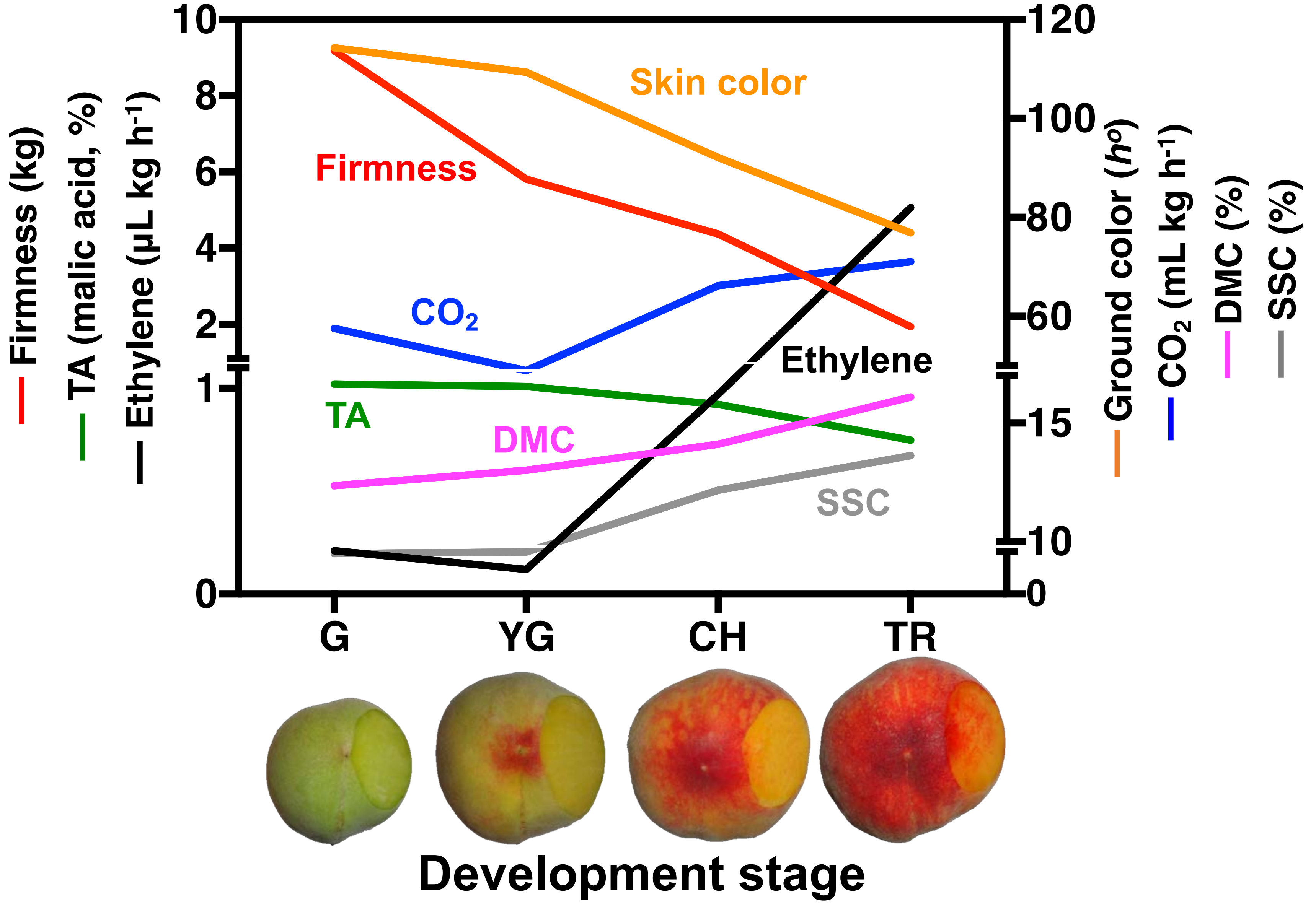
Light manipulation/ reflectance films
Layne et al. (2001)

Rootstock

Rootstocks
Font i Forcada et al. (2012)
Giorgi et al. (2005)
Inglese et al. (2002)
Gullo et al. (2014)
Reighard et al. (2015)
Remorini et al. (2008)

Reviewed by Minas et al., 2018. Scientia Horticulturae 235, 307–322

Quality changes during 'June Gold' peach fruit development & ripening on-tree



Fruit quality and maturity assessment methods are destructive and labor intensive

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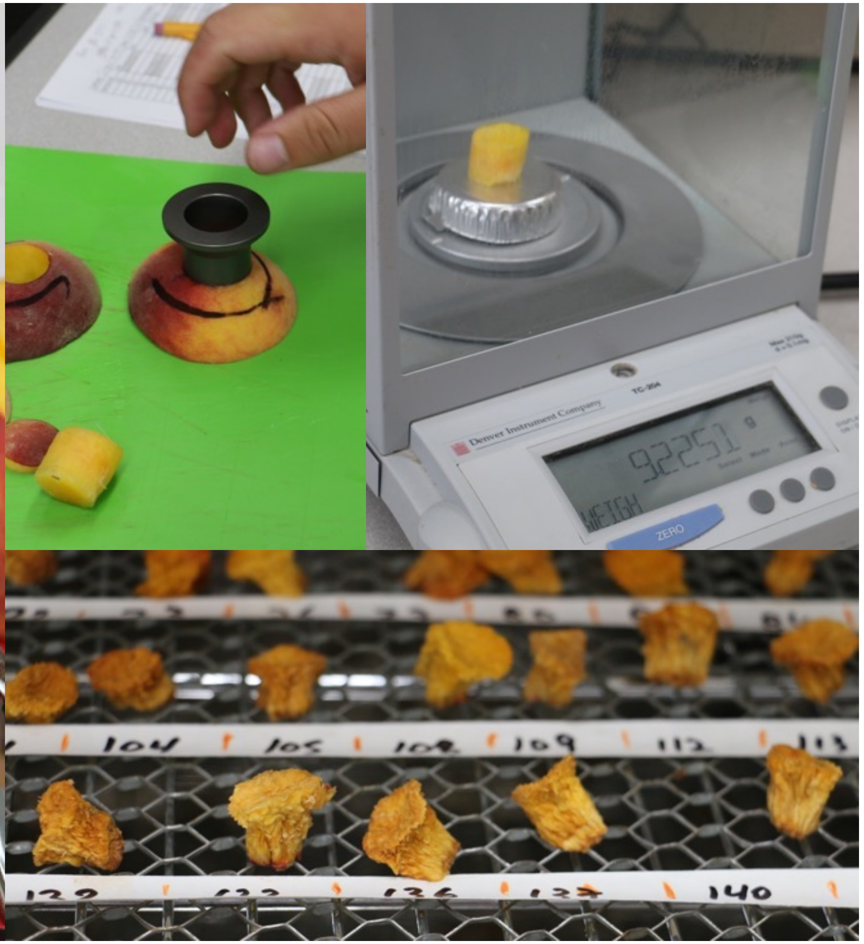
Flesh Firmness (FF)
'maturity' &
'shipment/storage potential'

Soluble Solids Concentration (SSC)
'sweetness'

Dry Matter Content (DMC)
'sweetness' &
'consumer acceptance'



Development of non-destructive technologies to estimate internal fruit quality

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Handheld non-destructive sensors to estimate internal fruit quality and maturity in the field

✓ **Analysis of larger fruit volumes to understand the effect of pre-harvest factors**

F-750 Produce Quality Meter
Near-Infrared Spectroscopy (NIR)

- "Open" type instrument (on-site calibration)
- **DMC and SSC at 729-935 nm**
- Three online measurements at the same time (2 displayed)

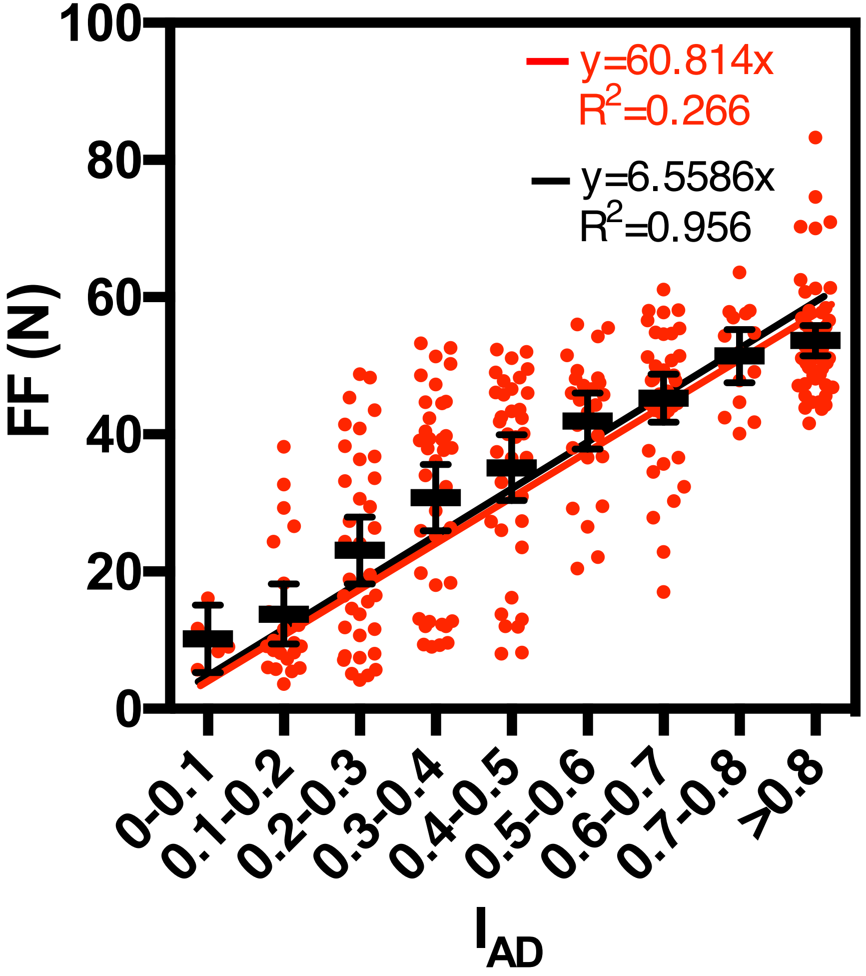
DA-meter
Vis/NIR

- **Costa et al., 2009**
- "Closed" type instrument (calibrated at the factory)
- **Index of Absorbance Difference (I_{AD})**
- **$I_{AD}=A_{670nm}-A_{720nm}$ (chlorophyll content)**
- **Fruit physiological maturity**

I_{AD} correlates with FF in ‘Sierra Rich’ peach only when I_{AD} values are plotted in clusters

(but describes physiological maturity better)

FF



I_{AD}

(Minas et al., 2021)

Accurate non-destructive prediction of peach fruit internal quality and physiological maturity with a single scan using Vis-NIRS

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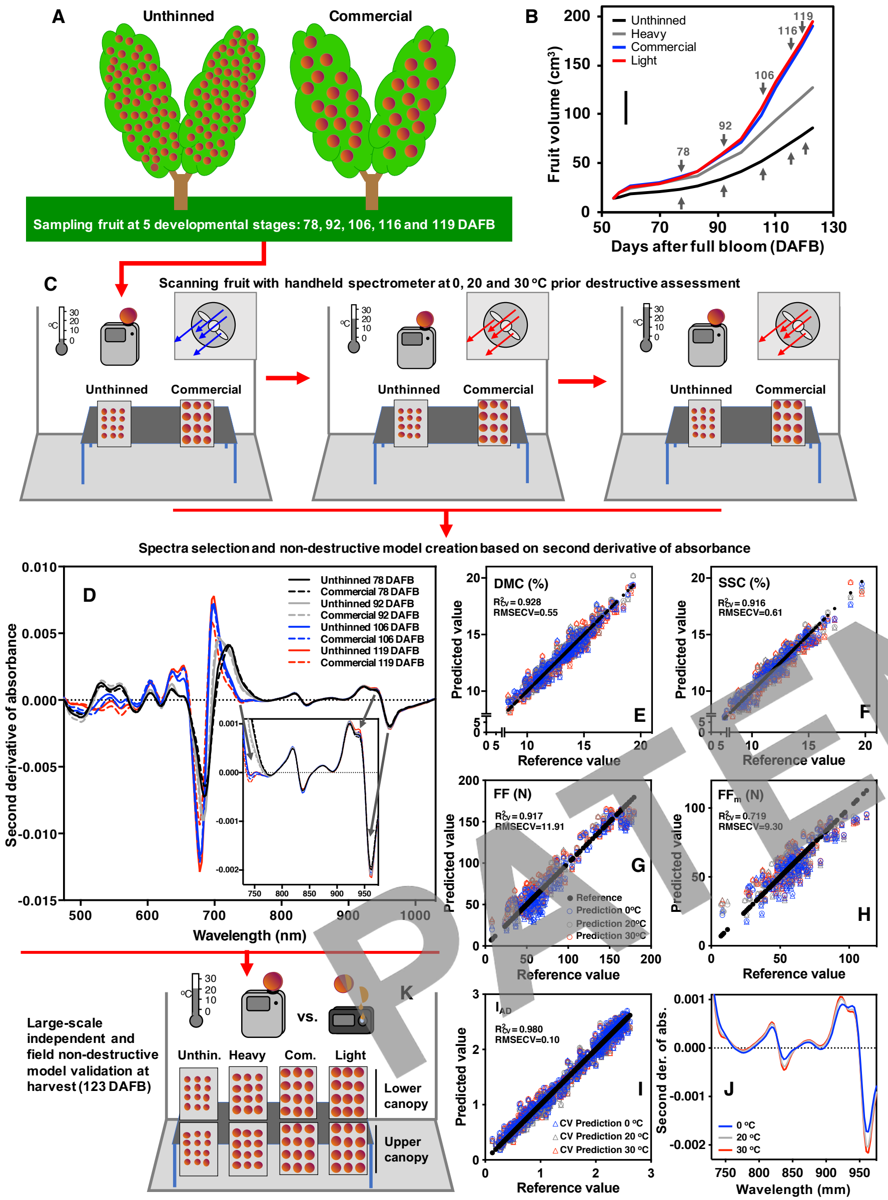
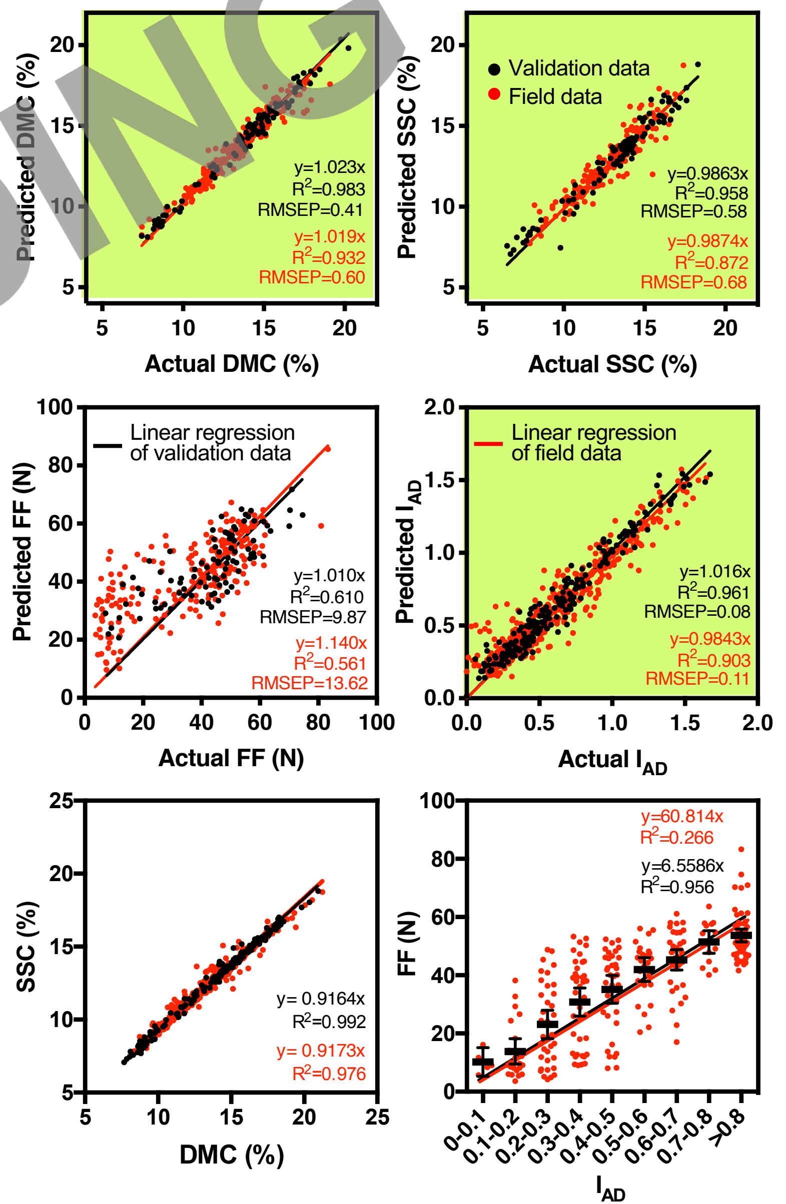


- Novel Vis-NIRS calibration protocol resulted in accurate regression models of peach quality and maturity
- DMC, SSC and I_{AD} can be predicted with a single scan to assess the true orchard impact on peach quality
- A novel concept device can assess peach quality and maturity during fruit growth, development and at harvest in the field and during postharvest
- This calibration protocol and concept device can enhance NIRS utilization across tree fruit supply chain

Minas et al, 2021. Accurate non-destructive prediction of peach fruit internal quality and physiological maturity with a single scan using near infrared spectroscopy. Food Chemistry 335, 127626.



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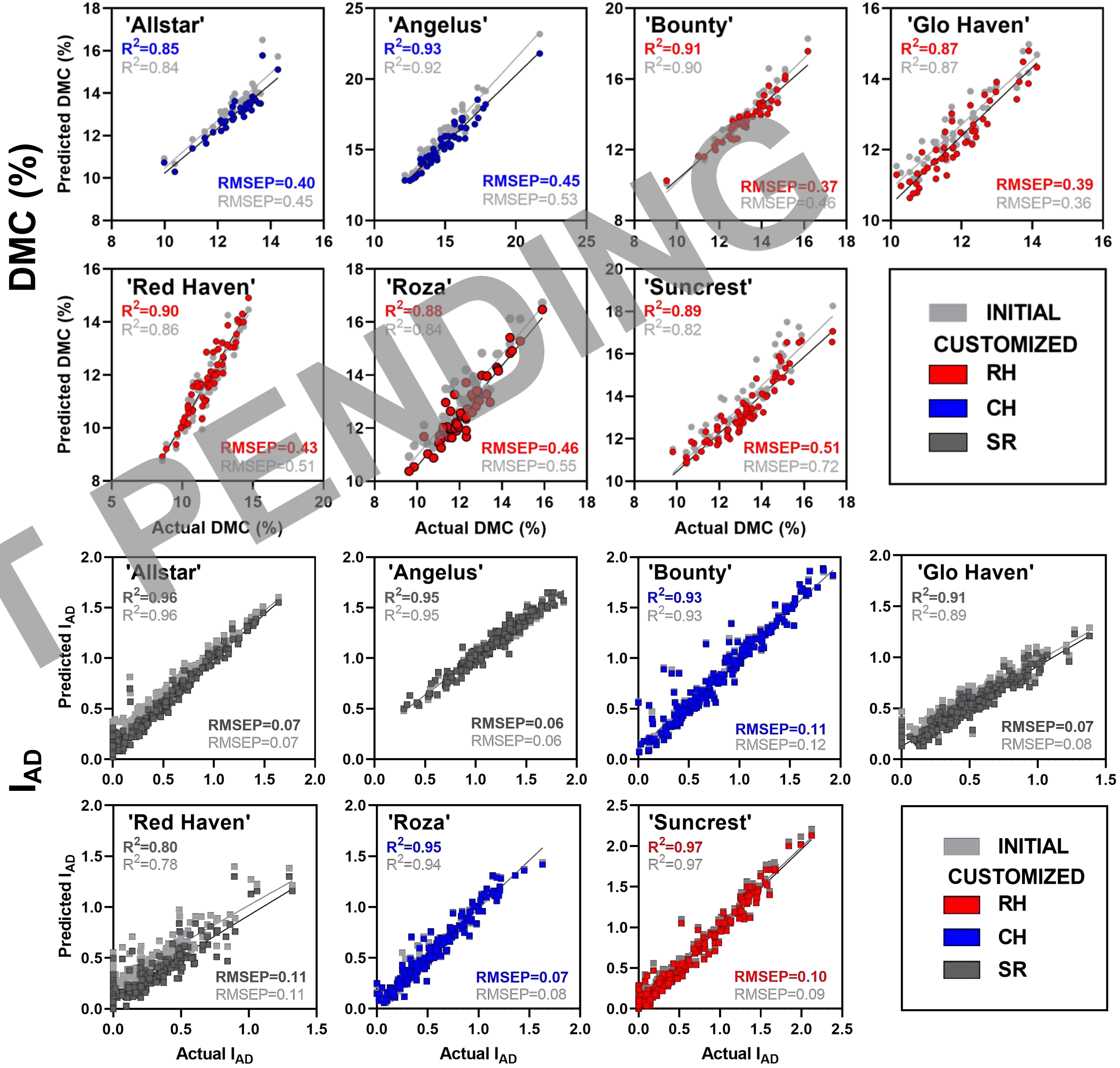
Technology Readiness Level: 5

Proof of concept-real world demonstration stage

Developed models of the concept device are showing strong performance with multiple peach cultivars

Anthony et al, 2021. *In press*



Cultivar Evaluation: 13 Cultivars of variable harvest date assessed for quality at three ripeness stages in 2021

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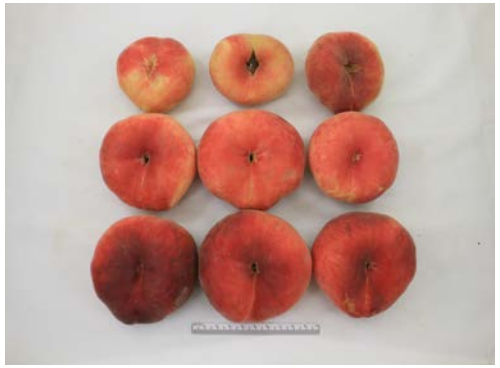
'Redhaven'


'Galaxy'*


'Newhaven'


'Starfire'


'Glohaven'


'PF-19'


'Suncrest'


'Glowingstar'


'Blushingstar'*


'PF-23'


'PF-24C'


'Angelus'


'O'Henry'

Row 1: Immature (>50 N)
Row 2: Commercial (30 – 50 N)
Row 3: Tree-ripe (<30 N)

Pott et al, 2022. *In preparation*

*white flesh

Cultivar Evaluation: 13 Cultivars of variable harvest date assessed for quality at three ripeness stages in 2021

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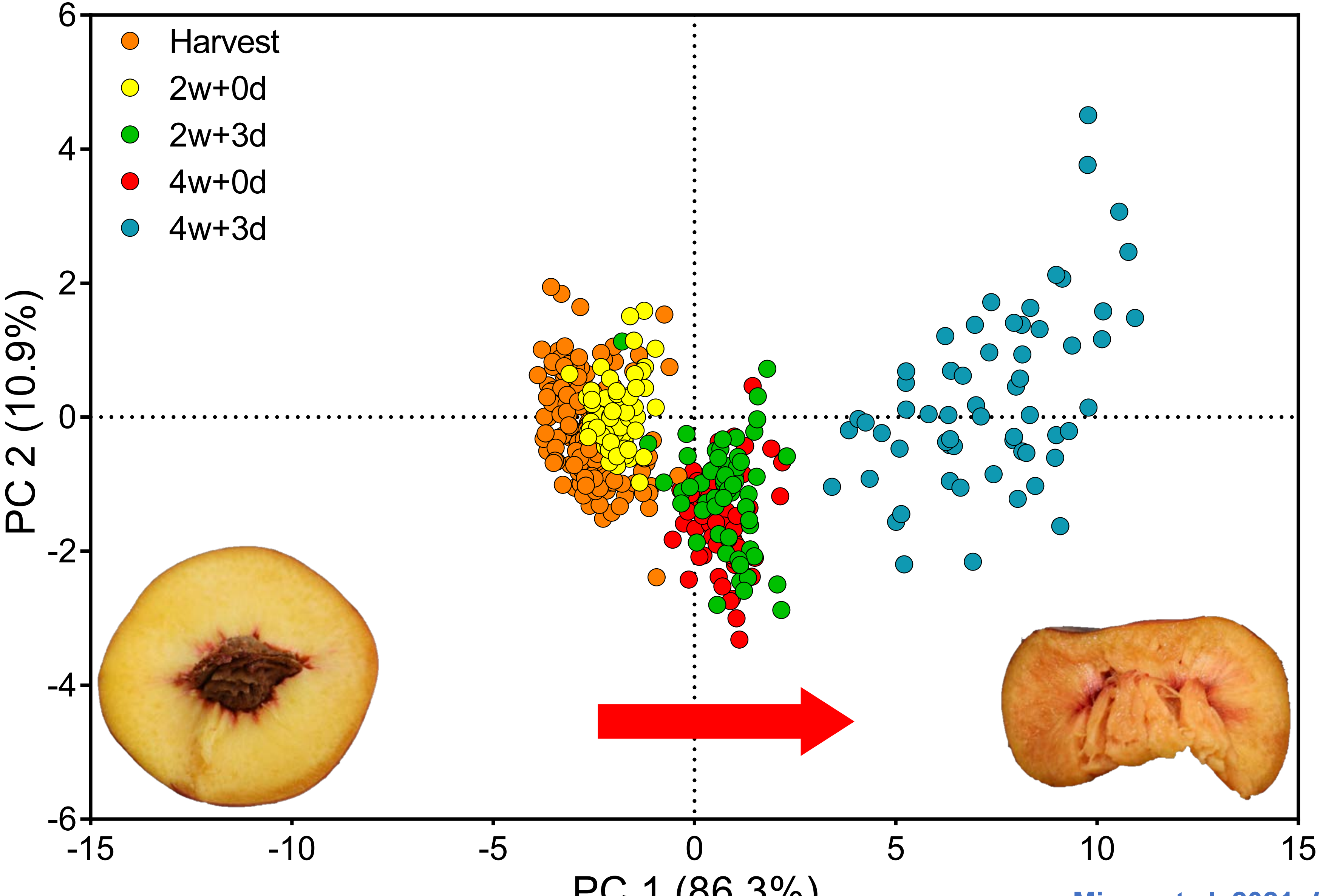
Cultivar	Harvest Date	Fruit FW (g)	Fruit size (diam., mm)	DA meter	Flesh firmness (N)	DMC (%)	SSC (%)	Crop load (fruit/cm^2 TCSA)
'Red Haven'	7/27	165.4 cd	69.1 fg	0.3 cd	40.3 a	12.6 ef	11.2 ef	2.0ab
'Galaxy'*	7/29 – 7/30	165.9 cd	79.6 a	0.5 a	40.6 a	15.8 b	15.1 a	1.9ab
'Newhaven'	7/30 – 8/2	157.6 d	69.9 efg	0.4 bc	42.4 a	11.9 fg	11.1 ef	1.9ab
'Starfire'	7/30 – 8/2	172.7 bcd	71.1 cdef	0.3 de	42.7 a	11.5 g	10.0 g	1.7ab
'Glohaven'	8/10	181.6 abc	70.5 cdefg	0.4 b	41.8 a	12.1 fg	10.8 f	1.9ab
'PF-19'	8/11	175.7 abcd	69.3 efg	0.2 de	41.0 a	13.1 de	11.6 def	1.2ab
'Suncrest'	8/12 – 8/13	190.6 ab	69.7 defg	0.5 ab	40.8 a	13.8 cd	12.3 cd	1.3ab
'Glowingstar'	8/17	192.1 a	73.1 bcd	0.2 e	42.2 a	13.0 de	12.6 bc	1.8ab
'Blushingstar'*	8/17 – 8/18	191.7 a	73.9 b	0.2 e	40.3 a	12.6 ef	11.6 de	1.7ab
'PF-23'	8/18	188.6 ab	72.3 bcde	0.3 de	41.0 a	13.6 d	12.4 c	0.8 b
'PF-24C'	8/19	156.4 d	68.5 g	0.2 de	42.5 a	13.4 d	12.5 c	2.4 a
'Angelus'	8/25-8/30	202.5 a	74.3 bc	0.2 de	39.7 a	17.4 a	15.6 a	1.4ab
'O'Henry'	9/8-9/13	197.0 a	71.2 bcdefg	0.5 ab	41.1 a	14.5 c	13.2 b	1.1 b

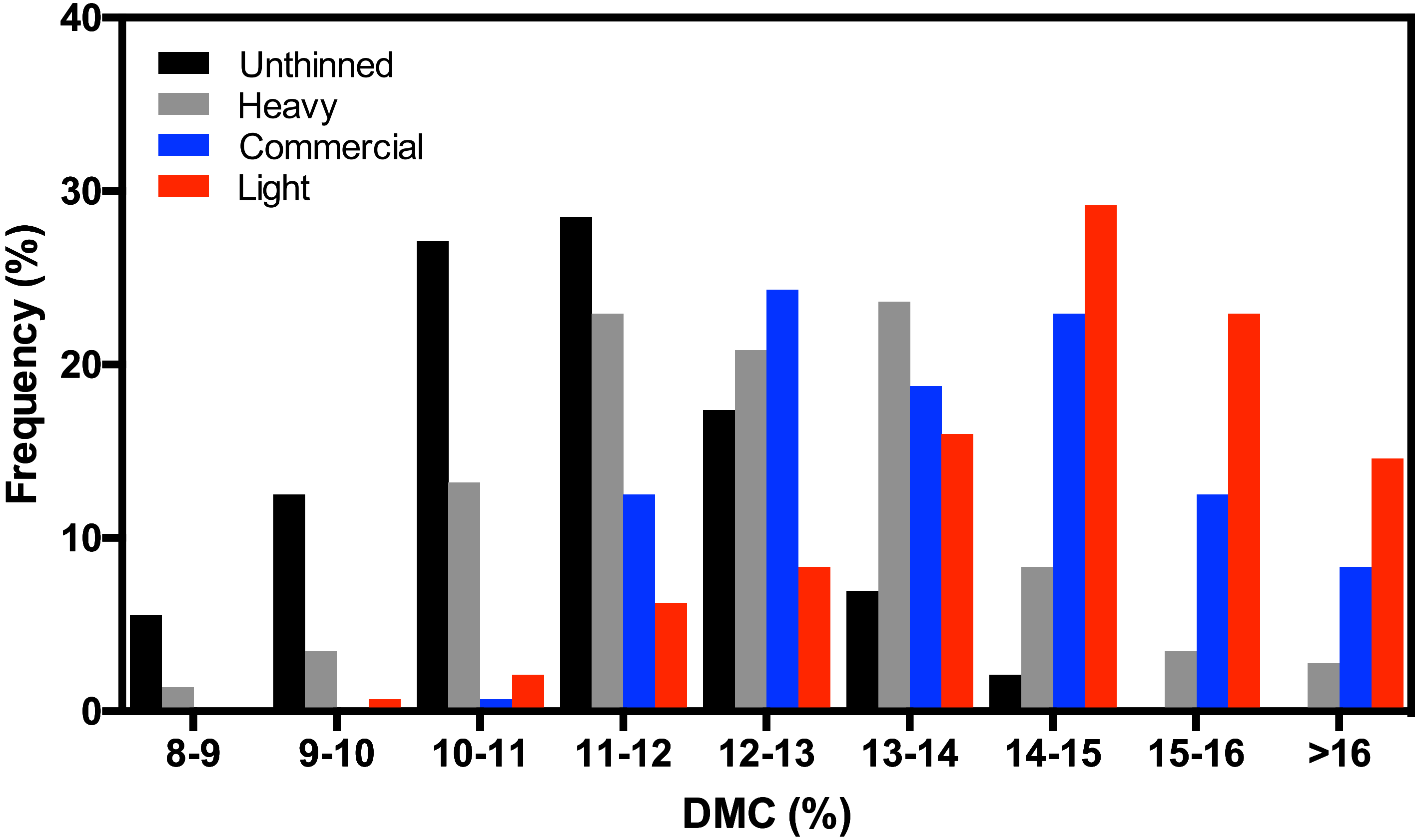
Pott et al, 2022. *In preparation*

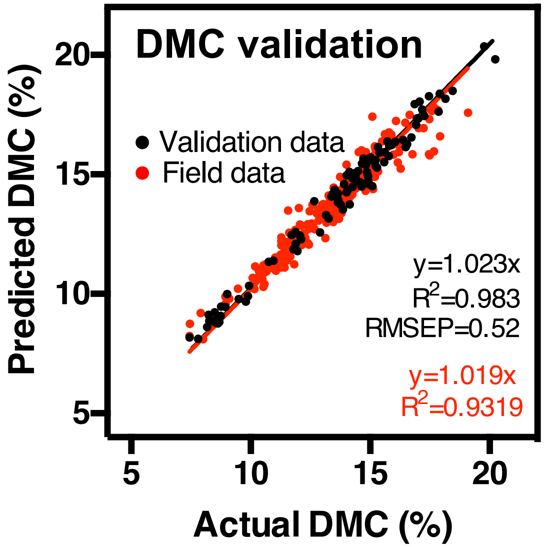
Use of NIR spectral data to predict chilling injury (CI) symptoms development that damage consumer quality

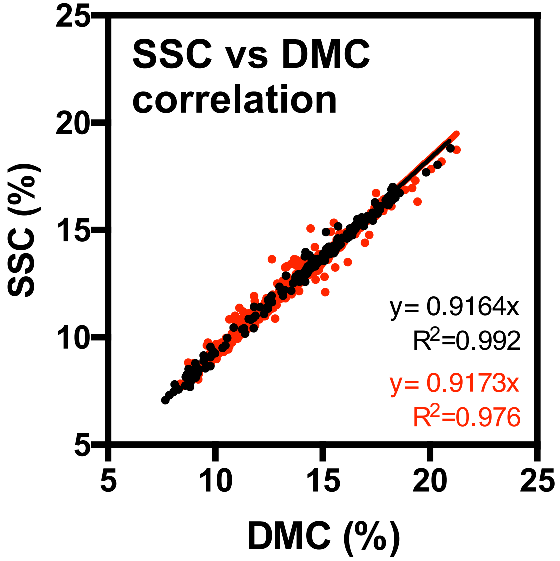


Minas et al, 2021. *In preparation*

Effect of crop load on ‘Sierra Rich’ peach DMC at harvest as predicted by NIR







Unthinned Heavy Commercial Light

(Minas et al., 2021)

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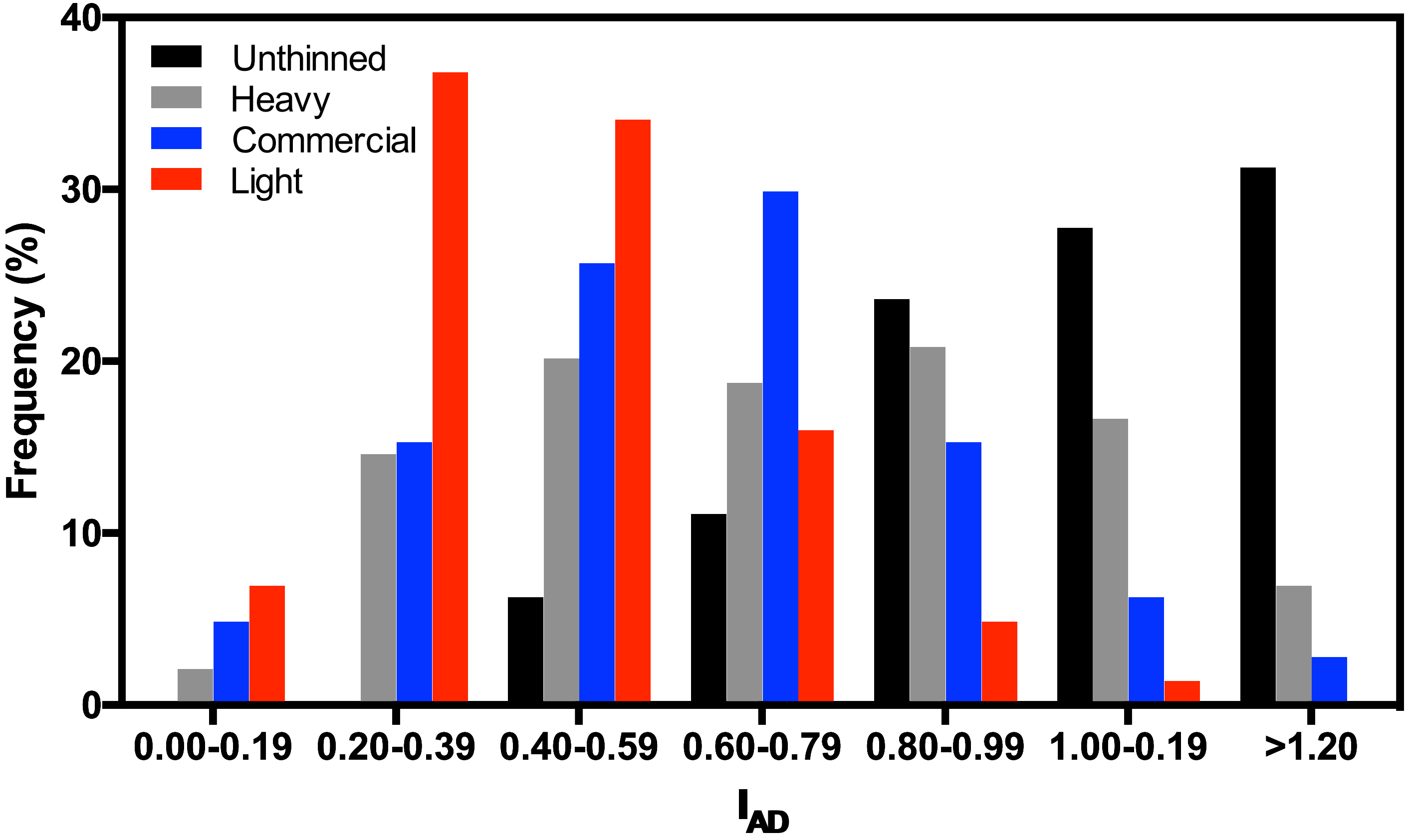
Effect of crop load on 'Sierra Rich' peach maturity at harvest assessed non-destructively with I_{AD} (DA-meter)



Light | Commercial | Heavy | Unthinned

(Minas et al., 2021)

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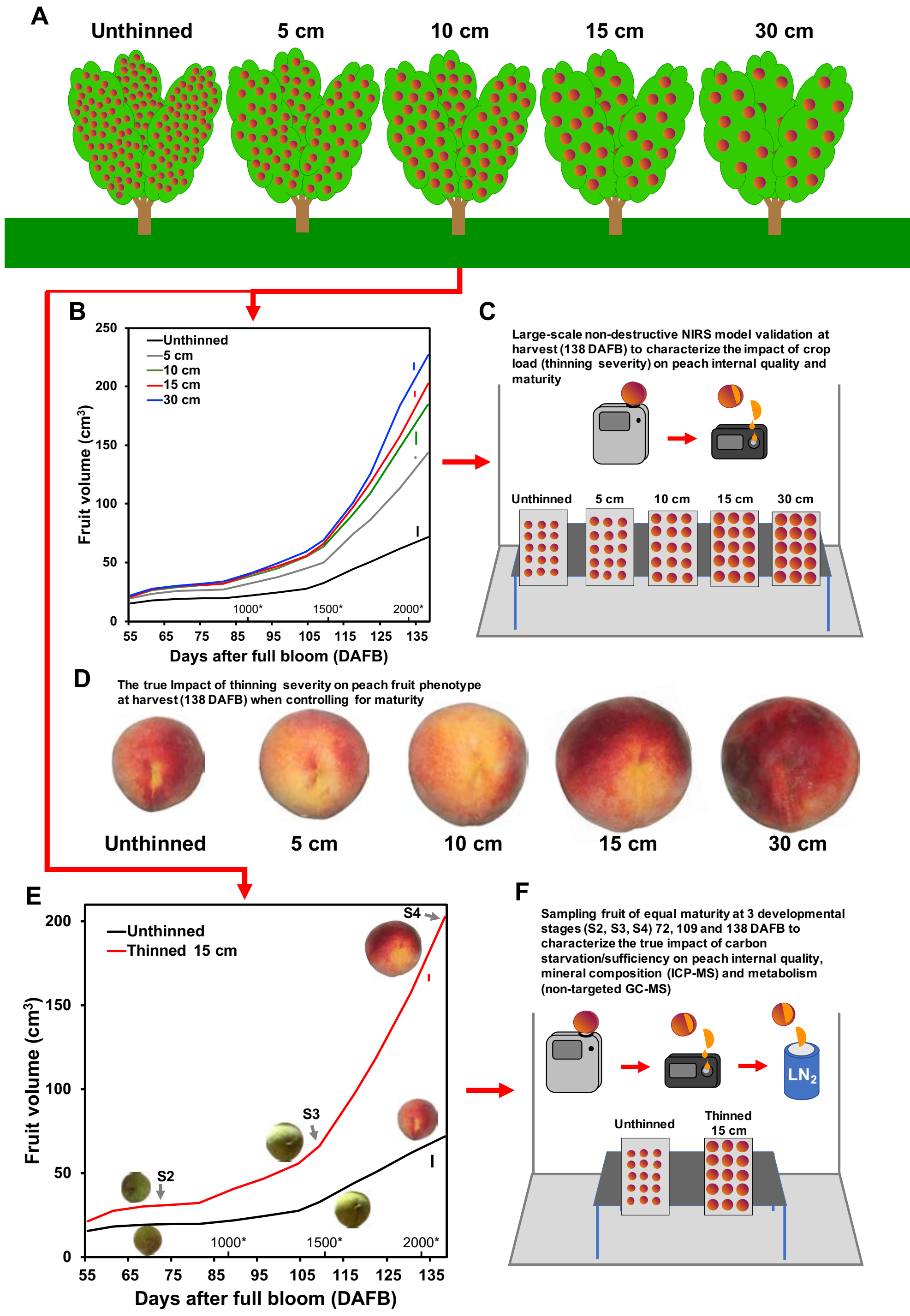
Effect of Thinning Severity and Carbon Competition on Peach Fruit Quality Development

(@ equal maturity)

- **Two distinct thinning severities** selected for in depth quality analysis and non-targeted metabolomic profiling:
  - Thinned (15 cm) – Carbon Sufficient
  - Unthinned – Carbon Starved
- At each dev. stage, **maturity was equal** between thinning treatments
- Fruit from the **thinned** (carbon sufficient) treatment **revealed superior fruit quality at harvest** (S4), when compared to the unthinned (carbon starvation) treatment



Anthony et al., (2020). Early metabolic priming under differing carbon sufficiency conditions influences peach fruit quality development. Plant Physiology and Biochemistry, DOI: 10.1016/j.plaphy.2020.11.004

Early metabolic priming under differing carbon sufficiency conditions influences peach fruit quality development

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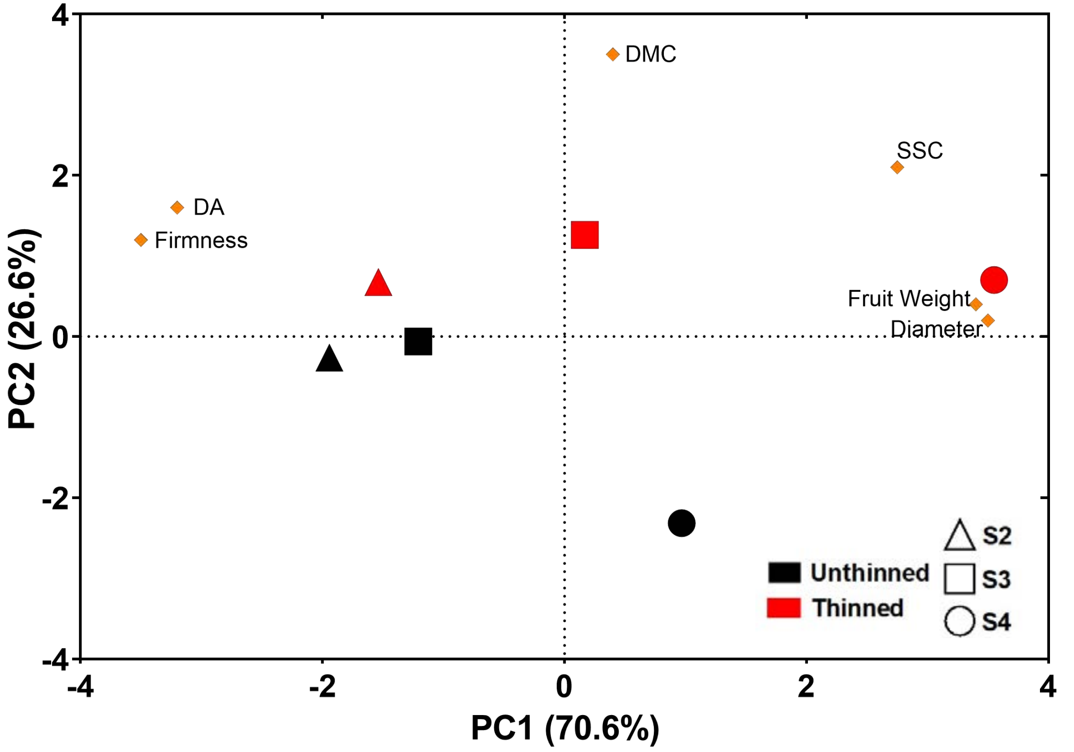
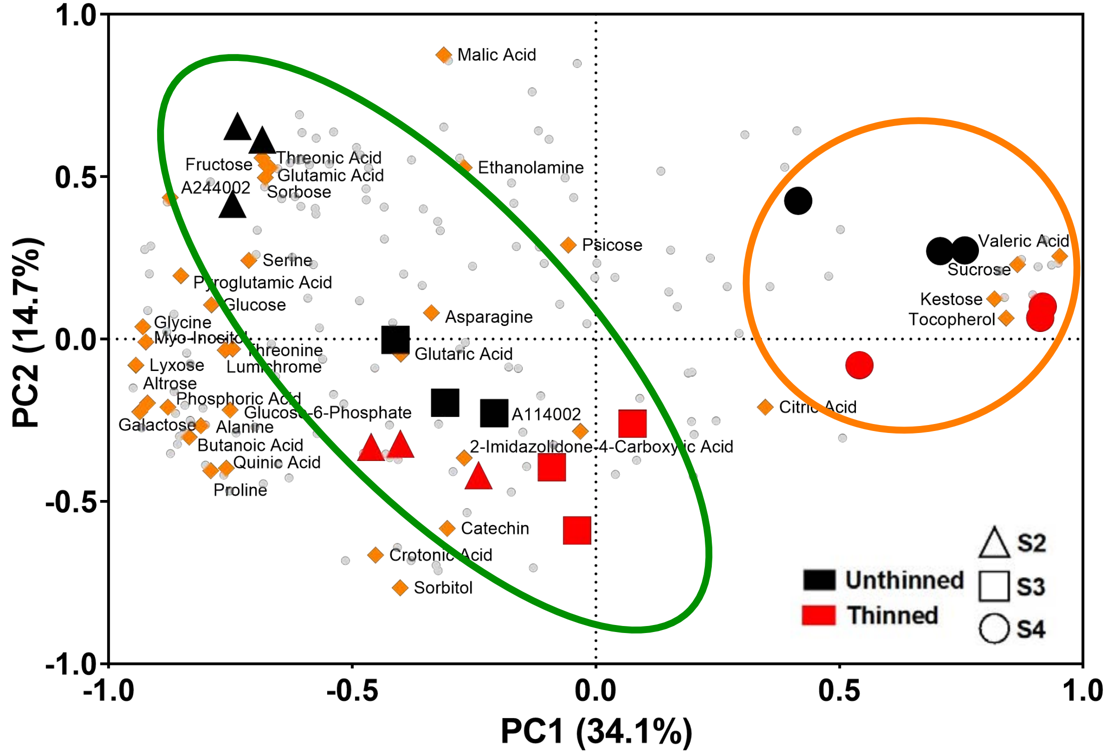
Fruit Quality



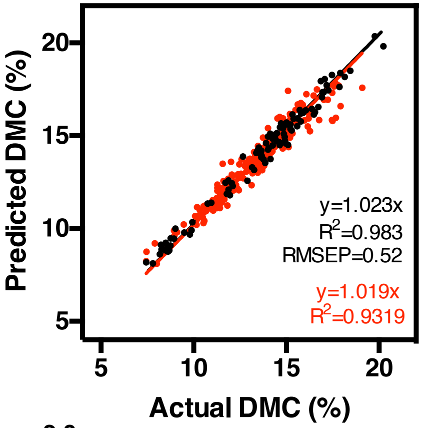
Metabolism

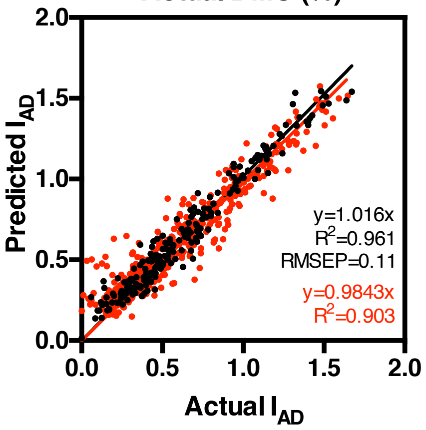


- Quality and **phenotypic differences were minimal at S2,** but vastly different at S4 (left)
- **Metabolic differences were vast at S2**, while profiles at S4 were similar (right)
- Many metabolites associated with the **primary metabolism shift according to development process**
- **Catechin** was **positively** related to **quality** parameters, DMC and SSC

(Anthony et al., 2020)

Effect of fruit position in the canopy on ‘Sierra Rich’ peach internal quality at harvest
(@ equal maturity)

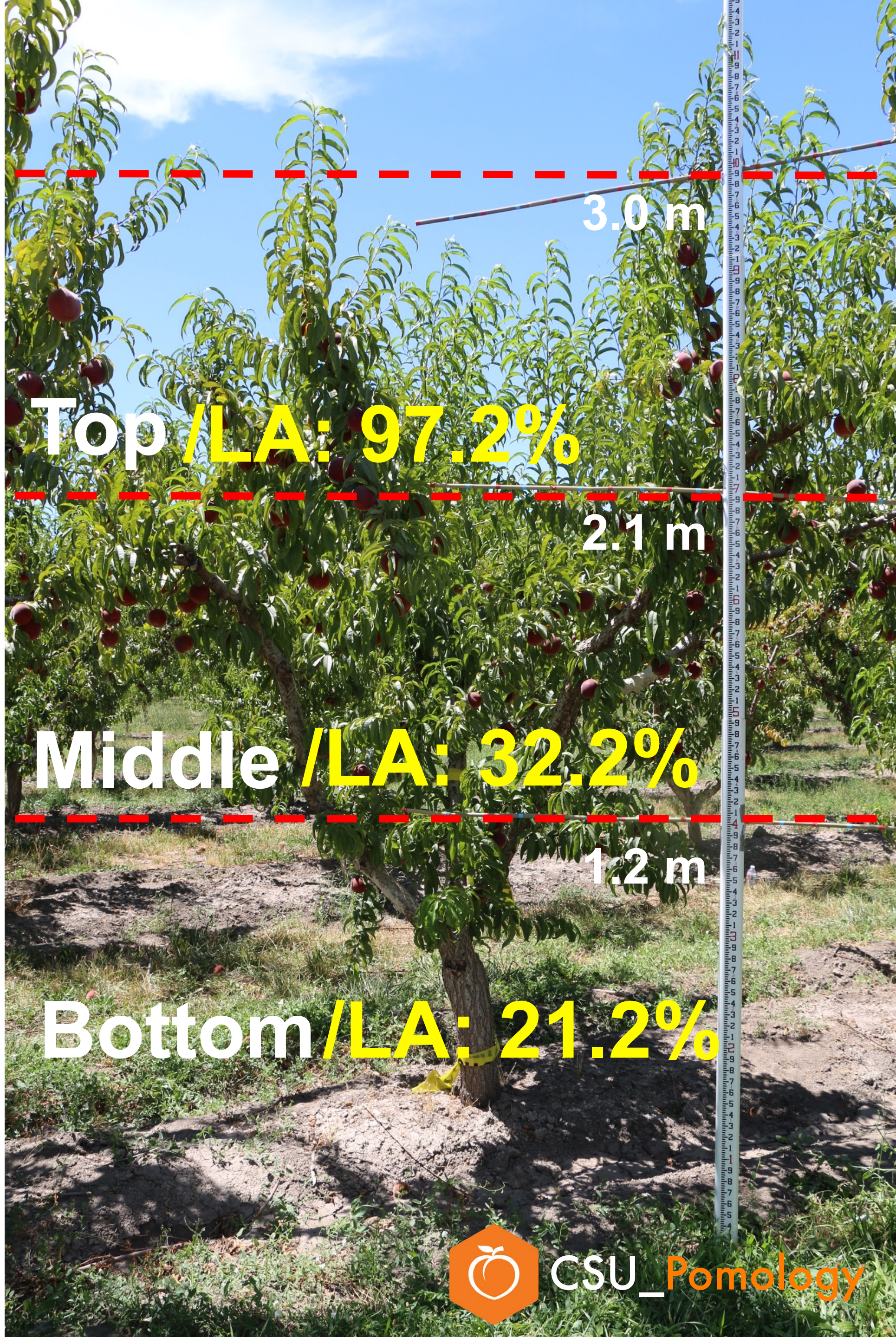




I_{AD}: 0.69
DMC (%):13.1

I_{AD}: 0.71
DMC (%):12.2

I_{AD}: 0.71
DMC (%):12.4

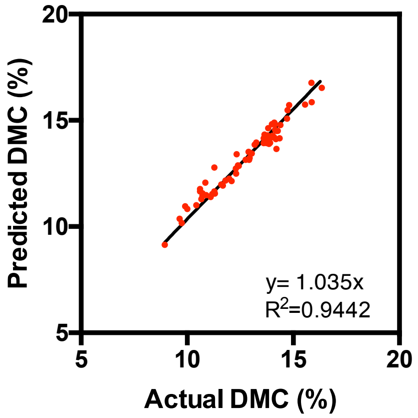


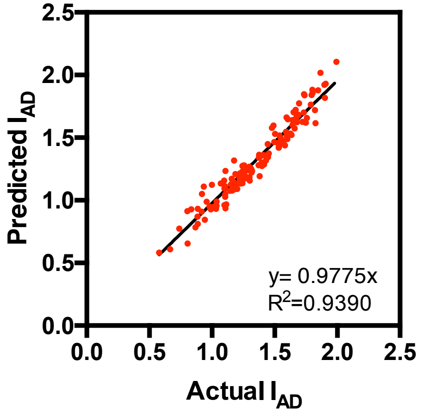
- **No significant differences** across canopy positions
- **Low vigor** = uniform light

Anthony et al., 2021. *Environmental & Experimental Botany*

*LA= Light Availability

Effect of fruit position in the canopy on ‘Cresthaven’ peach internal quality at harvest *(@ equal maturity)*

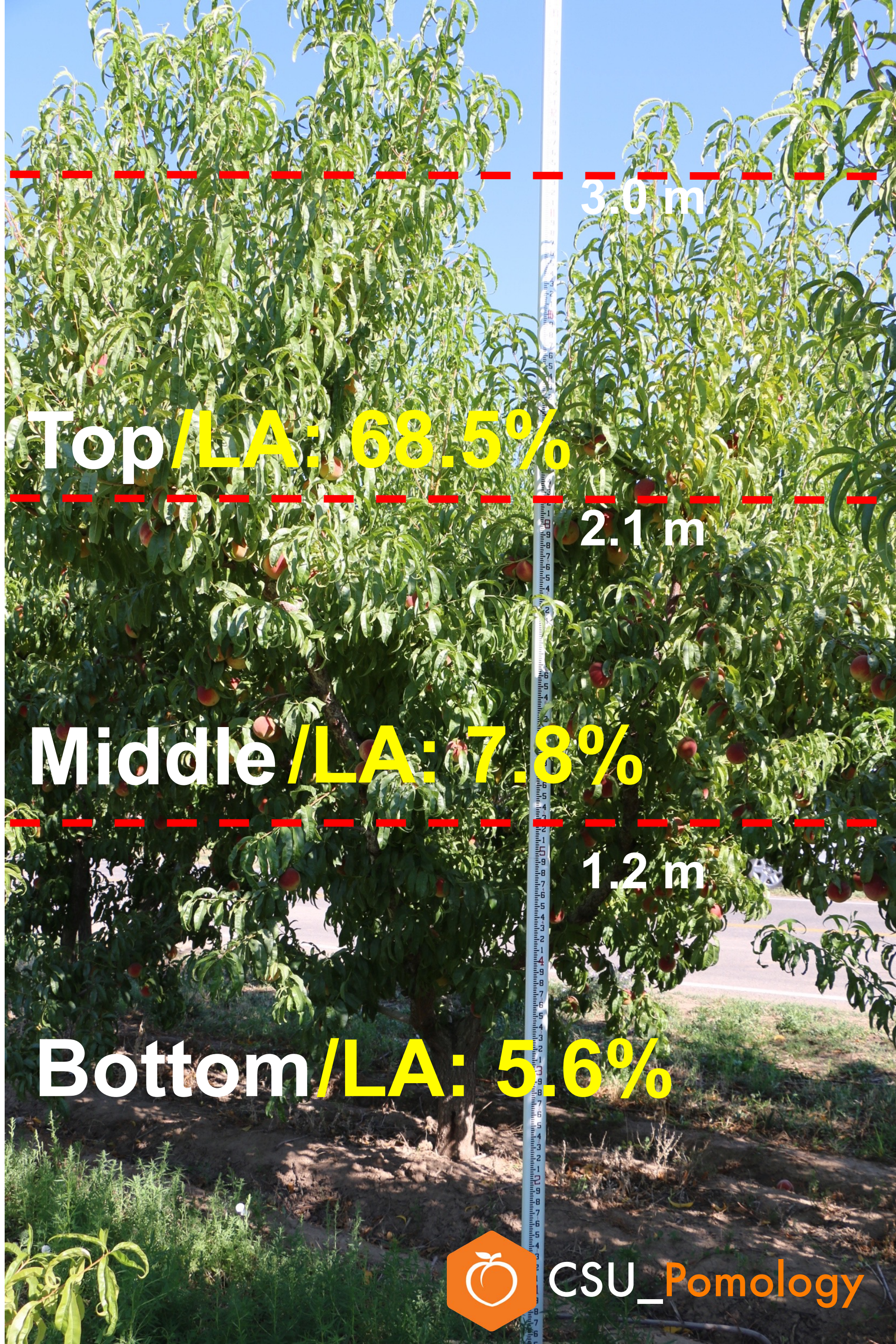




I_{AD}: 1.05
DMC (%):13.0* a

I_{AD}: 1.07
DMC (%):11.7* b

I_{AD}: 1.08
DMC (%):10.9* c

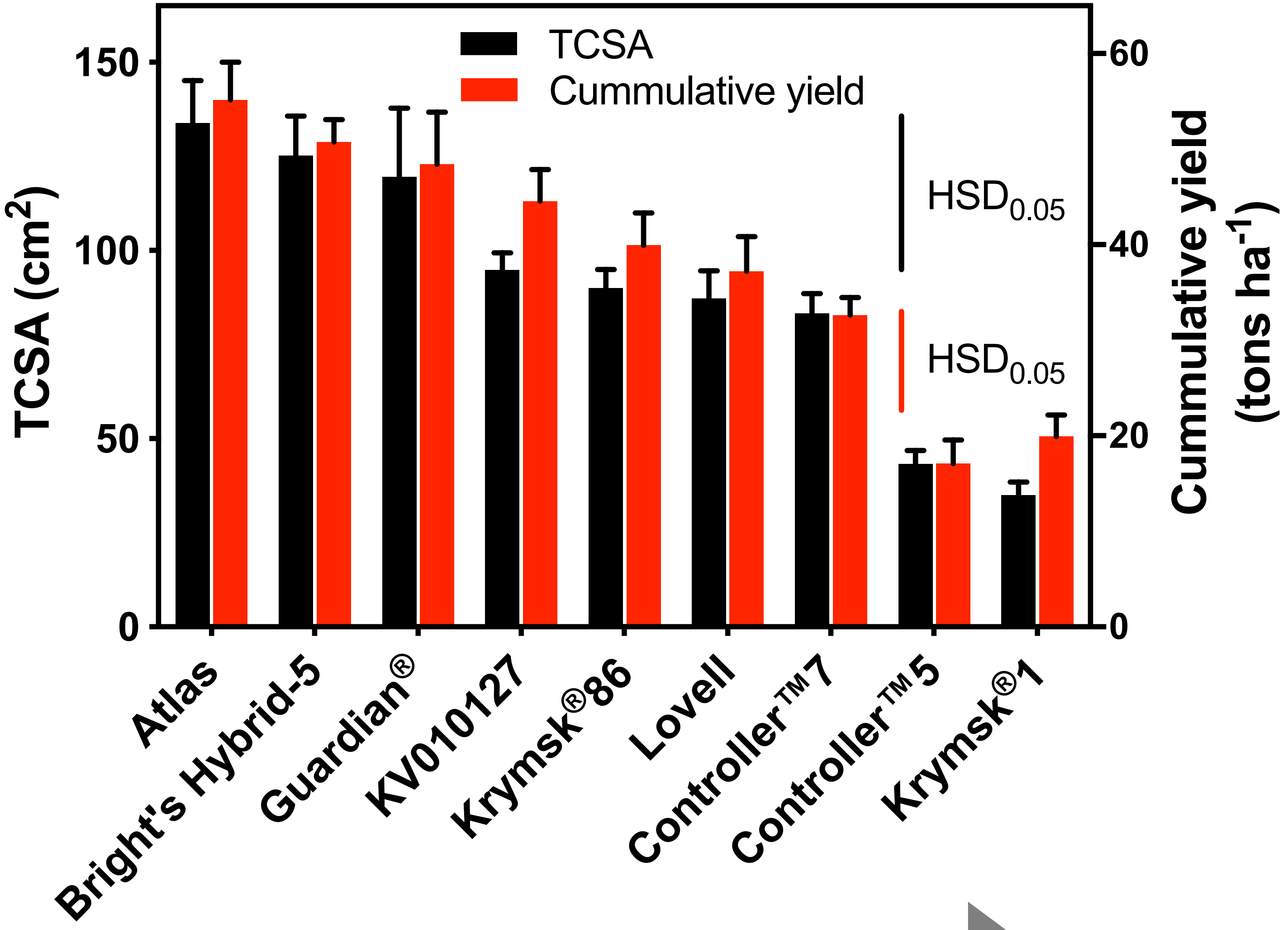


- ***Significant differences** across canopy positions
- **High vigor** = non-uniform light

*LA= Light Availability

Anthony et al., 2021. *Environmental & Experimental Botany*

Effect of rootstock on ‘Redhaven’ cumulative yield per tree (2009-2017)



Vigorous — Rootstock vigor → Dwarfing

2009 NC-140 ‘Red Haven’ Peach Rootstock Trial

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NC-140

Minas et al., 2021. *In preparation*

Influence of rootstocks on peach fruit internal quality

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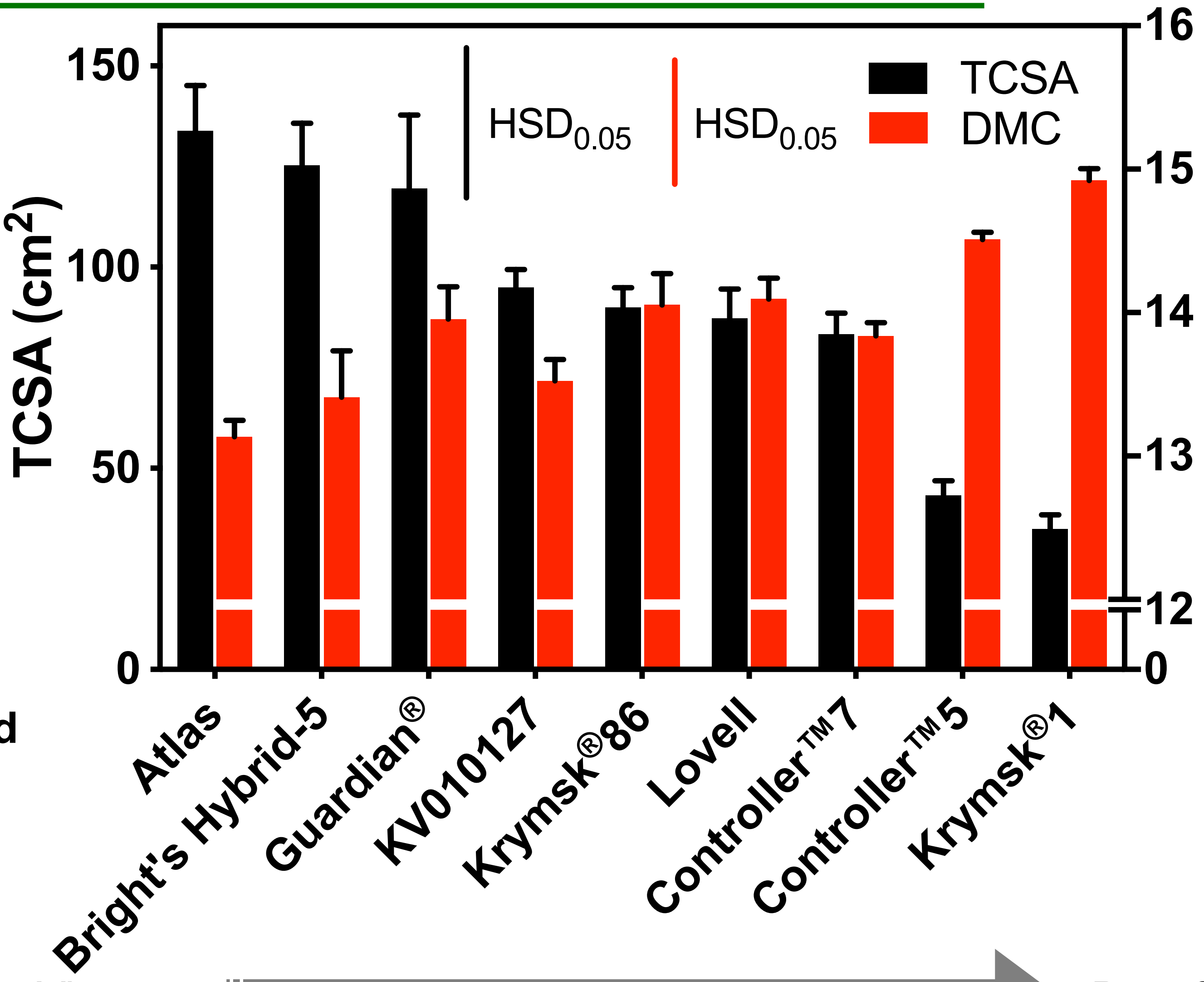
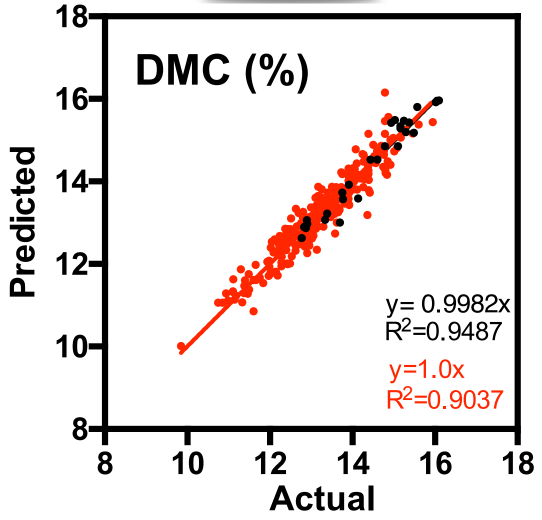
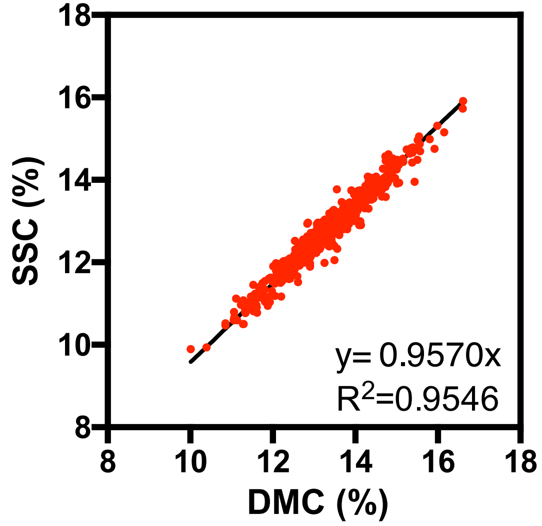
Rootstocks influence ‘Redhaven’ peach productivity and dry matter content (DMC) - 2016-18

(@equal maturity & crop load)



Vigorous | Rootstock vigor | Dwarfing





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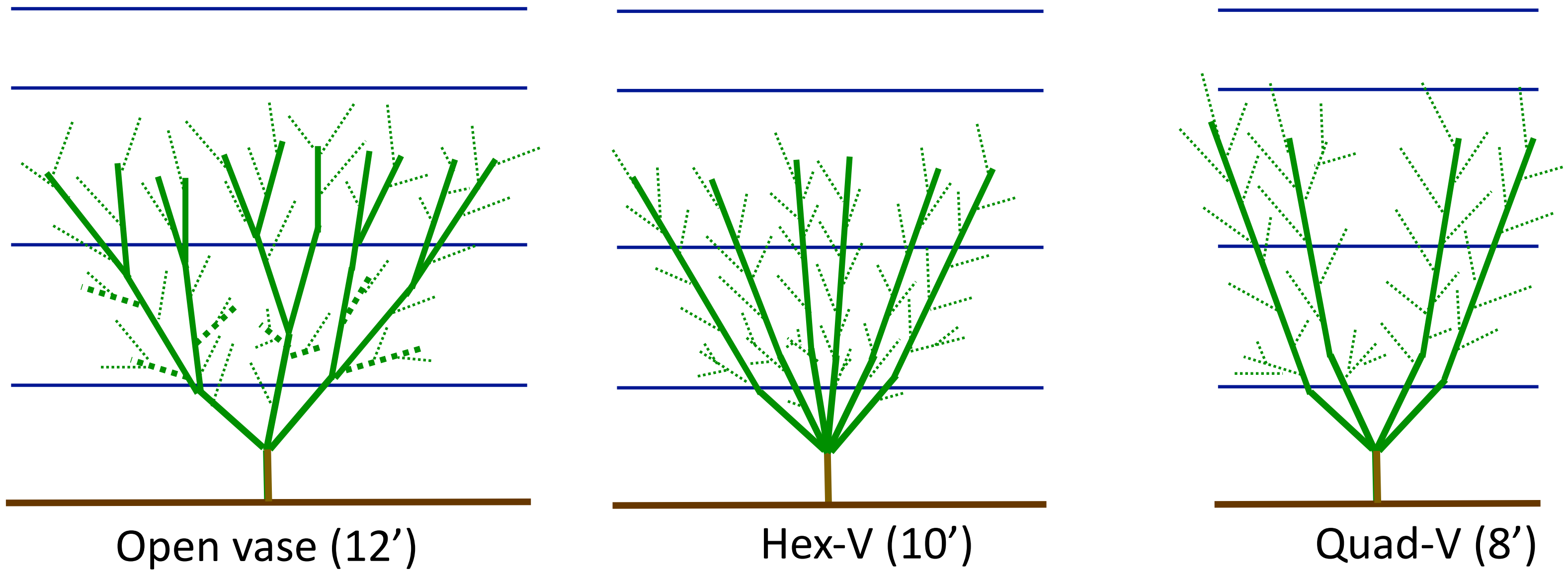
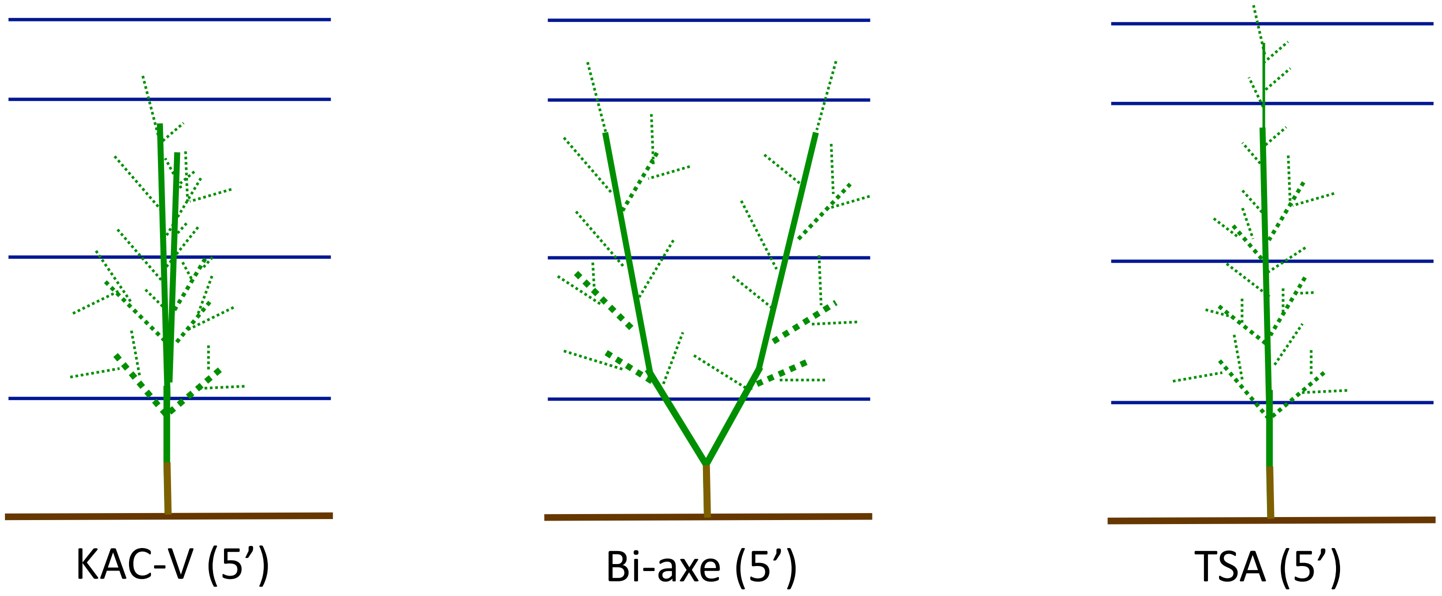
2009 NC-140 ‘Red Haven’ Peach Rootstock Trial

Minas et al., 2021. *In preparation*

Training Systems Trial: 2016 – 2021



Planted: May, 2016
Cultivars x Rootstocks:
- Red Haven x St. Julien (Early)
- O’Henry x Krymsk 86 (Late)



CDA funded project starting January 2020: ‘Management strategies to maximize Colorado peach orchards productivity and fruit quality potential’
PI: Minas

CDA COLORADO Department of Agriculture

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Training Systems: Before and after dormant pruning in ‘O’Henry’ on ‘Krymsk®86’ in 2019

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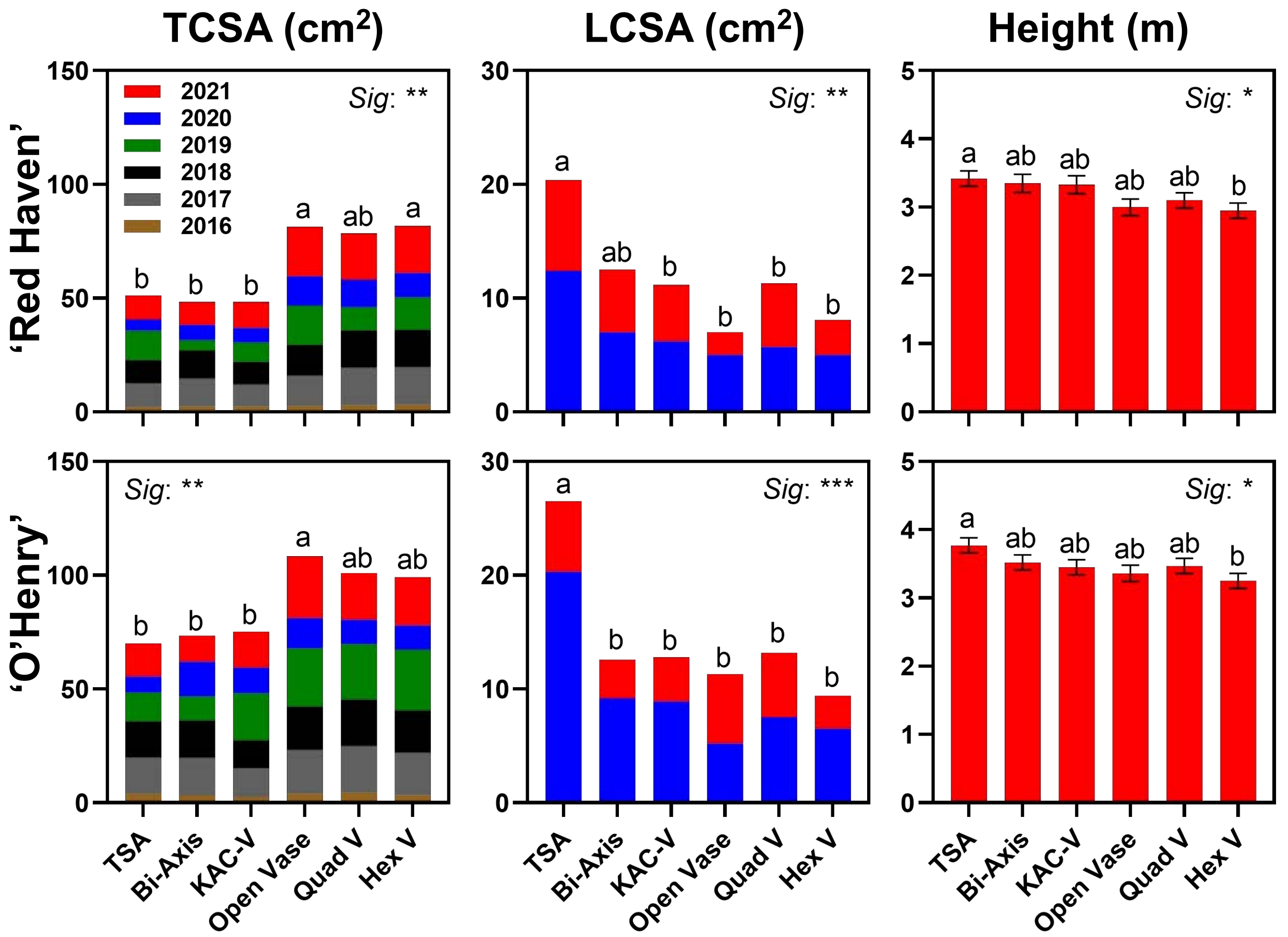
Recently Published: Anthony, B.M. and Minas, I.S., 2021. *Optimizing Peach Tree Canopy Architecture for Efficient Light Use, Increased Productivity and Improved Fruit Quality.* Agronomy, 11(10), p.1961. DOI: https://doi.org/10.3390/agronomy11101961

Training Systems: Cumulative growth of trunk and leader cross-sectional area and height in 2021

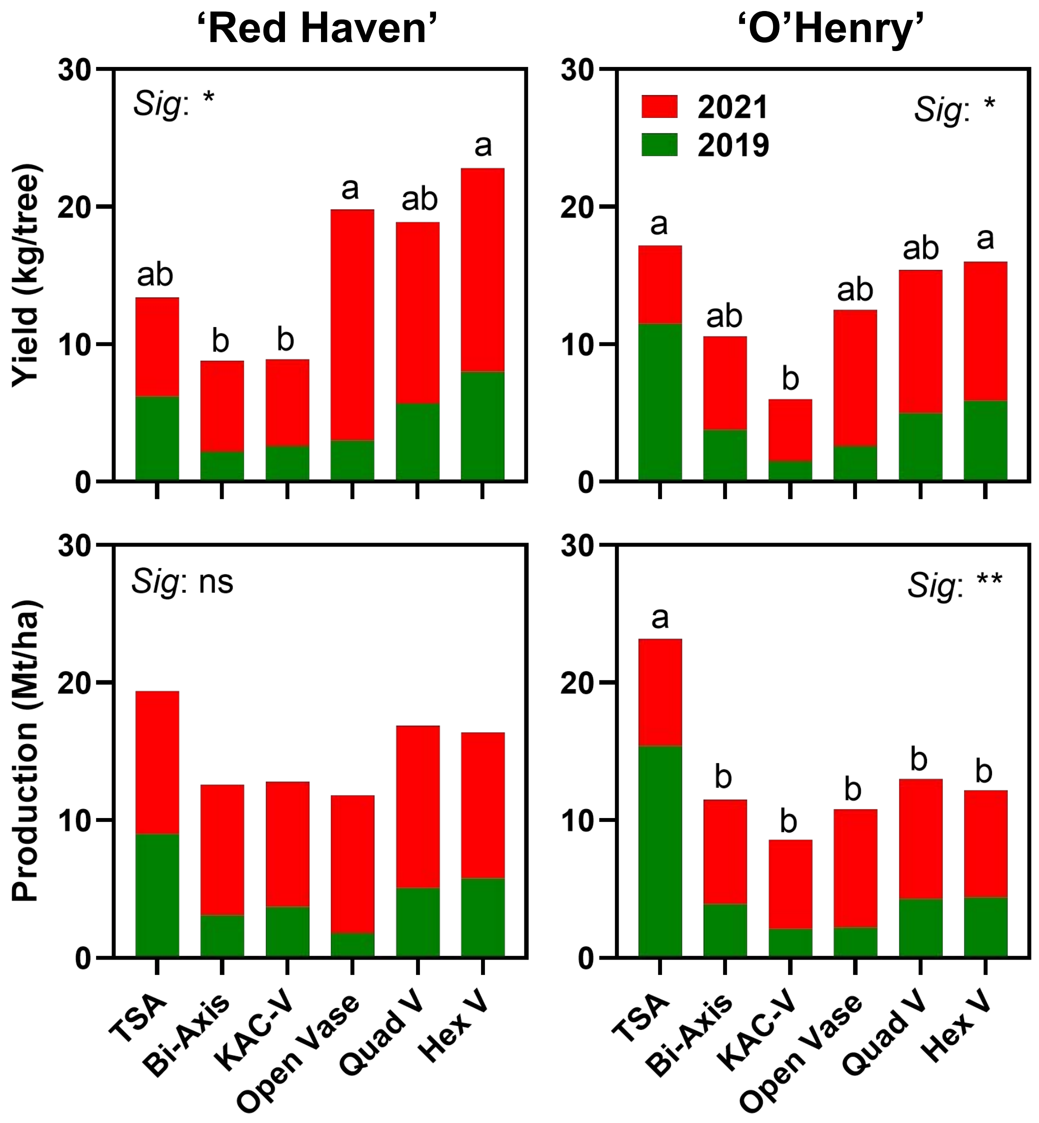
- More complex canopies sustain larger TCSA
- LCSA exhibits a diffusion of vigor with increased canopy complexity
  - Open vase continues to "fork," further reducing LCSA
- Reduced height with increased leader no., also demonstrates vigor reduction/diffusion



Anthony et al, 2022. *In preparation*

Training Systems: Cumulative yield and production across systems in 2019 + 2021

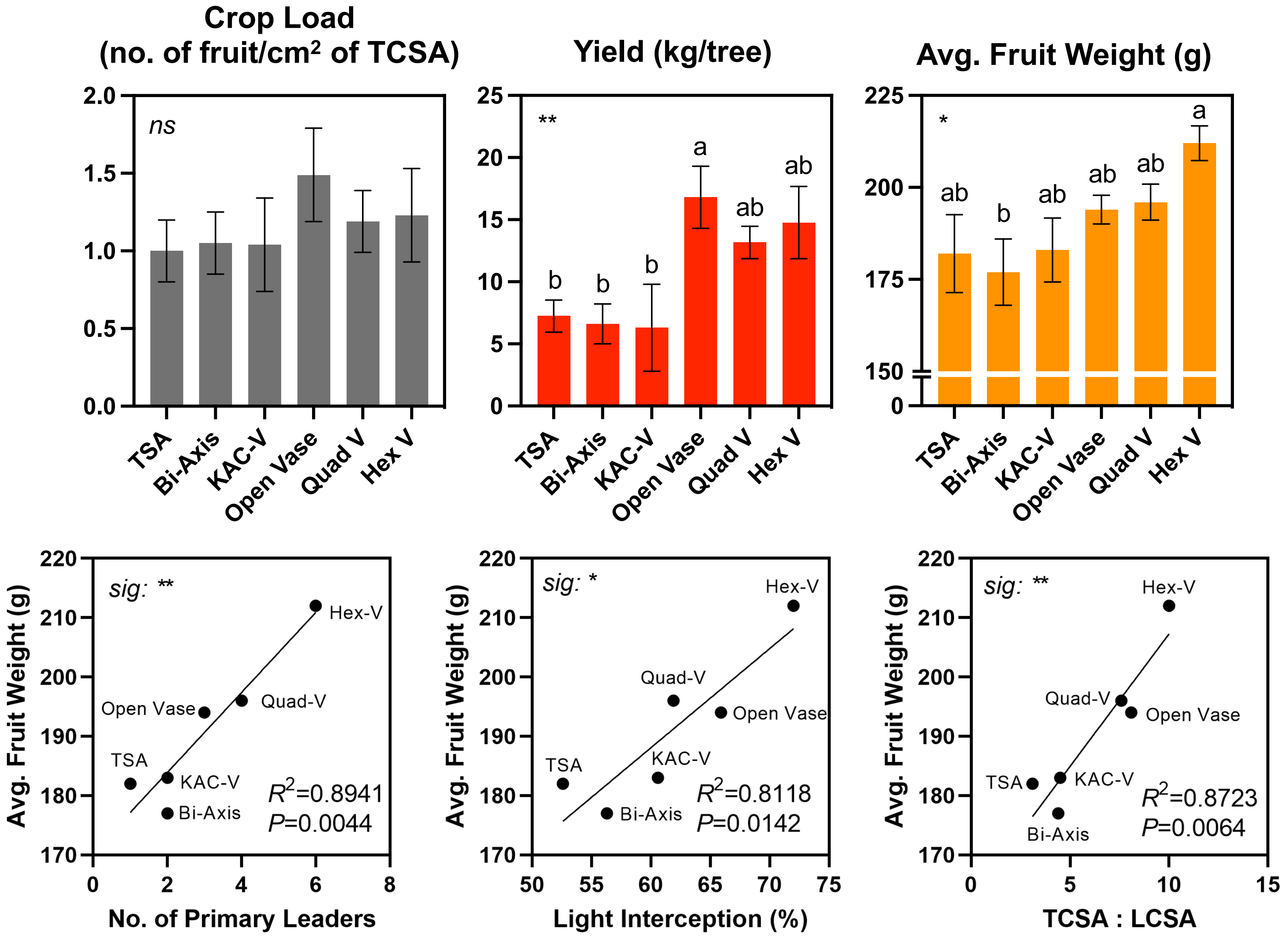
- Yield only available in 2019 and 2021 due to freeze event in 2020
- Yields on a per tree basis increase with increased tree size
    - Excess crop load in TSA in OH in 2019
    - OH did not achieve commercial crop load due to fall frost damage
- Production per hectare shows elevated levels with increased density and precocity of TSA



Anthony et al, 2022. ***In preparation***

Training Systems: Light, vigor diffusion & FW in 'Redhaven' 2021

- Crop loads were set to equal levels
- Yield increased with increased canopy size; fruit weight in RH was highest in Hex-V
- In 'Red Haven,' fruit weight increased with increased scaffold number, light interception and vigor diffusion factor (TCSA:LCSA)
- Hex-V intercepted an optimal amount of light (~70%) and demonstrated optimal diffusion factor (TCSA:LCSA)=~10
- **Hypothesis:** Fruit size related to light and vigor diffusion; crop loads were n.s.
- At least one more crop to confirm hypothesis



Anthony et al, 2022. *In preparation*

Developing the Next Generation 2D Peach Orchard

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7 Rootstocks: Krymsk®86, Hansen, Guardian®, Lovell, Controller™6, Rootpac®40, Rootpac®20

4 Training Systems: SSA (single leader, 3'), Bi-axe-U (wide crotch, 6'), Bi-axe-V (narrow crotch, 6'), Quad-axe (bi-cordon with 4 uprights, 8')

SSA (3' x 11', 1320 trees/acre)

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Bi-axe-U (6' x 11', 660 trees/acre)

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Quad-axe (8’ x 11’, 495 trees/acre)

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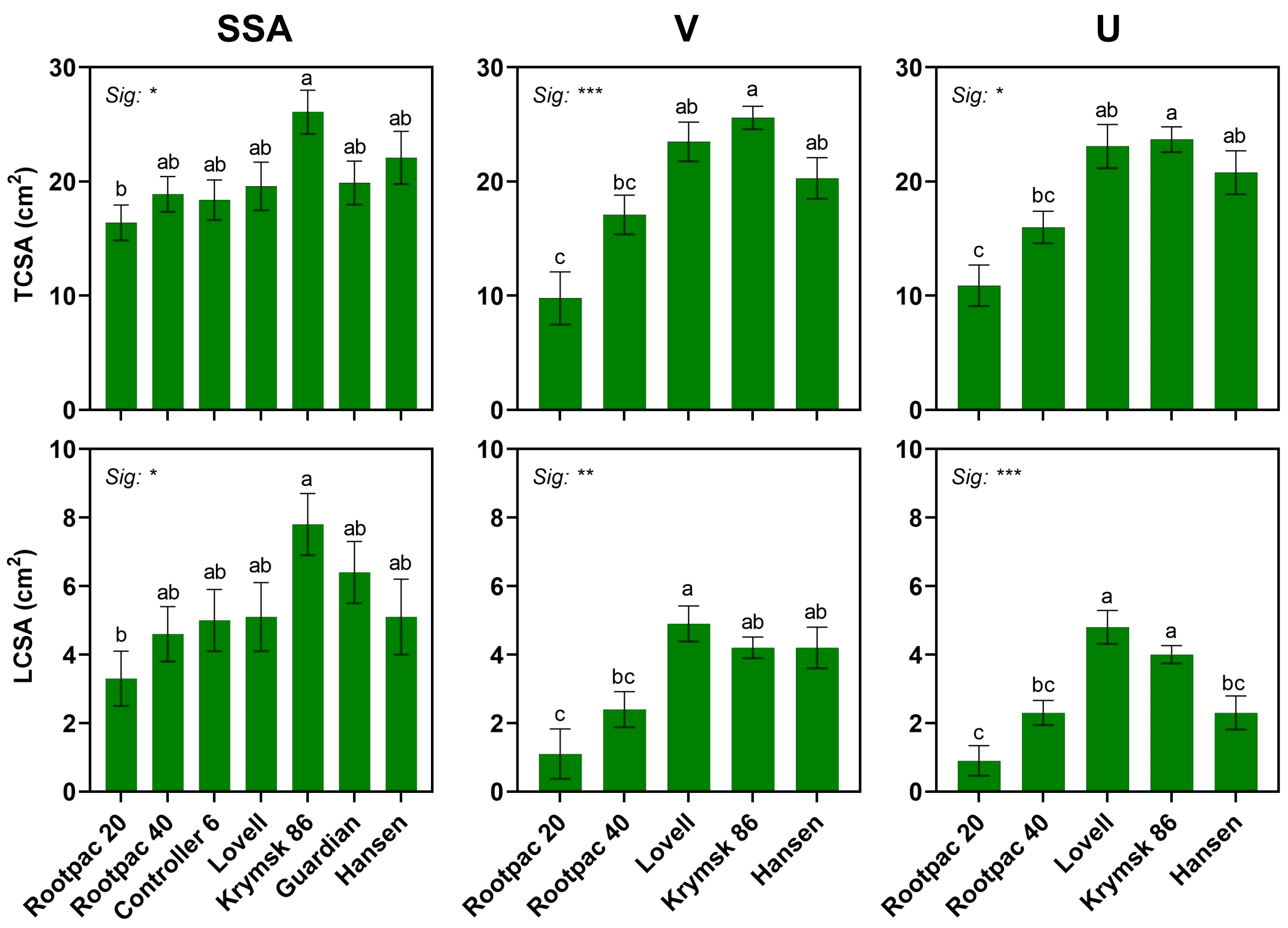
2021 Bi-axe-U vs. -V in ‘Suncrest’ on ‘K86’

Peach Next Gen Orchard: Trunk and leader cross-sectional area across rootstocks and training systems in 2021

- Rootpac®20 demonstrates the least vigor across systems
- Krymsk®86 demonstrates the most vigor across systems
- LCSA is further reduced in bi-axis systems (e.g., U and V) vs. SSA
    - Vigor diffusion across axes
- No statistical differences across rootstocks on first year of production in SSA
- RT20, RT40 and Cont. 6 show precocious tendencies
- Hansen536 appears to lack precocity, may not be suitable for early returns



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Mechanical Pruning on
SSA
in June 2021
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Before
Avg time/tree = 4.5 sec
SSA = 1500 trees/acre
Labor = 1.9 hours/acre/person
After

Questions?

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NC-140

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Western Colorado Horticultural Society

Talbott Farms

SINCE 1907 ELA FAMILY FARMS

Cherry Hill Farms

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