HORTICULTURE AND LANDSCAPE ARCHITECTURE
COLORADO STATE UNIVERSITY

CSU_Pomology
THE COLLEGE of AGRICULTURAL SCIENCES

January 20, 2022

Influence of Training Systems on Peach Vigor, Production and Fruit Quality

Dr. Brendon Anthony
Post-Doctoral Research Fellow at Minas Lab
brendon.anthony@colostate.edu

Pre-harvest factors affecting peach fruit quality

CSU_Pomology
THE COLLEGE of AGRICULTURAL SCIENCES

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)

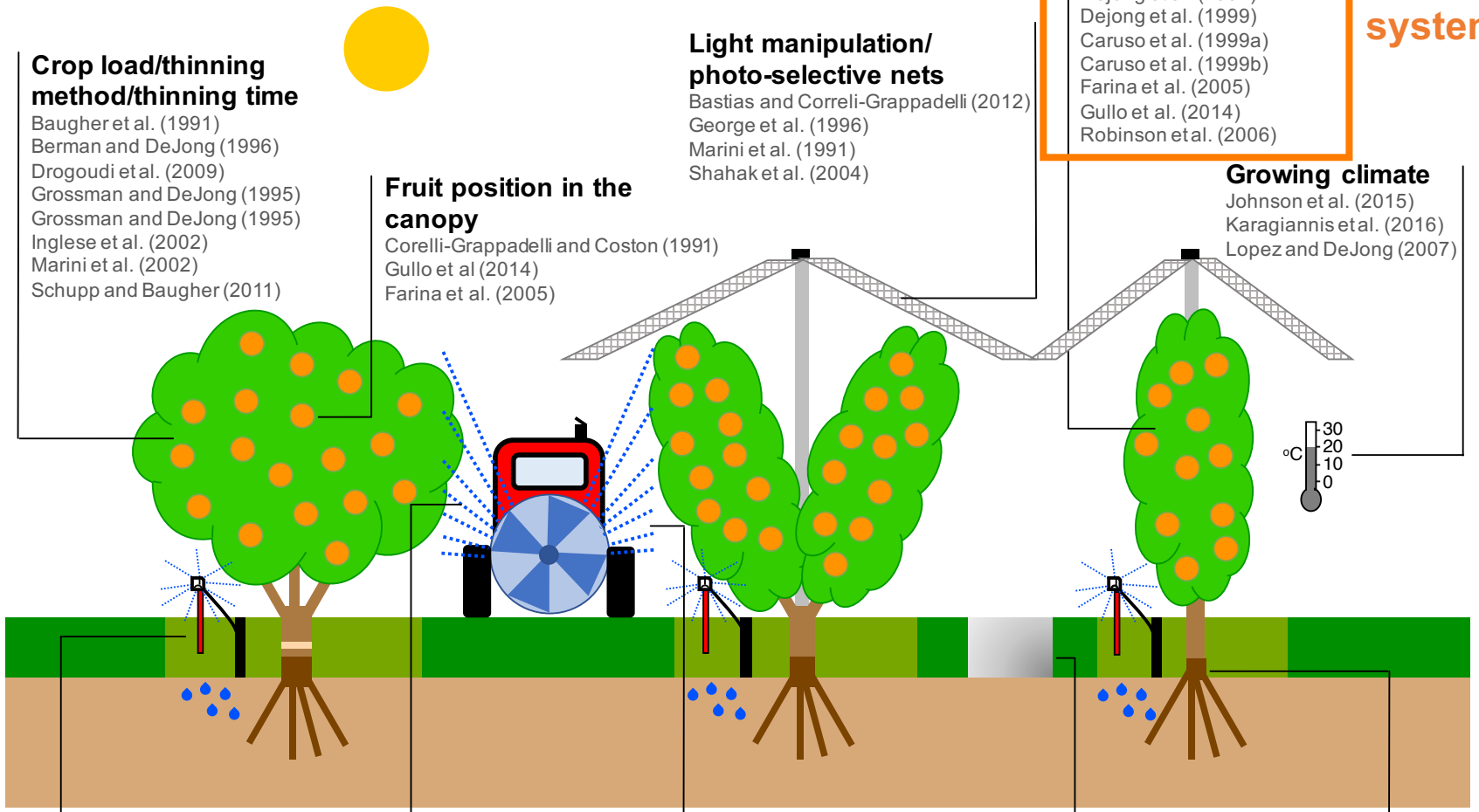
Training systems

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 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)

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)

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

CSU_Pomology
THE COLLEGE of AGRICULTURAL SCIENCES

Recently published training systems review in peach

agronomy

MDPI

Review

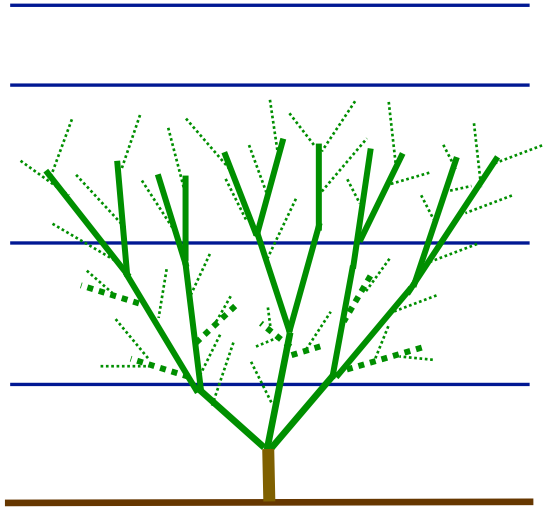
Optimizing Peach Tree Canopy Architecture for Efficient Light Use, Increased Productivity and Improved Fruit Quality

Brendon M. Anthony and Ioannis S. Minas *

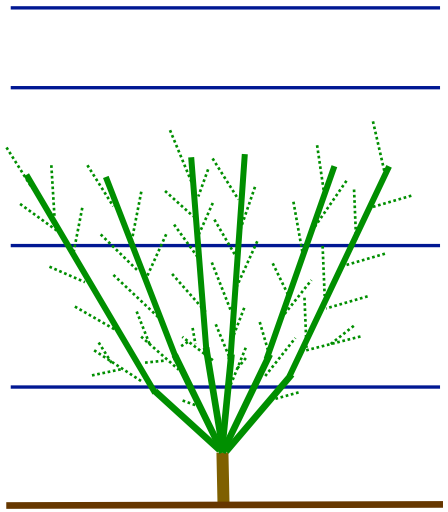
Recently Published: Anthony, B.M. and Minas, I.S., 2021. *Optimizing Peach Tree Canopy Architecture for Efficient Light Use, Increased Productivity and Improved Fruit Quality.* Agronomy, 11(10), p.1961. DOI: https://doi.org/10.3390/agronomy11101961

Training Systems Trial: 2016 – 2021

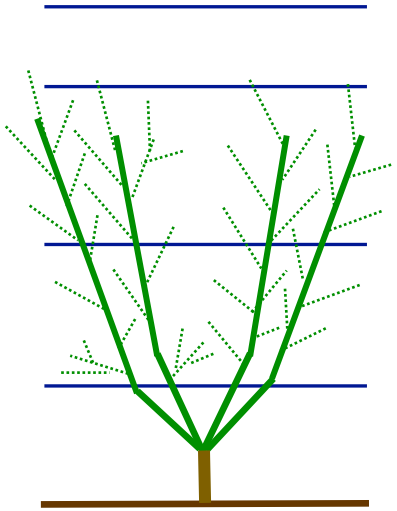
CSU_Pomology
THE COLLEGE of AGRICULTURAL SCIENCES



Open vase (12’)



Hex-V (10’)

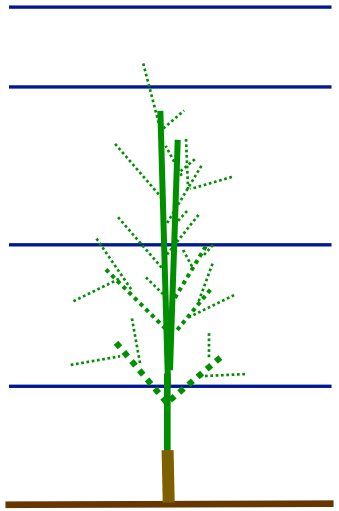


Quad-V (8’)

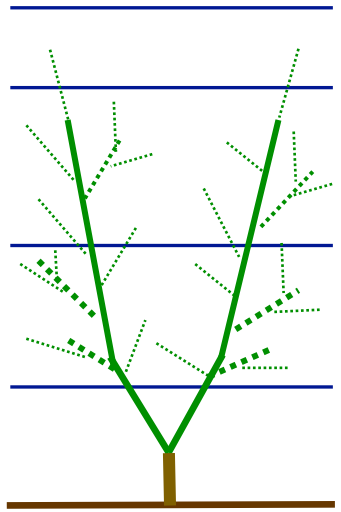
Planted: May, 2016

Cultivars x Rootstocks:

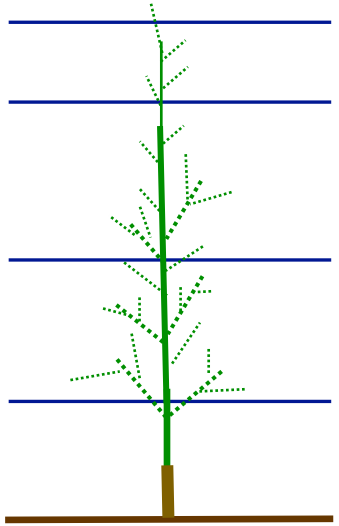
- Red Haven x St. Julien (Early)
- O’Henry x Krymsk 86 (Late)



KAC-V (5’)



Bi-Axis (5’)



TSA (5’)

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

COLORADO
Department of Agriculture

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

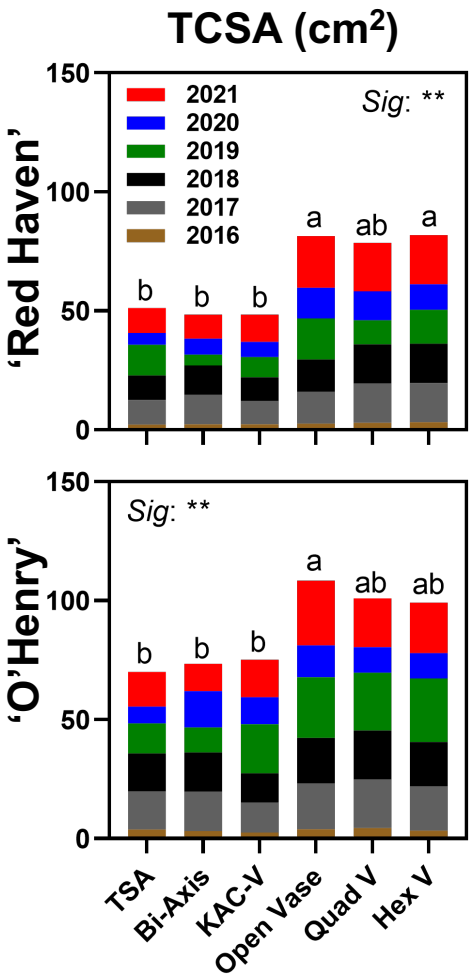
CSU_Pomology

	Open vase	Hex-V	Quad-V	KAC-V	Bi-Axis	TSA
Before						
	3 Scaffolds – 12'	6 Scaffolds – 10'	4 Scaffolds – 8'	2 Scaffolds – 5'	2 Scaffolds – 5'	1 Scaffold – 5'
After						

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

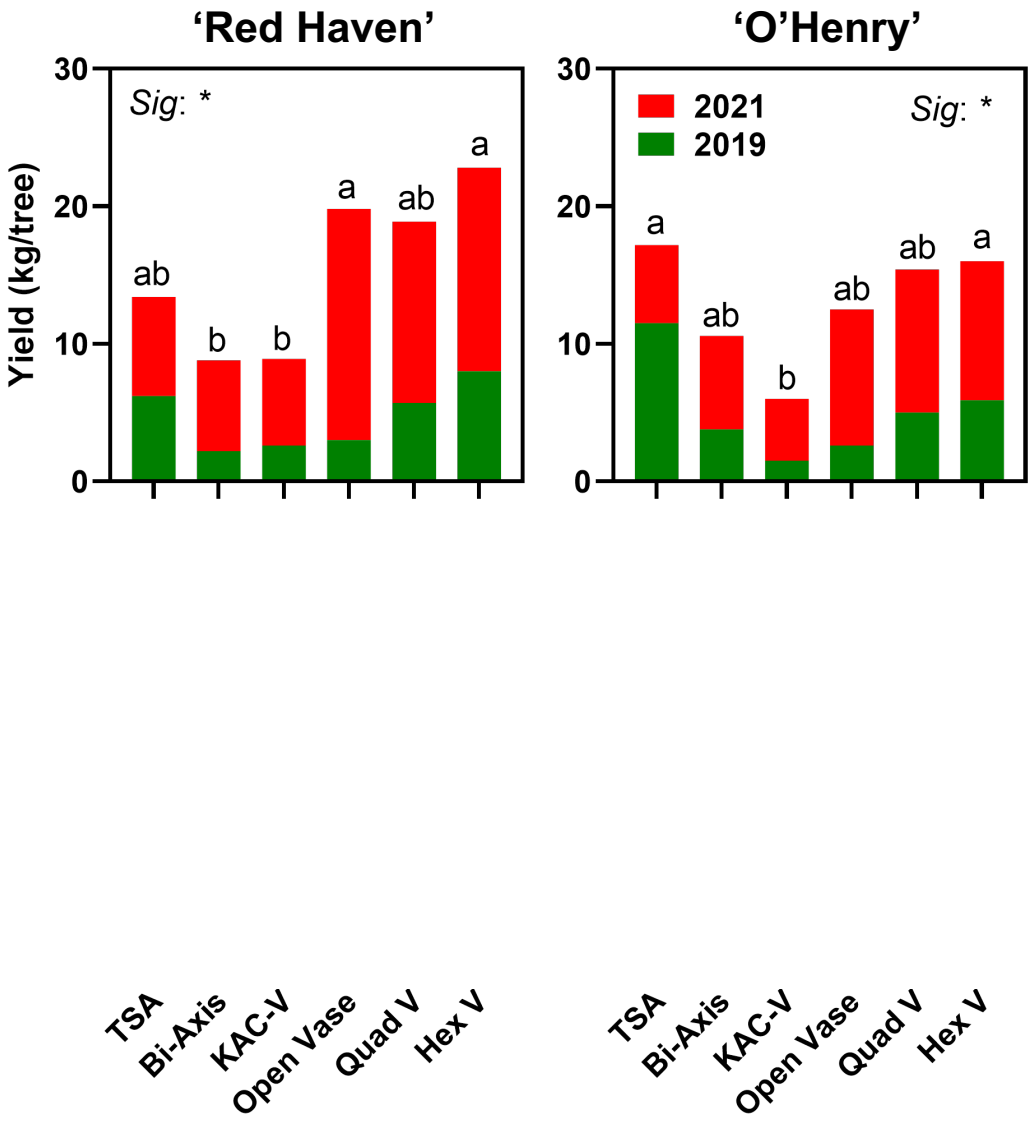
- More complex canopies sustain larger TCSA
- LCSA exhibits a diffusion of vigor with increased canopy complexity
  - Open vase continues to “fork,” further reducing LCSA
- Reduced height with increased leader no., also demonstrates vigor reduction/diffusion



Anthony et al, 2022. *In preparation*

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

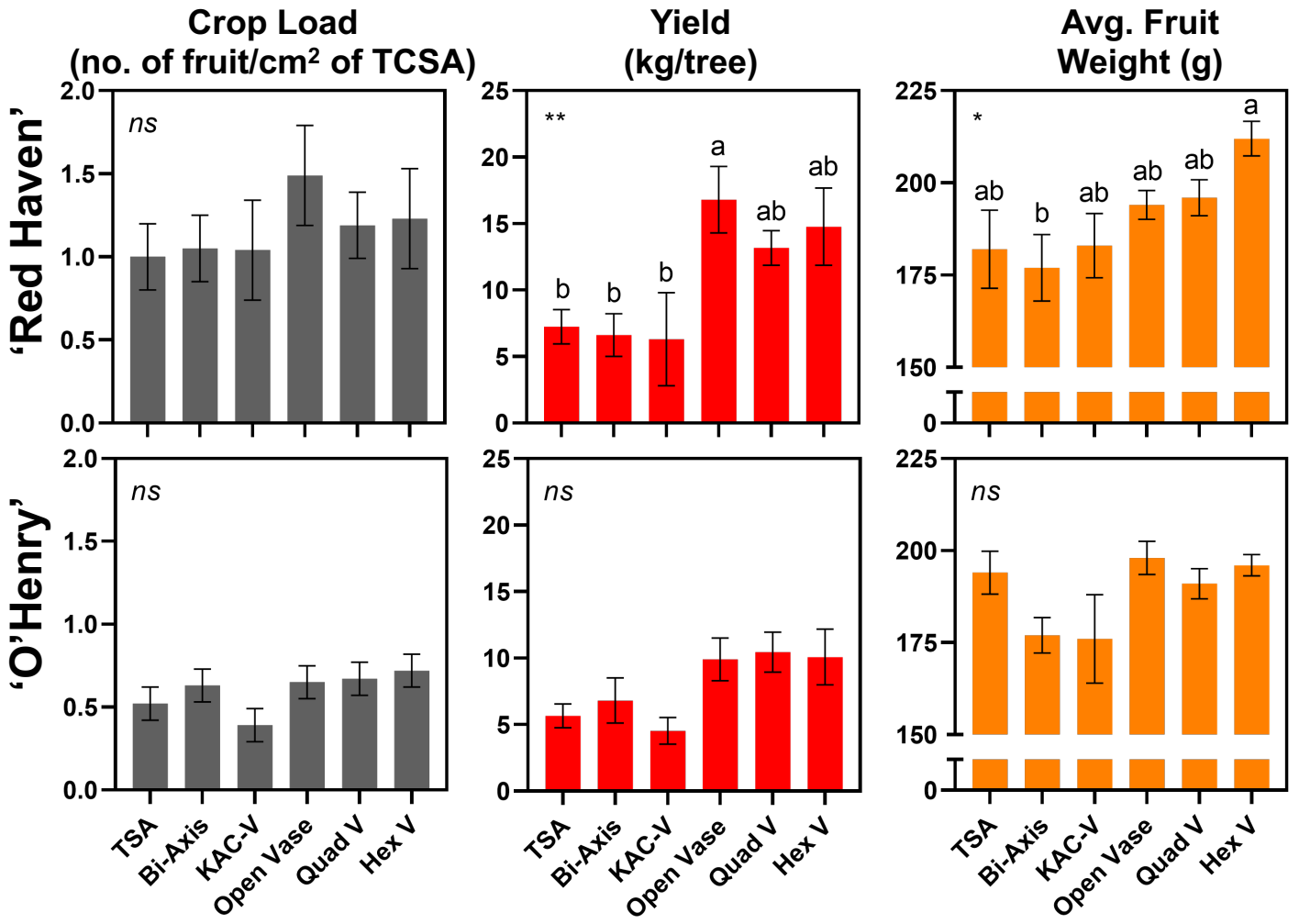
- Yield only available in 2019 and 2021 due to freeze event in 2020
- Yields on a per tree basis increases with increased tree size
  - Excess crop load in TSA in OH in 2019
  - OH did not achieve commercial crop load due to fall frost damage
- Production per hectare shows elevated levels with increased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

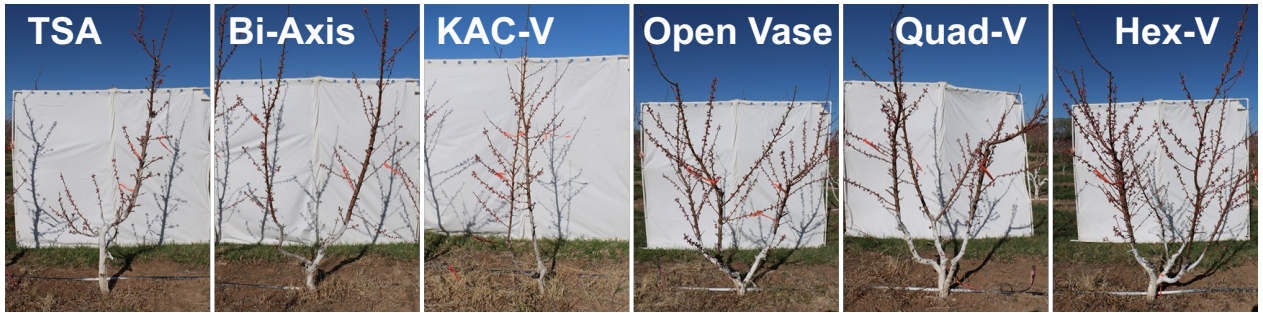


Anthony et al, 2022. *In preparation*

Training Systems: Yield and quality in 2021

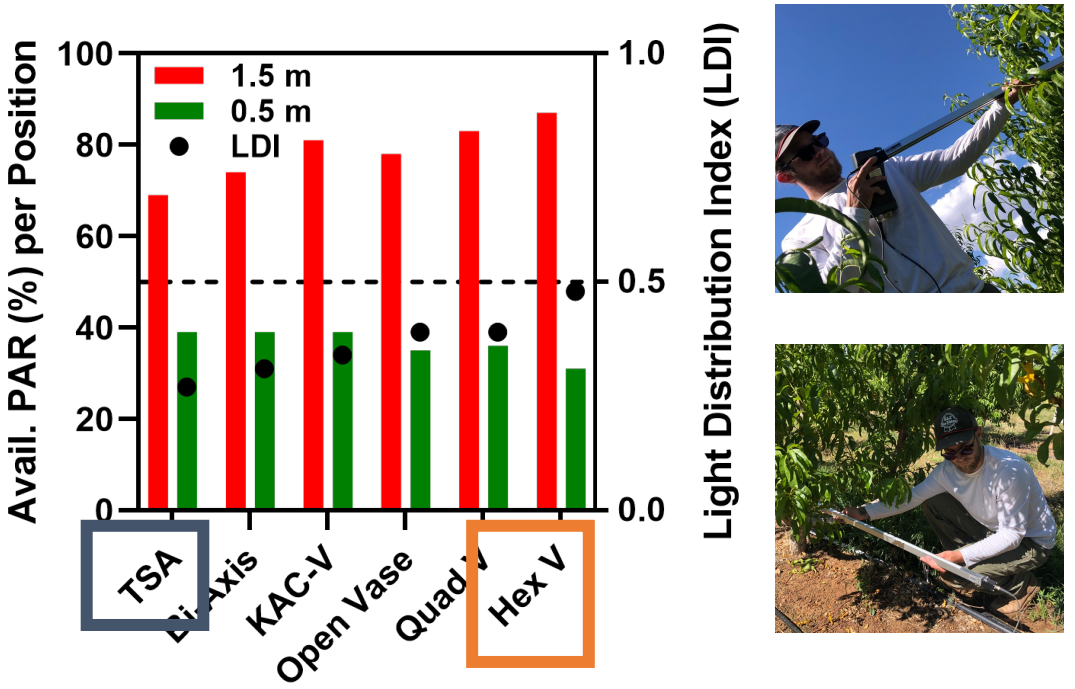
- Crop loads were set to equal levels
- OH did not achieve commercial crop load due to frost
- Yield increased with increased canopy size
- Fruit weight in RH was highest in Hex-V





CSU_Pomology
THE COLLEGE of AGRICULTURAL SCIENCES

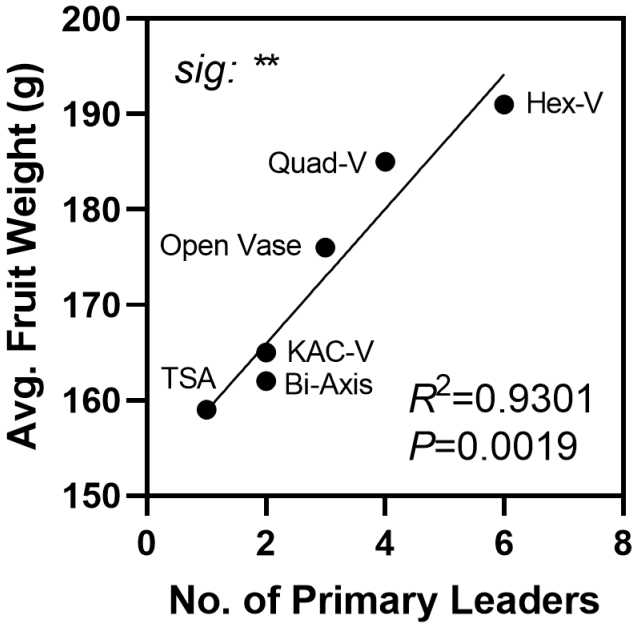
Training Systems: Distribution of light, vigor and fruit number at two positions across training systems in ‘Red Haven’

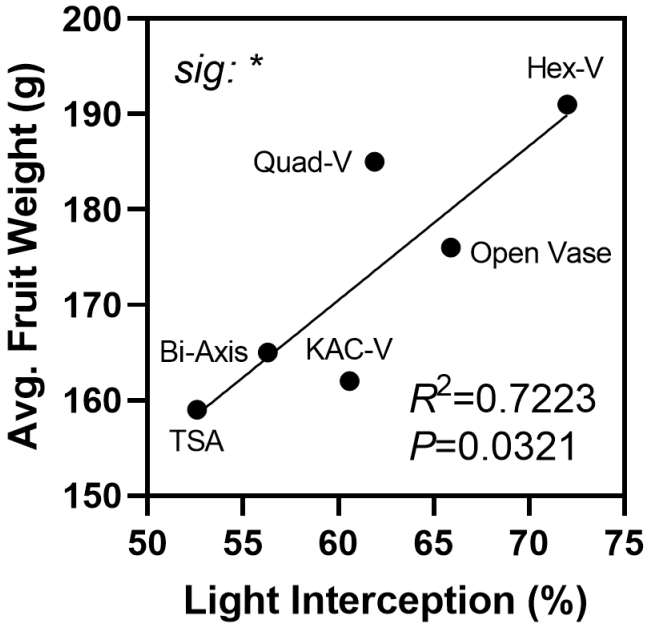


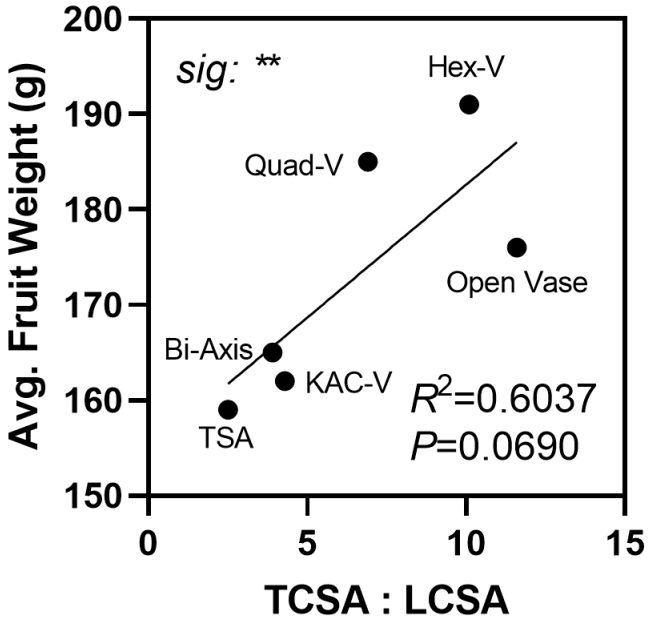
- **Hypothesis #1: *Uniform* productivity** occurs within uniform canopies (reduced differences in light and TCSA:LCSA, aka VDI) as seen in **TSA**

- **Hypothesis #2: *Increased* yield and quality** occurs within canopy zones exhibiting increased vigor diffusion (increased TCSA:LCSA ratio) and enhanced light availability (increased avail. PAR) as seen in **Hex-V**

Training Systems: Light, vigor diffusion and fruit weight in 'Red Haven'





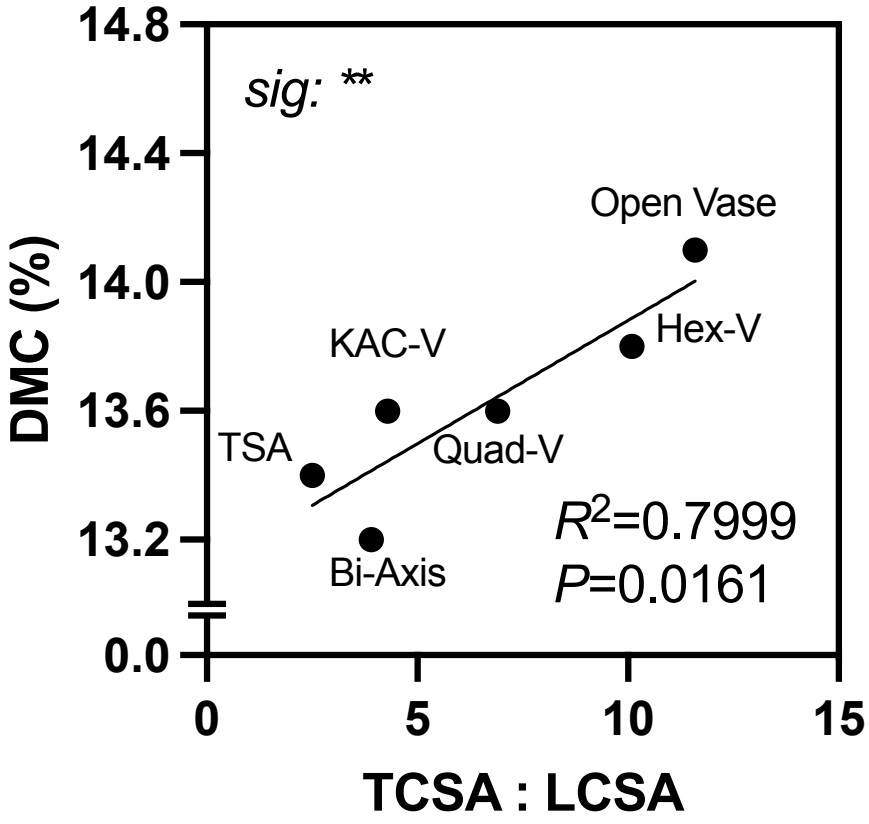


- In 'Red Haven,' fruit weight increased with increased scaffold number, light interception and vigor diffusion factor (TCSA:LCSA)
- **Hex-V** intercepted an optimal amount of light **(~70%)** and demonstrated a vigor diffusion factor (TCSA : LCSA) of ~10

- **Hypothesis #3:** Fruit size related to light and vigor diffusion; crop loads equal across systems
- Will seek another year of cropping to confirm hypothesis

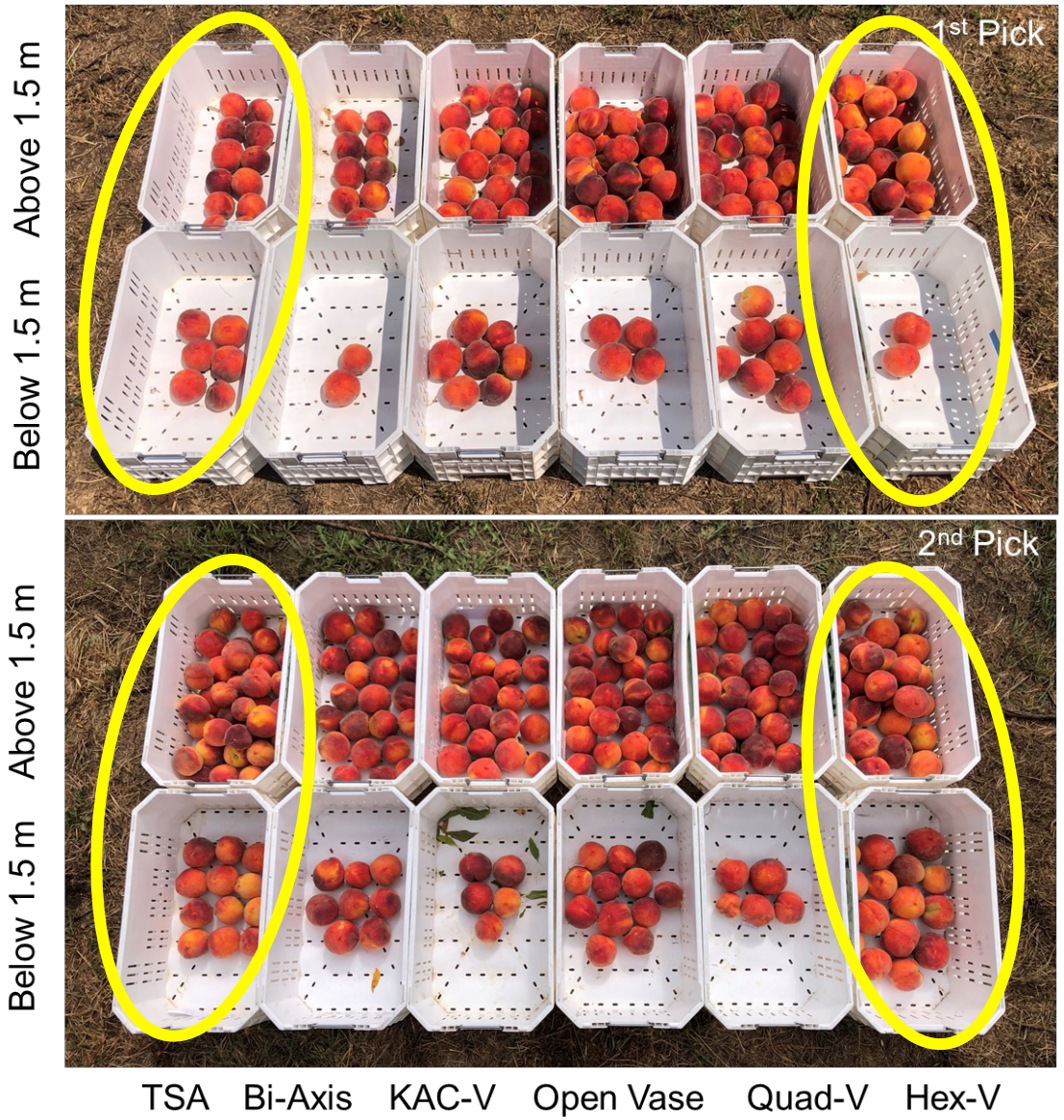
Training Systems: Vigor diffusion and fruit quality (DMC) in 'Red Haven' (*at equal maturity and crop load*)

- **Hypothesis #4:** Fruit quality as expressed as dry matter content (DMC, %) improved with increased vigor diffusion (TCSA : LCSA)
- **Hex-V and Open Vase**, given their increased scaffolds/branching, **better diffuse vigor and enhance quality**
- > 1% difference in DMC, significant improvement in consumer detection



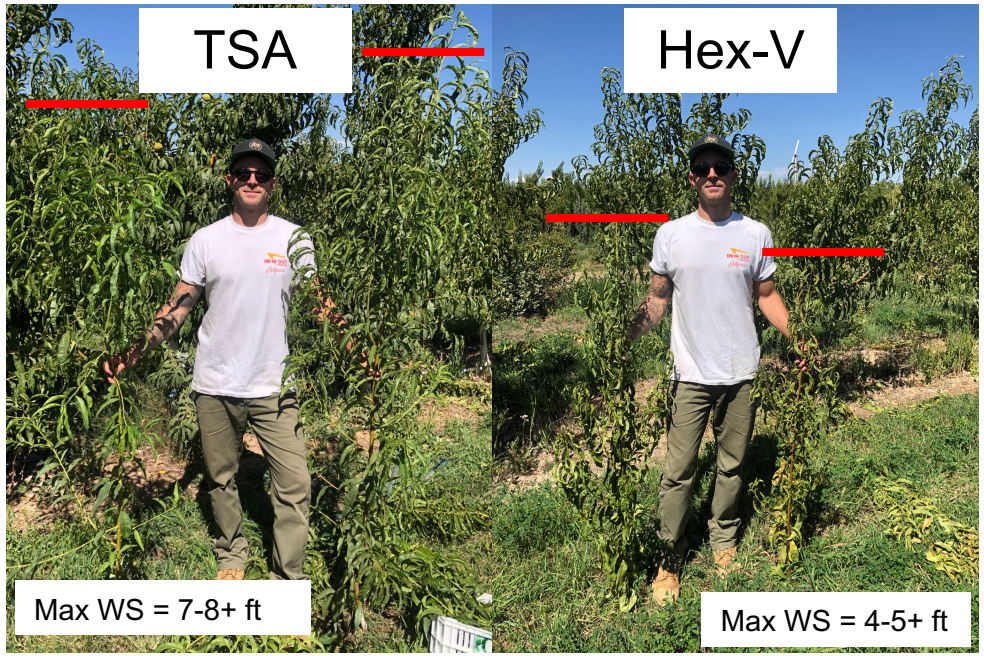
CSU_Pomology
THE COLLEGE of AGRICULTURAL SCIENCES

Training Systems: Additional highlights from the field



- **Uniform production in TSA**
- **Fruit size maximized in Hex-V**

- **Fruit set maximized in Hex-V**



- Reduced vigor, **smaller water sprouts,** makes it easier to summer prune

Training Systems: Conclusions

Tale of Two Contrasting Training Systems:

TSA (single leader, high-density: 5’ spacing)

- Early precocity/bearing, as it does not require heading back in the field
- Uniform light distribution and productivity, reduced pick numbers
- Highest production on land unit area basis
- *High upfront cost (more trees/acre) and very tall trees (need ladders, trellis?)*

Hex-V (six primary scaffolds, med- to low-density: 10’ spacing)

- Optimal light availability in the fruiting zone and highest diffusion of vigor
- Maximized fruit size and fruit set
- Reduced water sprout growth given vigor diffusion
- Ease in crop load management, easy to count 7 fruiting shoots/scaffold
- Reduced height; potential for pedestrian management
- *Requires lots of attention early on to establish six primary scaffolds*

- ***In short, horticultural manipulations via canopy architecture and training systems are an effective way to manage vigor and improve production and quality***

Developing the Next Generation 2D Peach Orchard

CSU_Pomology

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

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

Questions?

brendon.anthony@colostate.edu

http://minas.agsci.colostate.edu

Acknowledgements

Advisor

Dr. Ioannis Minas

CSU_Pomology Team

Jeff Pieper

David Sterle

Emily Dowdy

Jake Pott

COLORADO
Department of Agriculture

WESTERN SARE
Sustainable Agriculture Research & Education

USDA

NC-140

CSUVENTURES

Western Colorado Horticultural Society

AGRICULTURAL EXPERIMENT STATION
COLORADO STATE UNIVERSITY

HORTICULTURE AND LANDSCAPE ARCHITECTURE
COLORADO STATE UNIVERSITY