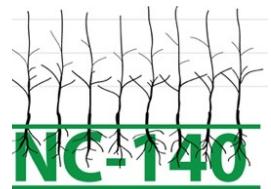




AGRICULTURAL  
EXPERIMENT STATION  
COLORADO STATE UNIVERSITY



Controller™ 6



Controller™ 7



Rootpac® 40



Rootpac® 20



Controller™ 8



Guardian®



# Annual Trial Report 2021

## 2017 NC-140 Semi-Dwarf Peach Rootstock Trial

Dr. Ioannis S. Minas

Associate Professor of Pomology  
[ioannis.minas@colostate.edu](mailto:ioannis.minas@colostate.edu)

MP-29

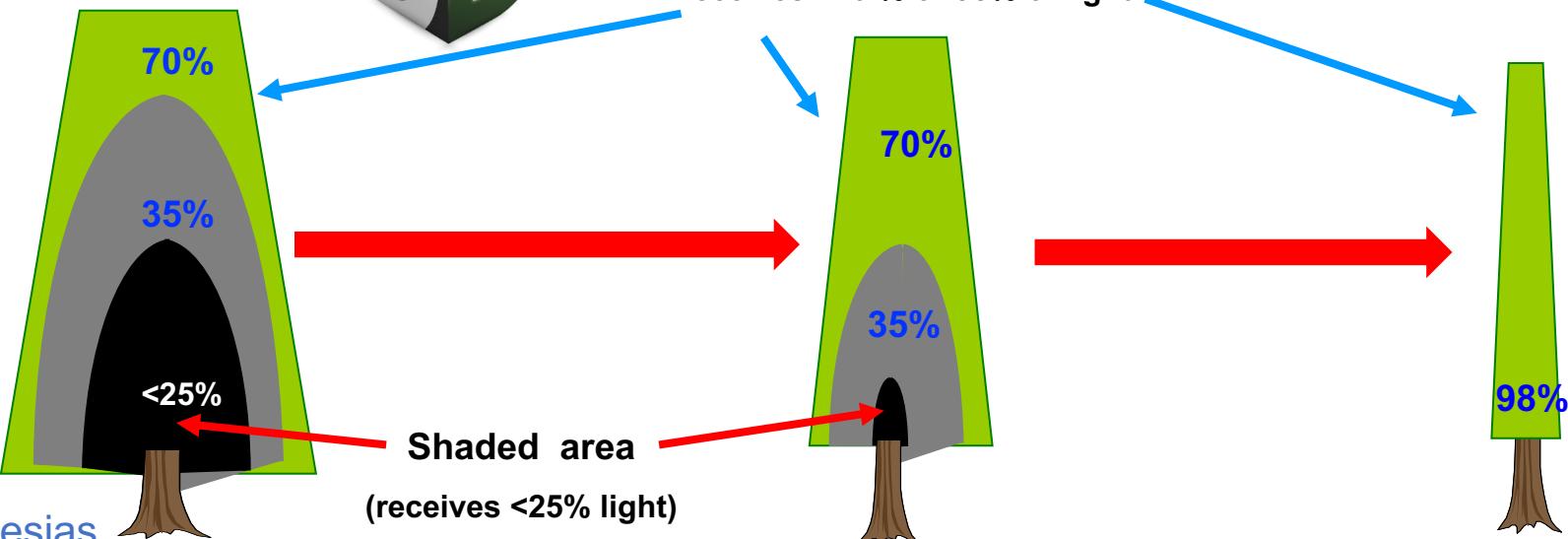


# Effect of canopy volume on light interception



3D

Well light exposed area  
receives >70 % or 98% of light



**Small trees are more efficient!**

- More well illuminated portion of the canopy
- More fruiting wood
- Fruits closer to main permanent structure



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Super slender-axe on a 2D setting with M.9 in apple

# High-density cropping systems and 2D canopy architectures in Sweet Cherry



Source: L. Long, G. Lang, S. Musacchi, M. Whiting. 2015. Cherry Training Systems. Pacific Northwest Extension Publication 667.

# The 2017 NC-140 Cresthaven Semi-Dwarf Peach Rootstock Trial



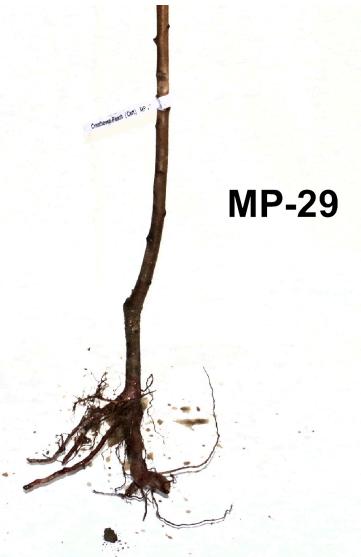
Controller™ 6



Controller™ 7



Controller™ 8



MP-29



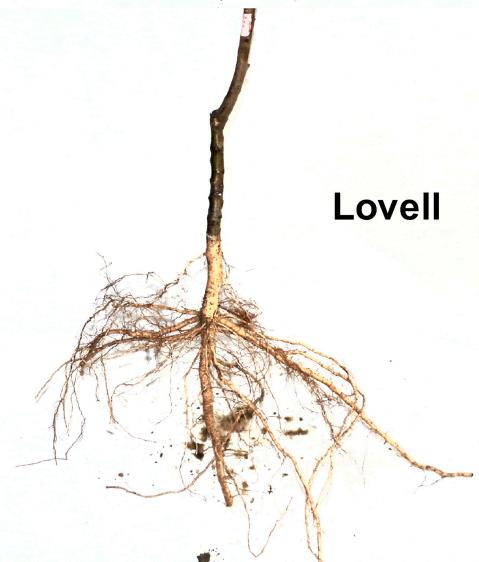
Rootpac® 40



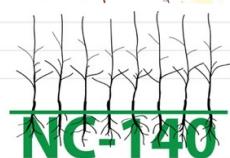
Rootpac® 20



Guardian®



Lovell



CSU\_Pomology

Good Fruit Grower, February 1<sup>st</sup>, 2018

# 2017 NC-140 Cresthaven Semi-Dwarf Peach Rootstock Trial

**Sites:** AL, CO, GA, MI, NC, NY, ONT, PA, SC, UT

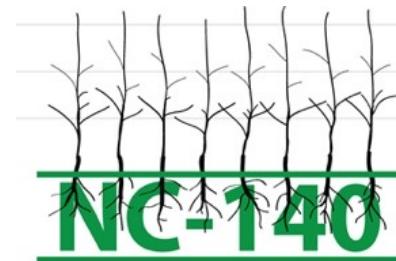
**Coordinator:** Ioannis Minas (Colorado State University)

**Cultivar:** 'Cresthaven'

**Training system:** KAC-V

**Spacing:** 1.8 x 4.5 m (6 x 15 feet)

**Trees/ha:** 1196 (/acre: 484)



Rootstock	Breeder, Country	Genetic origin
Controller™ 6 (HBOK 27)	UC Davis, USA	peach x peach hybrid ( <i>Prunus persica</i> x <i>P. persica</i> )
Controller™ 7 (HBOK 32)	UC Davis, USA	peach x peach hybrid ( <i>P. persica</i> x <i>P. persica</i> )
Controller™ 8 (HBOK 10)	UC Davis, USA	peach x peach hybrid ( <i>P. persica</i> x <i>P. persica</i> )
MP-29	USDA-Georgia, USA	plum x peach interspecific hyb. ( <i>P. umbellata</i> x <i>P. persica</i> )
Rootpac® 40 (Nanopac)	Agromillora Iberia, Spain	almond x peach interspecific hyb. [( <i>P. dulcis</i> x <i>P. persica</i> ) x ( <i>P. dulcis</i> x <i>P. persica</i> )]
Rootpac® 20 (Densipac)	Agromillora Iberia, Spain	plum x peach interspecific hybrid ( <i>P. besseyi</i> x <i>P. persica</i> )
Guardian®	Clemson/USDA, USA	peach seedling ( <i>P. persica</i> )
Lovell	G.W. Thissell, USA	peach seedling ( <i>P. persica</i> )

# 2017 NC-140 Semi-Dwarf Cresthaven Peach Rootstock Trial

3<sup>rd</sup> leaf -2019

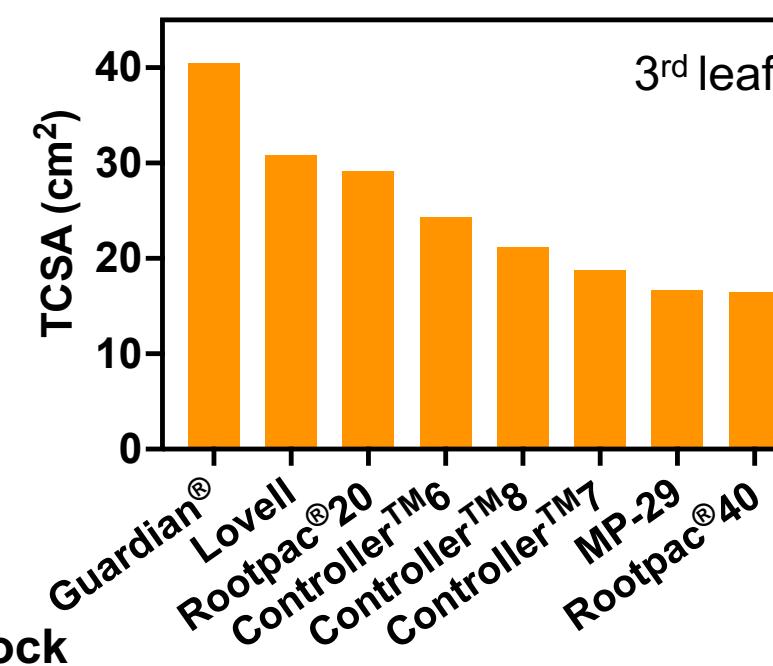
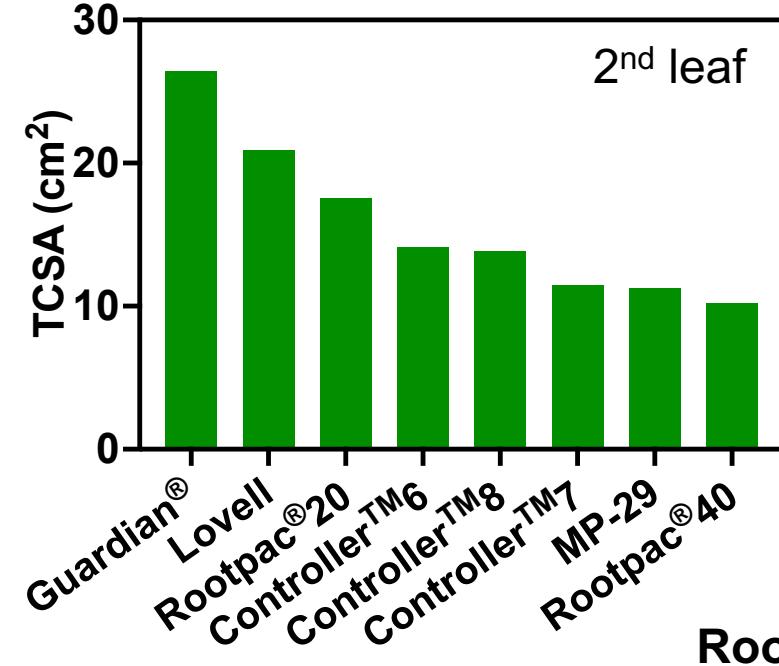
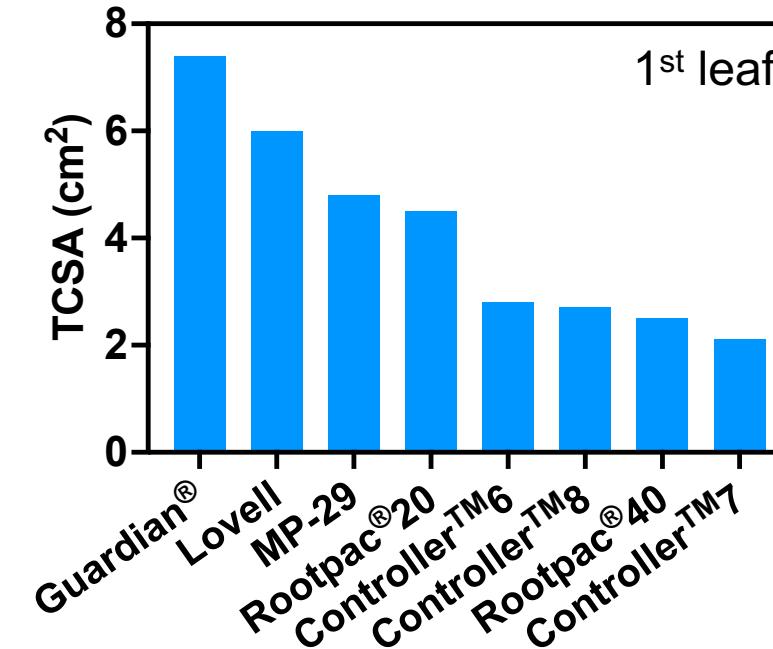
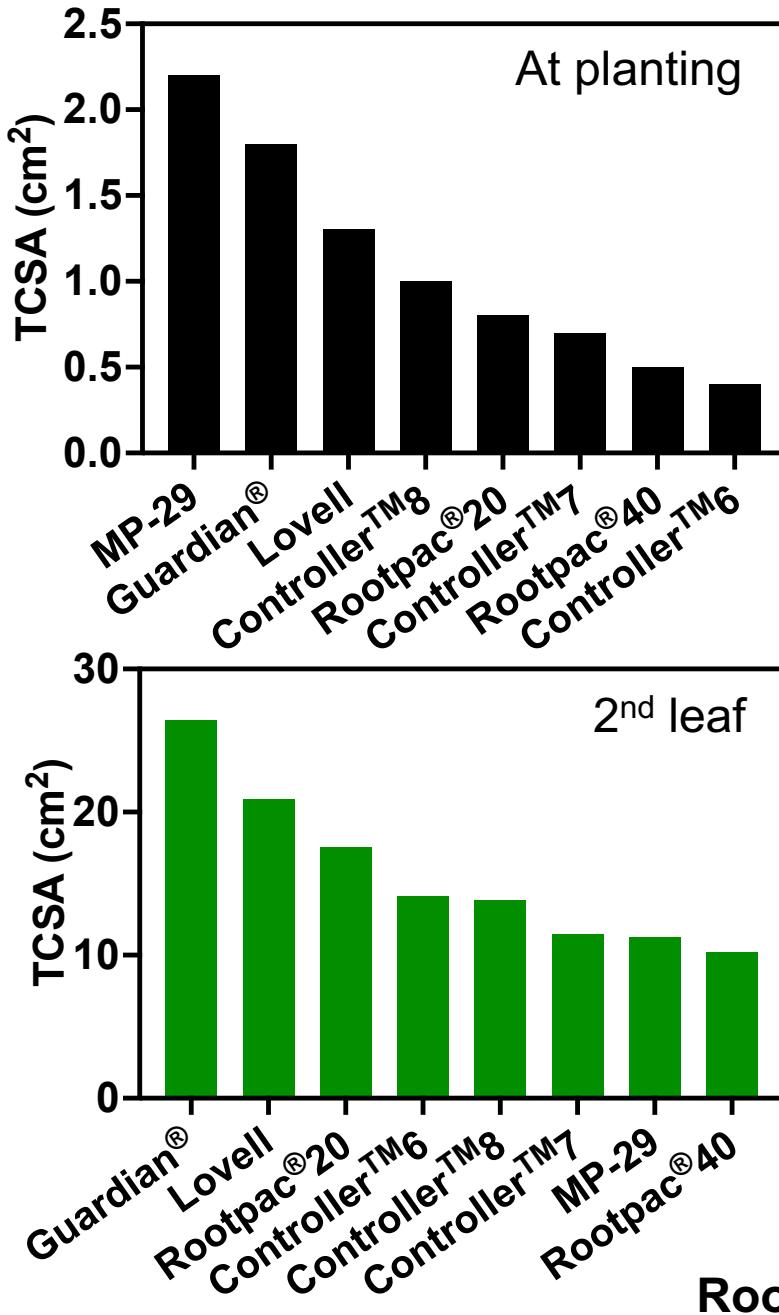
## Rootstock performance (all sites)

Rootstock	Survival (%)	Suckers (count)	TCSA (cm <sup>2</sup> ) at planting	TCSA (cm <sup>2</sup> ) 2019	% of Lovell 2019	% of Guard. 2019
Controller™6	87.7 <sup>a</sup>	0.3 <sup>b</sup>	0.4 <sup>f</sup>	24.3 <sup>cd</sup>	78.9	60.1
Controller™7	85.0 <sup>ab</sup>	0.1 <sup>b</sup>	0.7 <sup>ef</sup>	18.7 <sup>de</sup>	60.7	46.3
Controller™8	89.0 <sup>a</sup>	0.3 <sup>b</sup>	1.0 <sup>d</sup>	21.1 <sup>de</sup>	68.5	52.2
MP-29	86.8 <sup>ab</sup>	0.1 <sup>b</sup>	2.2 <sup>a</sup>	16.6 <sup>e</sup>	53.9	41.1
Rootpac®20	86.1 <sup>ab</sup>	4.1 <sup>a</sup>	0.8 <sup>de</sup>	29.1 <sup>bc</sup>	94.5	72.0
Rootpac®40	72.1 <sup>b</sup>	0.0 <sup>b</sup>	0.5 <sup>ef</sup>	16.4 <sup>e</sup>	53.2	40.6
Guardian®	96.0 <sup>a</sup>	0.9 <sup>b</sup>	1.8 <sup>b</sup>	40.4 <sup>a</sup>	131.2	100.0
Lovell	94.0 <sup>a</sup>	1.1 <sup>b</sup>	1.3 <sup>c</sup>	30.8 <sup>b</sup>	100.0	76.2
Estimated HSD	15.7	3.0	0.2	6.5		

\*Mean separation in columns by Tuckey's HSD ( $P=0.05$ ). HSD was calculated based on the number of observations per mean.

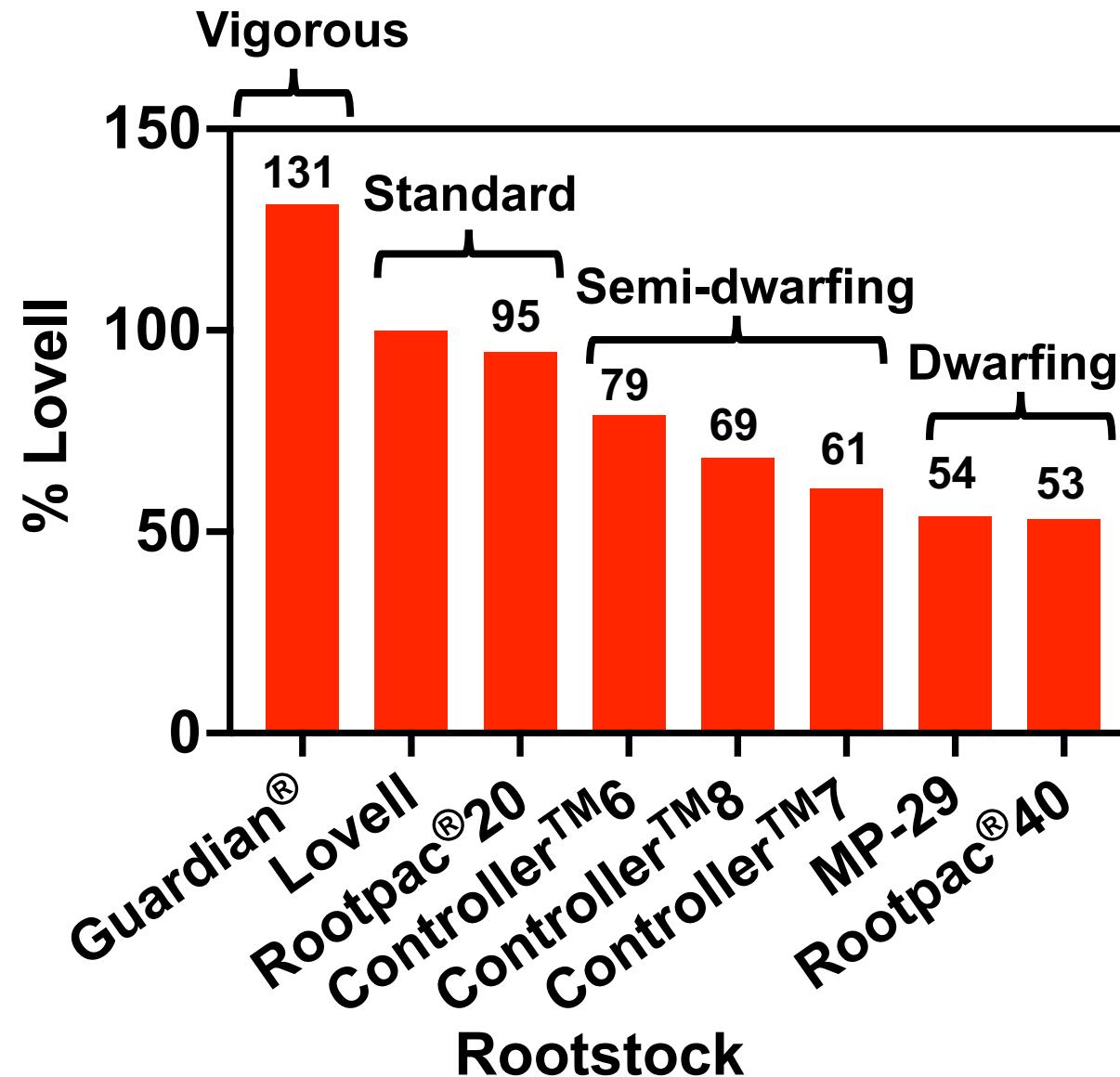


# TCSA at planting and during establishment years





# Relative peach tree size after the first 3 establishment seasons



# 2017 NC-140 Semi-Dwarf Cresthaven Peach Rootstock Trial

3<sup>rd</sup> leaf -2019

## Rootstock performance (all sites)

Rootstock	Julian 90% Bloom	Julian 10% Ripe	Yield (kg/tree)	Fruit FW (g)	Yield efficiency (kg/cm <sup>2</sup> )
Controller™6	103.0	226.2	4.7 <sup>bc</sup>	249.2 <sup>a</sup>	0.17 <sup>ab</sup>
Controller™7	102.9	221.8	4.3 <sup>bc</sup>	228.7 <sup>ab</sup>	0.18 <sup>ab</sup>
Controller™8	102.5	225.7	4.4 <sup>bc</sup>	230.9 <sup>ab</sup>	0.16 <sup>ab</sup>
MP-29	92.8	221.6	4.6 <sup>bc</sup>	210.4 <sup>b</sup>	0.26 <sup>a</sup>
Rootpac®20	100.1	221.8	6.5 <sup>b</sup>	230.3 <sup>ab</sup>	0.19 <sup>ab</sup>
Rootpac®40	101.7	219.2	3.0 <sup>c</sup>	241.6 <sup>ab</sup>	0.14 <sup>b</sup>
Guardian®	104.1	223.5	9.8 <sup>a</sup>	210.4 <sup>b</sup>	0.22 <sup>ab</sup>
Lovell	107.8	228.4	6.9 <sup>b</sup>	227.3 <sup>ab</sup>	0.19 <sup>ab</sup>
Estimated HSD	ns	ns	2.9	38.8	0.1

\*Mean separation in columns by Tukey's HSD ( $P=0.05$ ). HSD was calculated based on the number of observations per mean.

# 2017 NC-140 Semi-Dwarf Cresthaven Peach Rootstock Trial

4<sup>th</sup> leaf -2020

## Rootstocks performance (all sites)

Rootstock	Survival (%)	Suckers (count)	TCSA (cm <sup>2</sup> ) 2019	% of Lovell	% of Guard.	Julian 90% Bloom	Julian 10% Ripe	Yield (kg/tree)	Fruit FW (g)
Controller <sup>TM</sup> 6	90 <sup>ab</sup>	1.1 <sup>bc</sup>	35.6 <sup>bc</sup>	82.2	62.7	98.4 <sup>a</sup>	217.3 <sup>ab</sup>	11.2 <sup>a</sup>	217.4 <sup>a</sup>
Controller <sup>TM</sup> 7	88 <sup>ab</sup>	0.0 <sup>c</sup>	27.5 <sup>de</sup>	63.5	48.4	102.1 <sup>a</sup>	221.9 <sup>a</sup>	13.0 <sup>a</sup>	188.8 <sup>a</sup>
Controller <sup>TM</sup> 8	90 <sup>ab</sup>	0.5 <sup>bc</sup>	30.2 <sup>cd</sup>	69.7	53.2	97.1 <sup>a</sup>	215.6 <sup>ab</sup>	10.4 <sup>ab</sup>	216.1 <sup>a</sup>
MP-29	86 <sup>ab</sup>	0.9 <sup>bc</sup>	20.5 <sup>e</sup>	47.3	36.1	88.9 <sup>a</sup>	201.7 <sup>b</sup>	5.4 <sup>b</sup>	216.9 <sup>a</sup>
Rootpac®20	80 <sup>bc</sup>	5.0 <sup>a</sup>	40.3 <sup>b</sup>	93.1	71.0	95.5 <sup>a</sup>	214.5 <sup>ab</sup>	10.7 <sup>ab</sup>	189.5 <sup>a</sup>
Rootpac®40	67 <sup>c</sup>	1.5 <sup>bc</sup>	27.1 <sup>cde</sup>	62.6	47.7	99.2 <sup>a</sup>	218.6 <sup>ab</sup>	9.5 <sup>ab</sup>	212.4 <sup>a</sup>
Guardian®	97 <sup>a</sup>	2.5 <sup>b</sup>	56.8 <sup>a</sup>	131.2	100.0	98.1 <sup>a</sup>	211.8 <sup>ab</sup>	13.6 <sup>a</sup>	185.7 <sup>a</sup>
Lovell	93 <sup>ab</sup>	0.6 <sup>bc</sup>	43.3 <sup>b</sup>	100.0	76.2	100.8 <sup>a</sup>	217.2 <sup>ab</sup>	13.9 <sup>a</sup>	201.5 <sup>a</sup>
Estimated HSD	15.2	2.2	7.9			15.3	16.8	5.2	47.3

\*Mean separation in columns by Tukey's HSD ( $P=0.05$ ). HSD was calculated based on the number of observations per mean.

# 2017 NC-140 Semi-Dwarf Cresthaven Peach Rootstock Trial

3<sup>rd</sup> leaf -2019

## Site Performance

Site	Survival (%)	Suckers	TCSA (cm <sup>2</sup> ) at planting	TCSA (cm <sup>2</sup> ) 2019
AL	97.1 <sup>a</sup>	1.3 <sup>abc</sup>	n/a	43.2 <sup>a</sup>
CO	97.5 <sup>a</sup>	2.4 <sup>a</sup>	1.2 <sup>a</sup>	13.5 <sup>e</sup>
GA	72.5 <sup>b</sup>	1.2 <sup>abc</sup>	n/a	15.7 <sup>de</sup>
MI	98.8 <sup>a</sup>	n/a	1.0 <sup>ab</sup>	19.1 <sup>de</sup>
NC	73.7 <sup>b</sup>	0.4 <sup>bc</sup>	0.9 <sup>b</sup>	27.8 <sup>bc</sup>
NY	48.7 <sup>c</sup>	2.1 <sup>ab</sup>	1.0 <sup>ab</sup>	33.0 <sup>b</sup>
ONT	90.0 <sup>a</sup>	0.0 <sup>c</sup>	1.0 <sup>ab</sup>	21.5 <sup>cd</sup>
PA	100.0 <sup>a</sup>	0.4 <sup>bc</sup>	n/a	27.1 <sup>bc</sup>
SC	100.0 <sup>a</sup>	0.7 <sup>bc</sup>	1.2 <sup>ab</sup>	30.3 <sup>b</sup>
UT	96.0 <sup>a</sup>	0.1 <sup>c</sup>	n/a	28.8 <sup>b</sup>
Estimated HSD	16.3*	1.7	0.3	7.3

\*Mean separation in columns by Tuckey's HSD ( $P=0.05$ ). HSD was calculated based on the number of observations per mean.

# 2017 NC-140 Semi-Dwarf Cresthaven Peach Rootstock Trial

3<sup>rd</sup> leaf -2019

## Site Performance

Site	Julian 90% Bloom	Julian 10% Ripe	Yield (kg/tree)	Fruit FW (g)	Yield efficiency (kg/cm <sup>2</sup> )
AL	75.1 <sup>e</sup>	197.5 <sup>e</sup>	9.5 <sup>ab</sup>	227.1 <sup>c</sup>	0.22 <sup>b</sup>
CO	102.0 <sup>d</sup>	238.6 <sup>c</sup>	0.9 <sup>d</sup>	199.8 <sup>d</sup>	0.05 <sup>c</sup>
GA	n/a	n/a	0.6 <sup>d</sup>	127.9 <sup>e</sup>	0.03 <sup>c</sup>
MI	n/a	n/a	n/a	n/a	n/a
NC	n/a	n/a	2.8 <sup>d</sup>	213.9 <sup>cd</sup>	0.08 <sup>c</sup>
NY	128.0 <sup>b</sup>	246.0 <sup>b</sup>	6.9 <sup>bc</sup>	194.6 <sup>d</sup>	0.23 <sup>b</sup>
ONT	145.0 <sup>a</sup>	n/a	n/a	n/a	n/a
PA	n/a	224.0 <sup>d</sup>	7.2 <sup>bc</sup>	202.2 <sup>d</sup>	0.26 <sup>b</sup>
SC	69.8 <sup>f</sup>	197.3 <sup>e</sup>	6.4 <sup>c</sup>	266.9 <sup>b</sup>	0.21 <sup>b</sup>
UT	112.0 <sup>c</sup>	252.2 <sup>a</sup>	11.3 <sup>a</sup>	298.4 <sup>a</sup>	0.42 <sup>a</sup>
Estimated HSD	5.4	6.2	2.3	25.0	0.13

\*Mean separation in columns by Tuckey's HSD ( $P=0.05$ ). HSD was calculated based on the number of observations per mean.

# 2017 NC-140 Semi-Dwarf Cresthaven Peach Rootstock Trial

*4<sup>th</sup> leaf -2020*

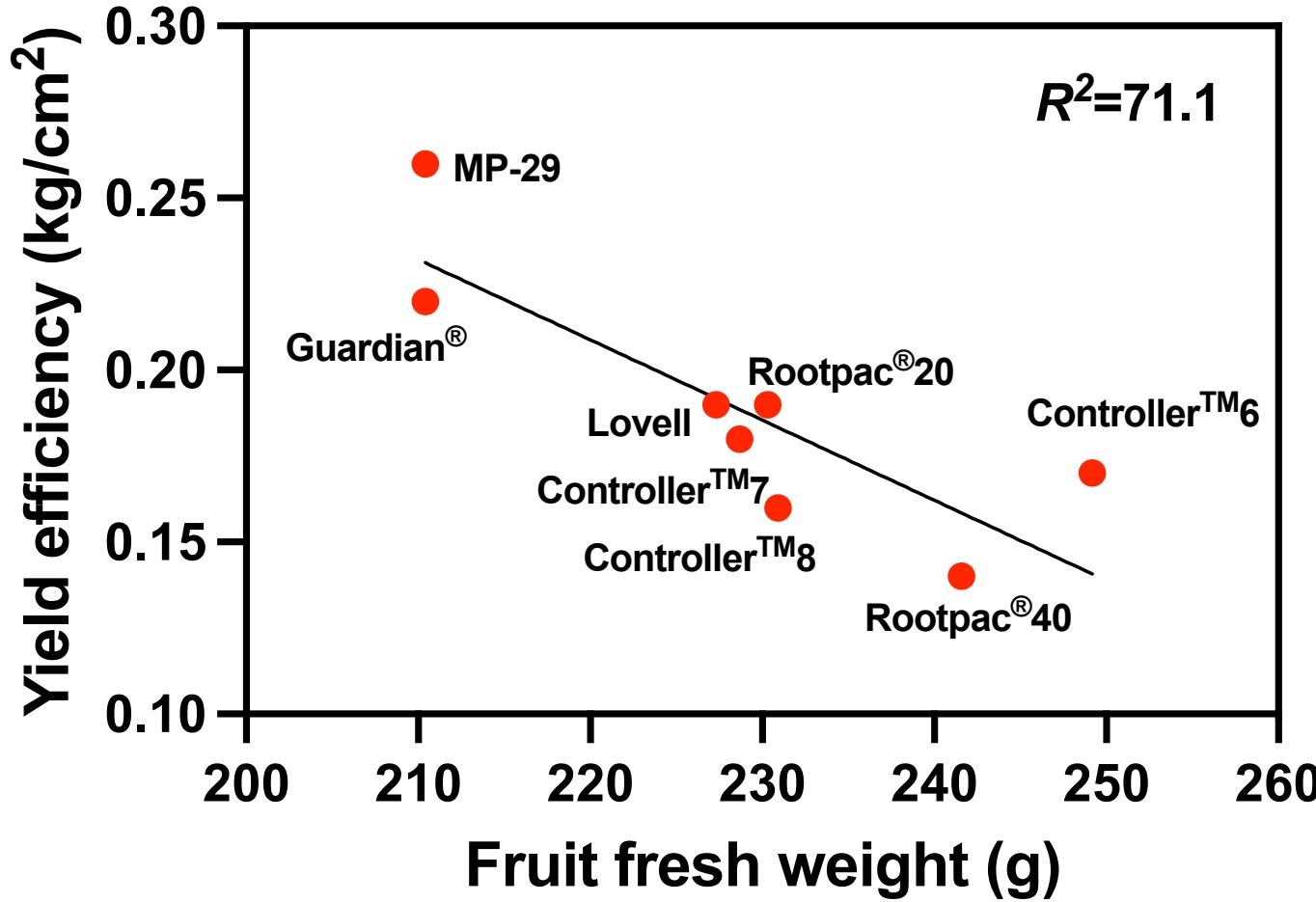
## Site Performance

Site	Survival (%)	Suckers	TCSA (cm <sup>2</sup> ) 2020	Julian 90% Bloom	Julian 10% Ripe	Yield (kg/tree)	Fruit FW (g)
AL	94 <sup>a</sup>	2.8 <sup>abcd</sup>	56.0 <sup>a</sup>	91 <sup>c</sup>	n/a	2.0 <sup>cd</sup>	206.2 <sup>bc</sup>
CO	98 <sup>a</sup>	4.0 <sup>a</sup>	20.2 <sup>e</sup>	97 <sup>b</sup>	n/a	n/a	n/a
GA	64 <sup>c</sup>	2.2 <sup>ab</sup>	22.3 <sup>e</sup>	n/a	192 <sup>d</sup>	0.3 <sup>d</sup>	n/a
MI	99 <sup>a</sup>	n/a	27.5 <sup>de</sup>	n/a	n/a	n/a	n/a
NC	49 <sup>d</sup>	n/a	39.6 <sup>bc</sup>	n/a	205 <sup>b</sup>	5.1 <sup>c</sup>	194.0 <sup>c</sup>
NY	n/a	n/a	n/a	n/a	n/a	n/a	n/a
ONT	84 <sup>ab</sup>	0.0 <sup>d</sup>	45.8 <sup>b</sup>	130 <sup>a</sup>	242 <sup>a</sup>	20.2 <sup>b</sup>	148.8 <sup>d</sup>
PA	99 <sup>ab</sup>	0.4 <sup>bcd</sup>	34.7 <sup>cd</sup>	n/a	n/a	14.9 <sup>b</sup>	203.8 <sup>c</sup>
SC	98.7 <sup>a</sup>	1.9 <sup>bc</sup>	43.6 <sup>b</sup>	78 <sup>d</sup>	204 <sup>c</sup>	13.6 <sup>b</sup>	256.0 <sup>a</sup>
UT	96 <sup>ab</sup>	0.2 <sup>cd</sup>	40.6 <sup>bc</sup>	n/a	n/a	13.0 <sup>b</sup>	232.4 <sup>b</sup>
Estimated HSD	14.9	2.1	9.3	0.7	0.8	3.3	26.7

\*Mean separation in columns by Tuckey's HSD ( $P=0.05$ ). HSD was calculated based on the number of observations per mean.



# Yield efficiency correlates with fruit size but MP-29 & Controller<sup>TM</sup>6 represent interesting outliers across rootstocks



# Iron chlorosis symptoms (CO site)

July, 26 2018

Controller 6  
Controller 8   Controller 7



# Iron chlorosis symptoms (CO site)

June, 9 2021

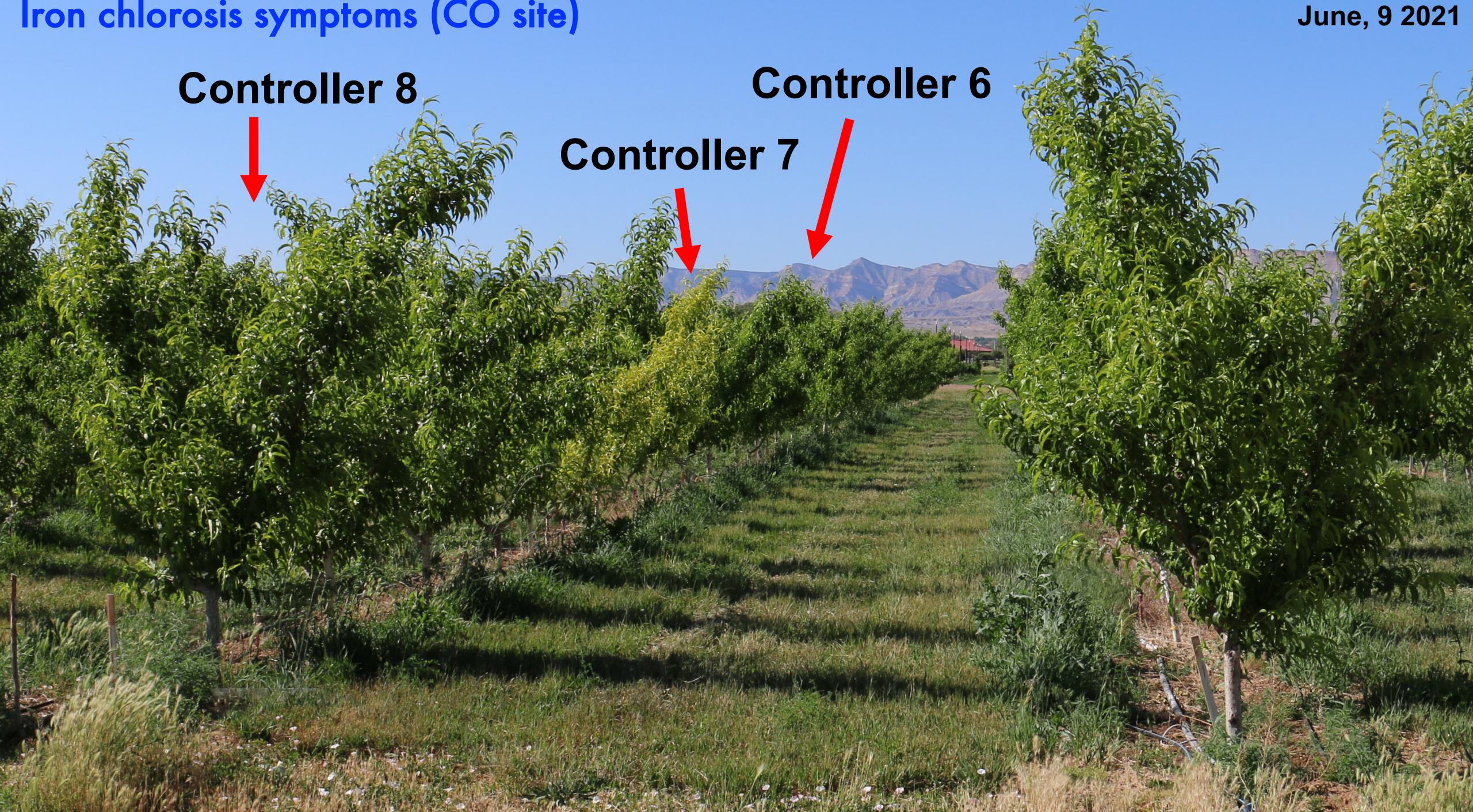
**Controller 8**



**Controller 6**



**Controller 7**





# Rootpac®20?



# Rootpac®40?

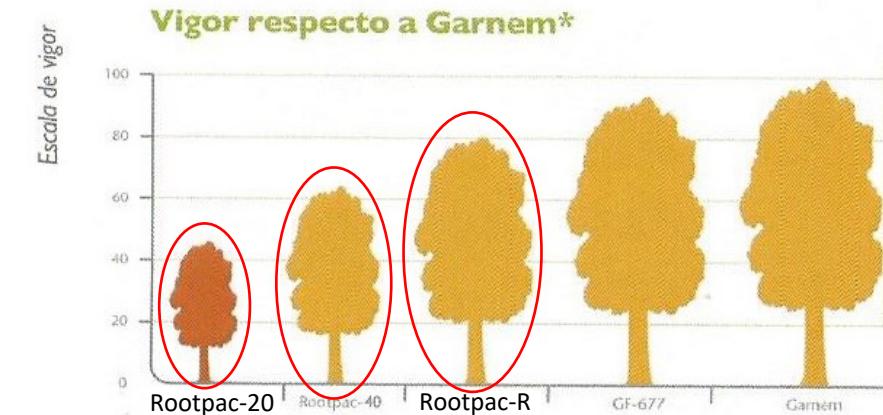


# Genetics: fundamental pillar

From our own breeding program we obtained recognized high quality products, such as:

## PRUNUS ROOTSTOCKS

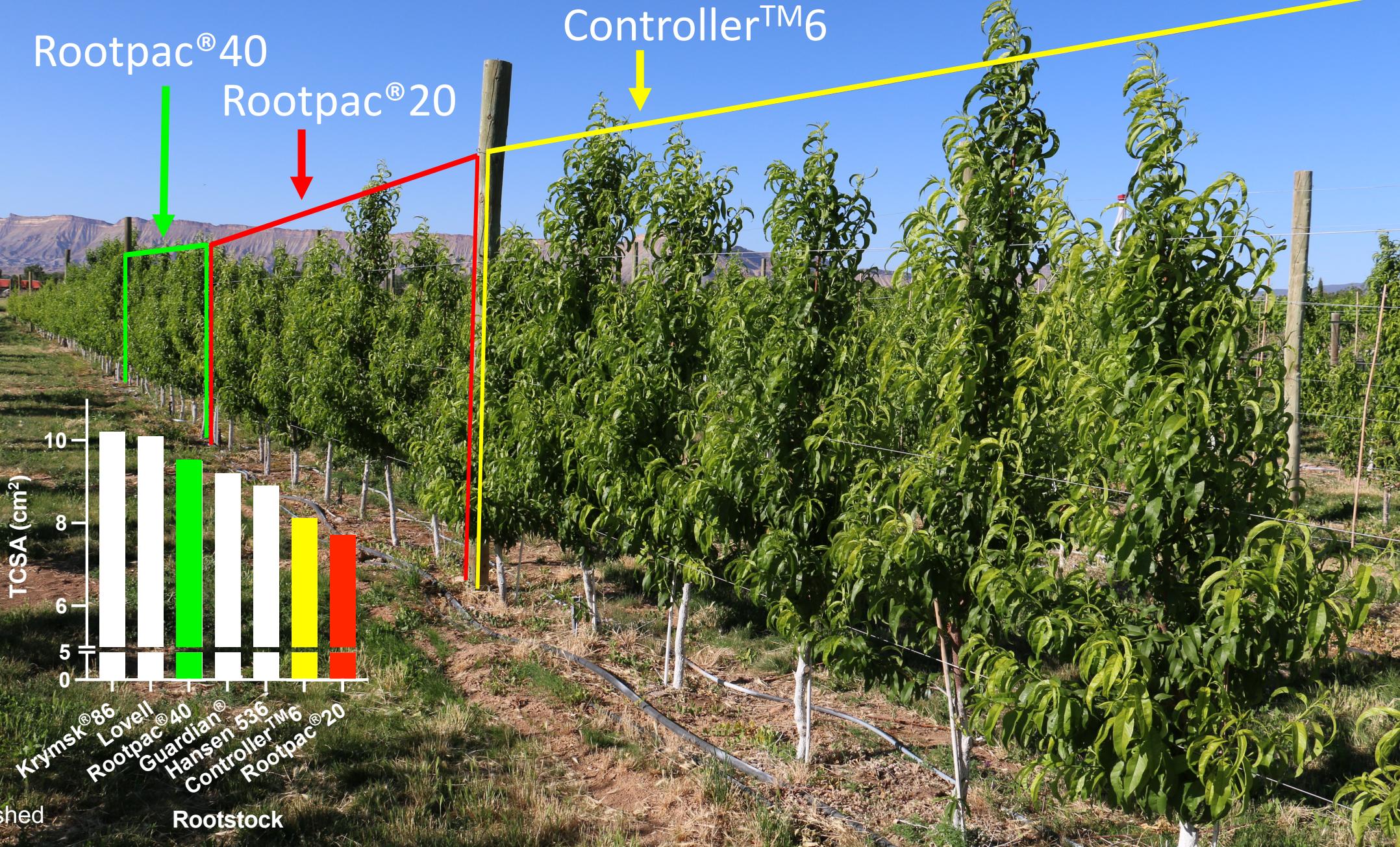
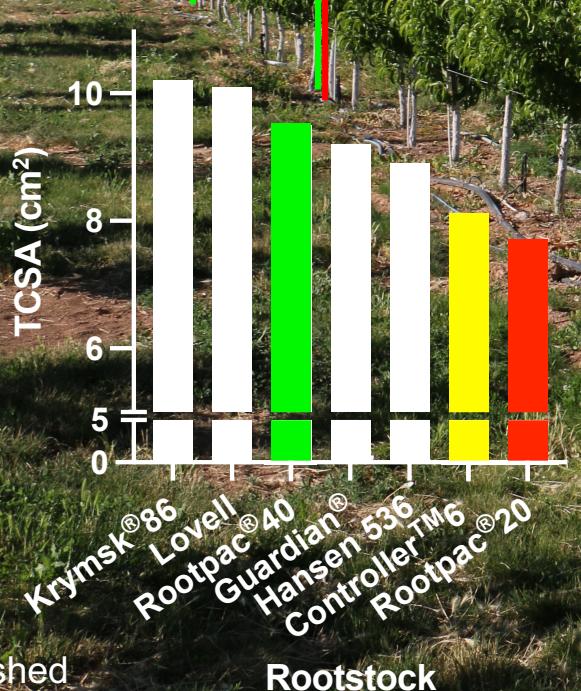
### ROOTPAC®



*2<sup>nd</sup> leaf 2019 Next Generation 2D Peach  
Orchard Trial, Grand Junction, CO*

Rootpac®40  
Rootpac®20

Controller™6

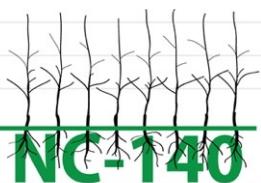




# Conclusions

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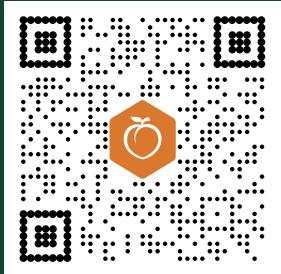
- Past NC-140 peach rootstock trials have shown rootstock productivity and performance can be safely judged after at least three bearing years
- This report is on year 3 and 4 after planting
- So far 'Controller<sup>TM</sup>6' seems to be a promising semi-dwarfing rootstock, as well as Controller<sup>TM</sup>7 and 8 for eastern states (e.g., PA)
- 'MP-29' has the potential to make an interesting dwarfing rootstock
- Performance of Rootpac<sup>®</sup>20 and 40 in this trial across all sites is in contrary with previous reports or other plantings
- This year an SSR analysis with 10 markers indicated Rootpac<sup>®</sup>20 and 40 are in fact the correct genotypes
- More confident conclusions on the performance of the rootstocks under evaluation in this trial can only be made with the collection of additional data in year 5 (2021)



CSU\_Pomology

# Questions?

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## Acknowledgements

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- Brent Black, USU (UT)
- John Cline, UoG (ONT)
- Mike Parker, NCSU, (NC)
- Jim Schupp, PSU (PA)
- Elina Coneva, UA (AL)
- Dario Chavez, UG (GA)

## CSU\_Pomology Team



David Sterle



Brendon Anthony



Jeff Pieper



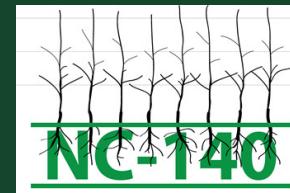
Emily Dowdy

# Acknowledgements

## Funding:



COLORADO  
Department of Agriculture



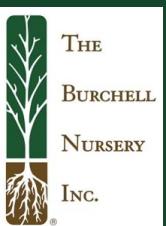
## Support:



Sierra Gold  
Nurseries



AGROMILLORA



AGRICULTURAL  
EXPERIMENT STATION  
COLORADO STATE UNIVERSITY

## Questions?

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