HLB tolerant early season sweet oranges

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Early season sweet oranges and their importance to Florida Citrus

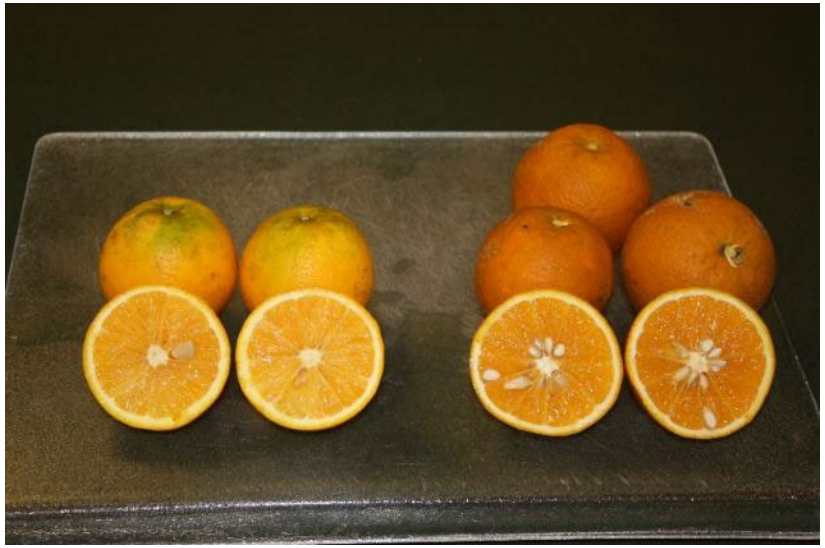
Myth: All sweet oranges are highly susceptible to HLB!

Reality: Although all sweet oranges share a similar genetic makeup, they vary in how they react to HLB, with certain cultivars showing greater tolerance than others.

Why do we need early season oranges?

- Early season juice oranges, such as the primary Hamlin cultivar are highly sensitive to HLB.
- The juice color and quality of Hamlin sweet oranges have significantly deteriorated under endemic HLB conditions.
- The handful of orange juice-processing plants left in Florida need more robust early season sweet orange cultivars to produce quality juice in December and January.

The Parson Brown



It is a variety that dates back to the 1800s and was the principal orange of the early season for many years until it was virtually replaced by the 'Hamlin' orange. 'Parson Brown' is seedy with a relatively thick peel that is slightly rough or pebbly. It has been grown largely for its supposedly better juice flavor and color as compared to 'Hamlin,' but its lower yield was the primary reason precluding its widespread adoption in the Florida citrus industry.

Proc. Fla. State Hort. Soc. 123:78–81. 2010.

'Parson Brown' Sweet Orange Performance in a Rootstock Planting

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DPI Records for Parson Brown

Variety Clone	Clone Status
Parson Brown 1	Discontinued
Parson Brown 23	Discontinued
Parson Brown 25	Discontinued
Parson Brown SPB-1-2-3	Discontinued
Parson Brown 31-4-2	Discontinued
Parson Brown 3-402	Discontinued
Parson Brown 3-6	Discontinued
Parson Brown 51-15-16	Discontinued
Parson Brown F-56-2	Still Active
Parson Brown 61	Discontinued
Parson Brown 61-13	Discontinued
Parson Brown 65-5-13	Discontinued
Parson Brown 68-11-8	Discontinued
Parson Brown F-59-1	Discontinued
Parson Brown SPB-1	Discontinued

Current clones in DPI:

1. Parson Brown F-56-2
2. Carney Orange DPI 229-2
3. Carney Orange DPI 229-3
4. UF PB 1-2-3 – recent re-introduction by UF – freely available.

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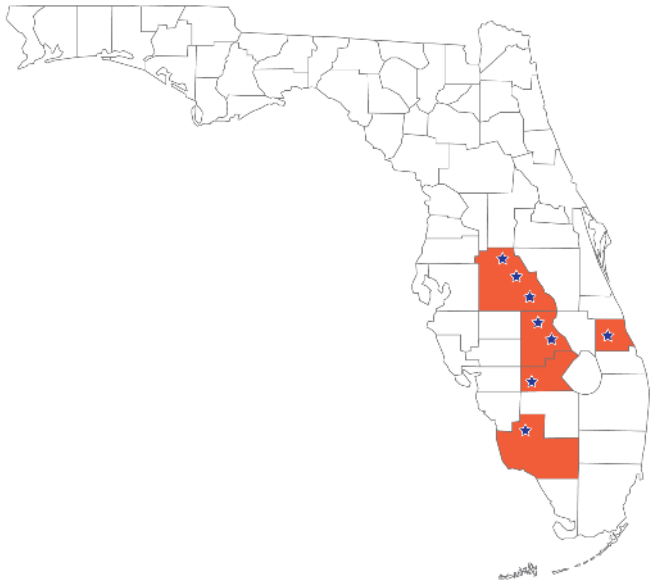
Recent work

- We recently reported that the Parson Brown early season sweet orange has better tolerance to HLB compared to Hamlin oranges.
- Thus, a degree of HLB tolerance is available in some sweet oranges.



HortScience 58(10):1149–1160. 2023. https://doi.org/10.21273/HORTSCI17241-23

A Comparative Study between 'Parson Brown' and 'Hamlin' Sweet Oranges Growing under Endemic Huanglongbing Conditions in Florida

HLB Status in Hamlin and Parson Brown trees from different locations

Location	March		November	
	"Hamlin"	"Parson Brown"	"Hamlin"	"Parson Brown"
Haines City	27.19 ± 0.37	27.99 ± 0.42	28.57 ± 0.42	27.53 ± 0.45
Lake Wales 1	30.88 ± 0.41	29.01 ± 0.25	26.60 ± 0.78	28.04 ± 0.84
Lake Wales 2	28.37 ± 0.46	27.02 ± 0.35	24.99 ± 0.04	28.20 ± 0.88
Sebring	26.36 ± 0.21	25.96 ± 0.25	26.30 ± 0.72	30.89 ± 0.72
Lorida	29.36 ± 0.40	28.16 ± 0.55	26.46 ± 0.22	25.48 ± 0.44
Fort Pierce	28.37 ± 0.39	29.20 ± 0.67	27.85 ± 0.33	27.37 ± 0.22
Ortona	27.01 ± 0.43	26.23 ± 0.28	27.65 ± 1.00	29.26 ± 1.04
Immokalee	27.60 ± 0.60	27.45 ± 0.44	28.61 ± 1.17	26.32 ± 0.53

Juice parameters in ‘Hamlin’ and ‘Parson Brown’ trees.

Variables	Cultivars	Locations							
		Haines City	Lake Wales 1	Lake Wales 2	Sebring	Lorida	Fort Pierce	Ortona	Immokalee
Juice per box (lb)	H	47.2 ± 0.1 D*	51.4 ± 0.6 AB	51.7 ± 0.4 A	49.5 ± 0.6 BC*	53.5 ± 0.0 A*	53.2 ± 0.2 A	51.9 ± 0.1 A	47.7 ± 0.5 CD*
	PB	51.4 ± 0.3 bc	50.9 ± 0.0 c	51.7 ± 0.1 bc	51.4 ± 0.2 bc	51.3 ± 0.4 c	53.8 ± 0.2 a	52.4 ± 0.1 b	51.5 ± 0.2 bc
Acidity %	H	51.6 ± 2.6 D	81.0 ± 0.7 A*	58.3 ± 0.80 CD*	68.6 ± 1.3 B*	67.6 ± 1.3 B*	54.3 ± 0.5 D*	63.9 ± 3.0 BC*	44.6 ± 0.3 E*
	PB	46.0 ± 1.2 bc	44.3 ± 0.5 bc	48.6 ± 0.6 b	57.1 ± 1.6 a	49.0 ± 2.6 b	42.3 ± 0.9 c	45.6 ± 1.4 bc	48.6 ± 0.7 be
Total Brix	H	09.2 ± 0.1 BCD*	10.5 ± 0.2 A	10.0 ± 0.0 AB*	09.1 ± 0.0 CD*	09.8 ± 0.1 ABC*	09.5 ± 0.0 BCD*	09.0 ± 0.2 D*	09.0 ± 0.2 D*
	PB	08.2 ± 0.1 e	10.1 ± 0.0 a	09.7 ± 0.0 b	09.5 ± 0.0 bc	09.3 ± 0.0 cd	09.0 ± 0.0 d	10.2 ± 0.1 a	10.0 ± 0.0 a
Brix to acidity ratio	H	18.5 ± 1.0 AB	13.0 ± 0.3 C*	17.2 ± 0.2 B*	13.4 ± 0.2 C*	14.6 ± 0.2 C*	17.6 ± 0.1 B*	14.3 ± 0.5 C*	20.2 ± 0.7 A
	PB	18.0 ± 0.3 cd	22.8 ± 0.2 a	20.0 ± 0.3 bc	16.8 ± 0.5 d	19.6 ± 0.8 bc	21.5 ± 0.4 ab	22.6 ± 0.5 a	20.8 ± 0.4 ab
Solids per box (lb)	H	4.6 ± 0.0 BC*	5.4 ± 0.0 A*	5.1 ± 0.0 A*	4.5 ± 0.0 C*	5.2 ± 0.0 A*	5.0 ± 0.0 AB*	4.6 ± 0.1 C*	4.3 ± 0.1 C*
	PB	3.9 ± 0.1 e	5.1 ± 0.0 bc	5.0 ± 0.0 bcd	4.9 ± 0.0 cd	4.8 ± 0.0 d	4.8 ± 0.0 d	5.3 ± 0.0 a	5.1 ±0.0 ab
Juice color	H	31.7 ± 0.1 E*	32.8 ± 0.1 CD*	33.3 ± 0.0 B*	32.7 ± 0.0 D*	33.9 ± 0.0 A	33.2 ± 0.1 BC*	33.2 ± 0.1 BCD*	33.2 ± 0.1 BC
	PB	32.7 ± 0.1 e	33.6 ± 0.0 cd	33.9 ± 0.1 bc	34.16 ± 0.18 b	33.2 ± 0.1 de	35.0 ± 0.0 a	34.3 ± 0.1 b	33.5 ± 0.0 cd

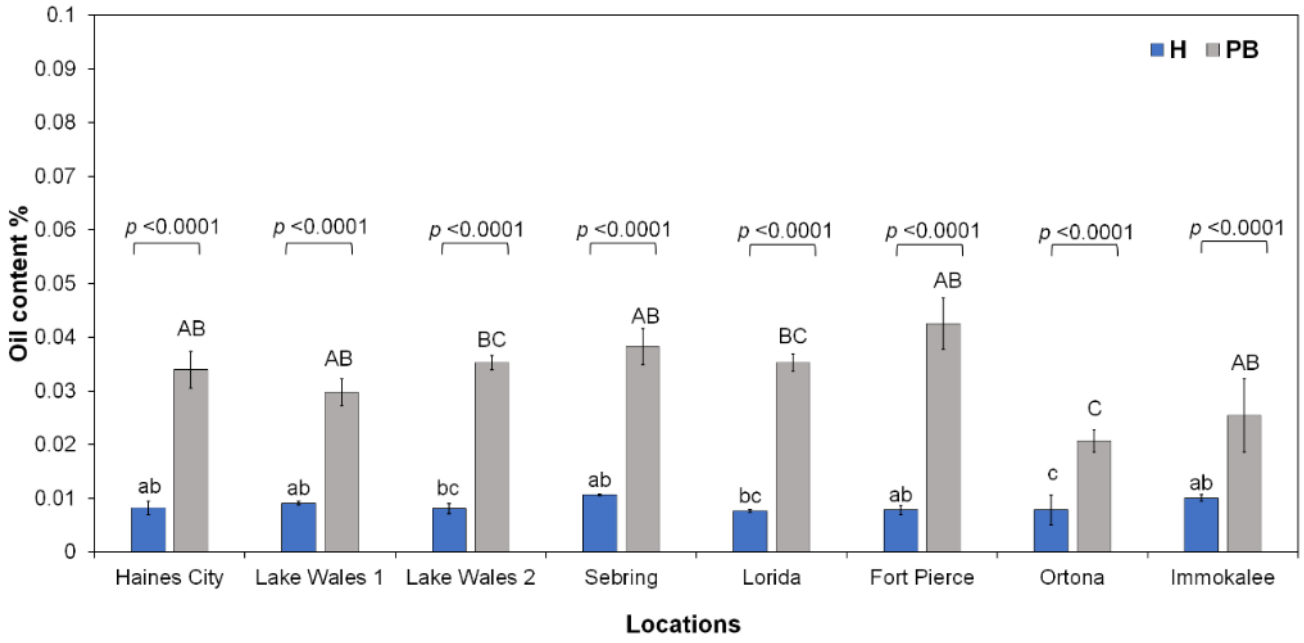
Summary:

- The ratio of Brix to acidity was higher in ‘Parson Brown’ fruits compared to ‘Hamlin’ fruits under all field locations.
  - Ranged from 13.01 to 20.28 in ‘Hamlin’ fruits in all the locations,
  - Ranged from 16.87 to 22.84 in ‘Parson Brown’ fruits.
- Lbs. solids per box ranged between 4.32 and 5.40 in ‘Hamlin’ and 3.90 and 5.35 in ‘Parson Brown’.

Table VII - Pasteurized Orange Juice

Factors	Grade A				Grade B			
Quality:								
Appearance.	Fresh orange juice.				Fresh orange juice.			
Coagulation.	None.				None.			
Separation	No material.				Some.			
Color.	Very Good. (Not as good as OJ 5 but much better than OJ 6.)				Good. (Fails Grade A, but not off color.)			
Score Points . .	36 - 40.				32 - 35.			
Defects.	Practically free.				Reasonably free.			
Score Points	18 - 20.				16 - 17.			
Flavor.	Very good.				Good.			
Score Points . .	36 - 40.				32 - 35.			
Total Score Points.	Minimum - 90.				Minimum - 80.			
Analytical:								
	Unsweetened		Sweetened		Unsweetened		Sweetened	
Brix: Minimum.	11.0		11.0		10.5		10.5	
Soluble orange solids, exclusive of sweetener (percent by weight of finished product): Minimum.			11.0				10.5	
Brix/Acid Ratio:	Min	Max	Min	Max	Min	Max	Min	Max
California/Arizona . . .	11.5:1	18.0:1	12.5:1	20.5:1	10.5:1	23.0:1	10.5:1	23.0:1
Outside California/ Arizona	12.5:1	20.5:1	12.5:1	20.5:1	10.5:1	23.0:1	10.5:1	23.0:1
Recoverable Oil (percent by volume): Maximum.	0.035				0.045			

https://www.ams.usda.gov/sites/default/files/media/Canned_Orange_Juice_Standard[1].pdf



- The oil content in all the “Hamlin” juice samples was Grade A.
- “Parson Brown” had a higher and variable oil content percentage, which depended on the location from which the fruit was harvested.
- As there are many clones of the “Parson Brown” still being grown in Florida, clonal differences may be partly responsible for this.

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Summary

- Most citrus sweet orange cultivars are highly sensitive to HLB, and the trees decline a few years after infection.
- Several groves with mature (20+) 'Parson Brown' trees were surveyed and found to experience minimal leaf and fruit drop compared to 'Hamlin' sweet orange under endemic HLB conditions. “Hamlin’ trees in these sites were all less than 10 years of age, having been replanted.
- It was observed that regardless of location, clone, or rootstock, 'Parson Brown' trees demonstrated enhanced tolerance to HLB.

Hamlin (?) escape trees – the Buckhill grove

- Located in Lake County. Managed by Mr. Bill Lennon.
- Gary England has been observing Hamlin trees in this grove for several years.
- Trees were planted after the late 1980s freeze.
- Supposed to be Hamlin on Swingle rootstock.

Some escape trees – the Buckhill grove

- All trees infected with HLB.
- Sporadic beautiful trees with full canopy and good crop load.

Rootstock- Scion Conundrum

At the time of planting, all trees should have been on Swingle Rootstock.

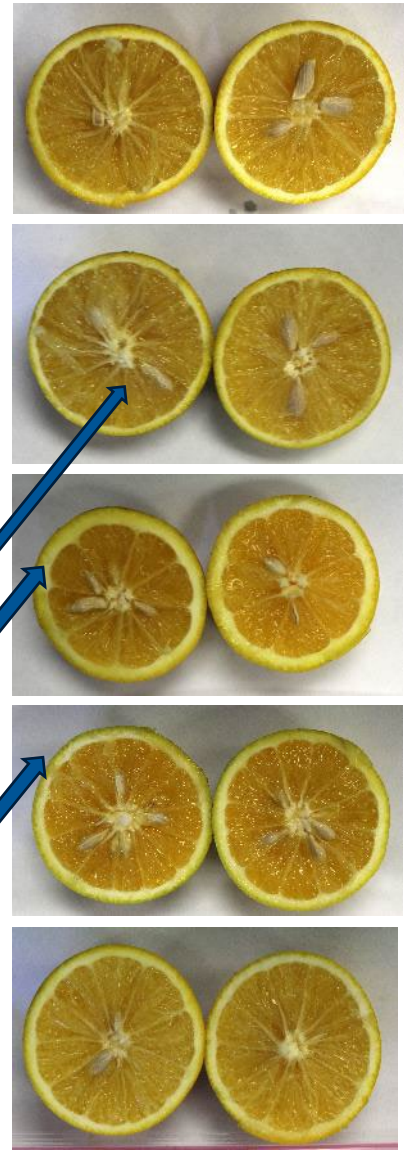
- It's possible that some may be resets, but the lack of records makes it difficult to determine.

Dr. Gmitter tested the genetic identity of the rootstocks from several select trees using SSR markers.

- Some were true to type Swingle
- Several are zygotic trees of Swingle that originated from selfing.
- One zygotic tree derived from outcrossing.

Escape trees – the Buckhill grove

	Tree No - Row No	Lbs. Solids Per Box	
		2022	2023
1	17-34	5.8292	5.9533
2	18-25	5.9389	6.0378
3	19-17	5.7043	6.1311
4	19-20	5.6353	5.7751
5	19-35	6.0331	5.7749
6	20-30	5.9404	5.9735
7	20-35		5.8593
8	20-38	5.9543	5.7631
9	21-34	5.8228	5.5138
10	21-36	5.7775	6.2920
11	22-2	5.9984	5.1883
12	22-31	5.8675	5.0326
13	22-32	5.6624	5.4522
14	23-33	6.2216	5.5478
15	23-36-CHK	5.8911	6.0297
16	24-24	5.8754	5.9834
17	24-31	6.3024	5.6334
18	25-19	6.0835	6.0888
19	25-25	6.0971	6.3414
20	25-35	6.0645	5.7215
21	25-36	5.6316	5.9324
22	25-5	5.7787	5.7206
23	26-32	6.0427	5.0743
24	29-1	5.8187	6.0890
25	29-4	6.3583	5.4955
26	36-17	6.3770	5.4738
27	39-17	6.1891	6.1750



Tree #	Average Seeds	2023 Juice Color
18-25	3-8	32.6
25-19	1-9	32
25-25	7-15	33.6
29-1	6-19	33.5
39-17	2-4	32.1
HAMLIN	1-4	31.4
PARSON BROWN	9-11	33.1
ROBLE	8-13	31.5
EV1	9-10	34.02

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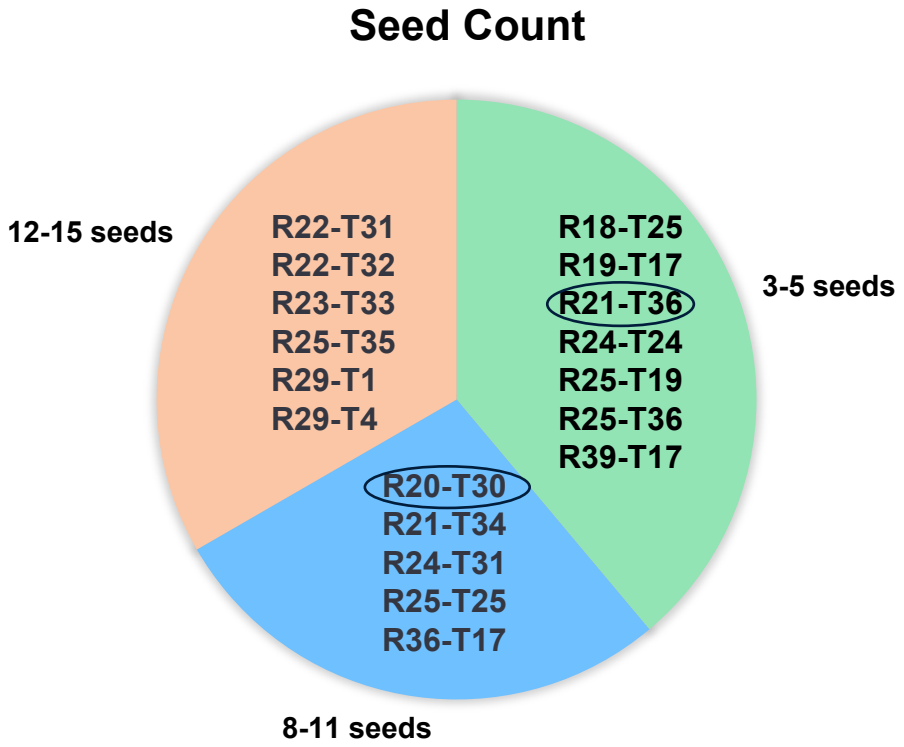
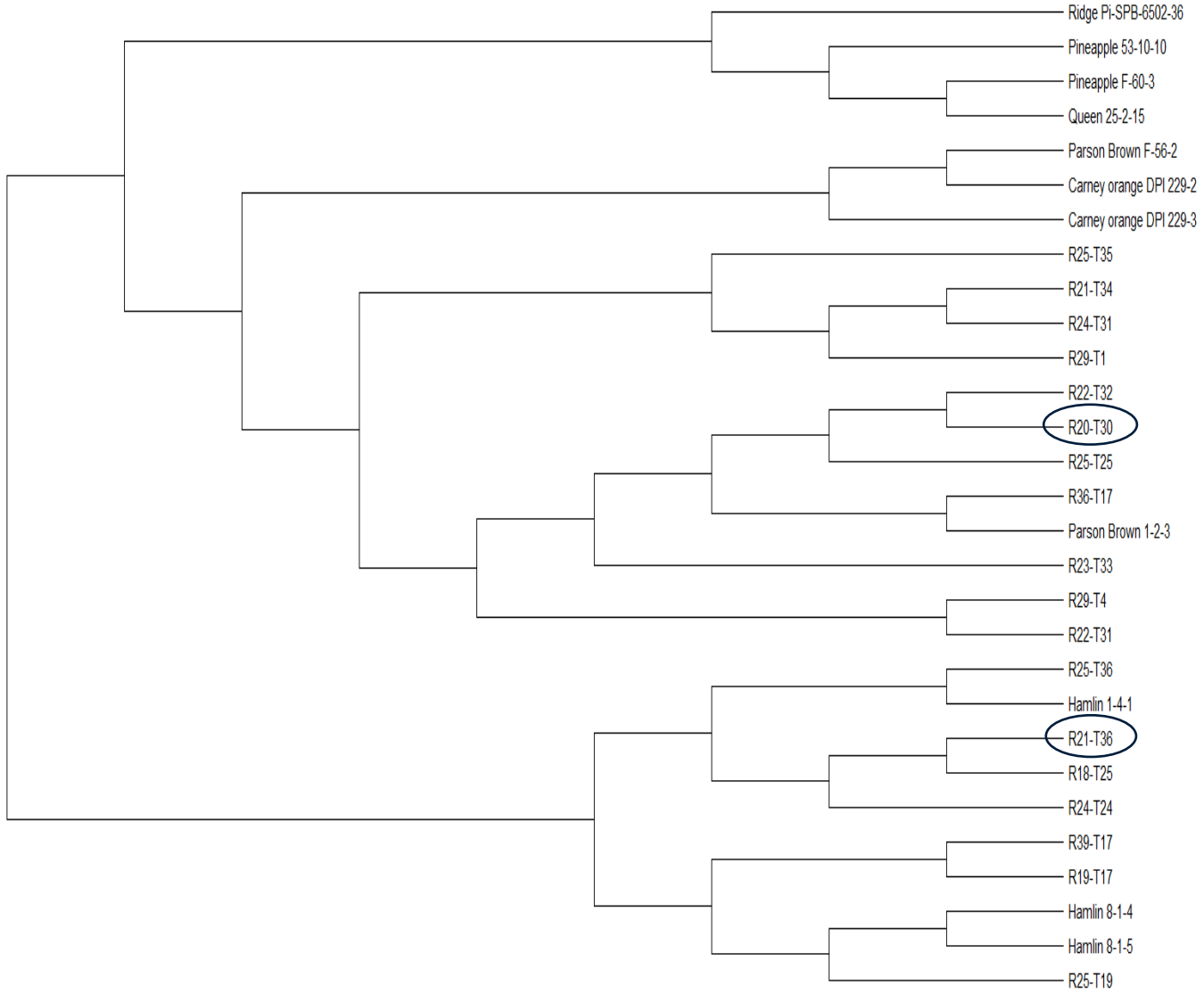
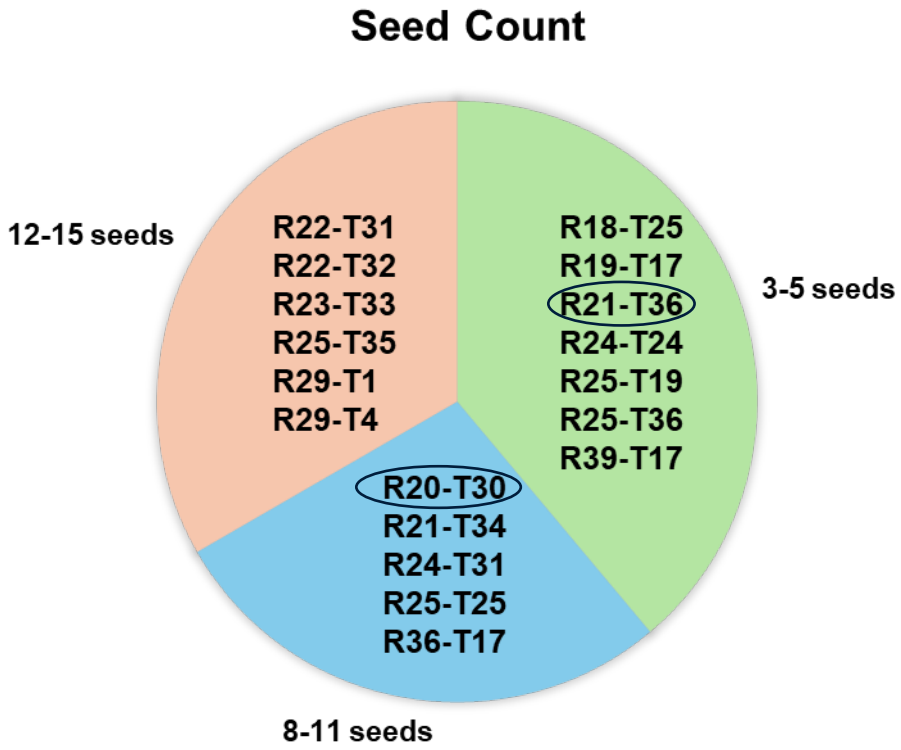
Seed count analysis



- All the cultivars are expected to be 'Hamlin', but they've displayed varying seed counts.
- Based on the seed count, cultivars were categorized into three sections.
- Additionally, to investigate their origin, these cultivars, along with several DPI cultivars, have been sequenced using Illumina technology.





DNA sequencing of the escape trees in the Buckhill block indicates that most of the trees are likely either Parson Brown types, or Hamlin clones.

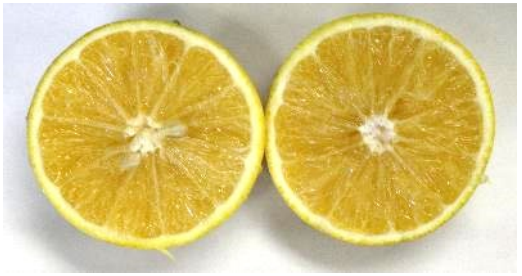
Summary – Trees included in CRAFT Cycle Six

Control

R20T30 - PB type

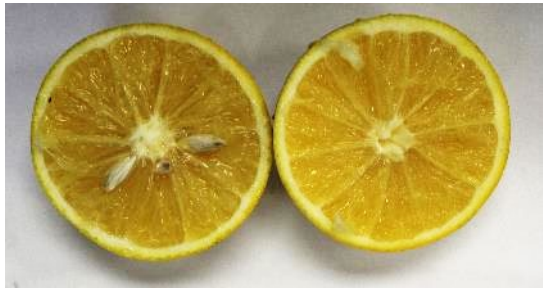
R21T36 - Hamlin type

HLB



24 ± 0.037

30 ± 0.119



31 ± 0.055

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Summary – Trees included in CRAFT Cycle Six

R20T30 - PB type

R21T36 - Hamlin type

	Sample ID	Wt. Sample	Wt. Juice	Lbs. Juice Per Box	% Acid	Total °Brix	Ratio	Lbs. Solids Per Box	Lbs. Solids Per Load	Juice Color
2022	20-30	16.95	10.07	53.469	0.51	11.11	21.78	5.9404	5.94	33.2
	21-36	15.99	9.02	50.769	0.86	11.38	13.23	5.7775	5.78	31.8
2023	20-30	20.88	12.03	51.853	0.54	11.52	21.33	5.9735	5.97	34.25
	21-36	19.37	11.21	52.086	0.83	12.08	14.55	6.2920	6.29	33.36

Take home Messages

- Parson Brown has enhanced tolerance to HLB.
- Survivor trees at the Buckhill grove were mainly Parson Brown types with a few Hamlin clones.
- Rootstock identity in many of the survivor trees is unknown and will be determined.

Any questions?

Thank you!

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