Use ofInterstocks for HLB management

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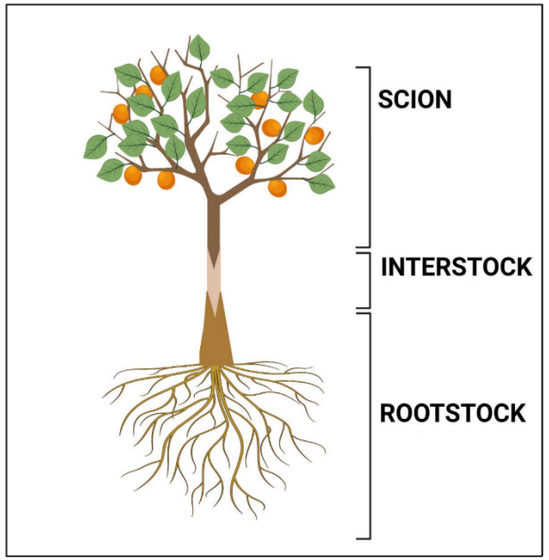
WHAT IS ANNTERSTOCK

An interstock is a graft of a citrus selection which can be used as a **“bridge”** between the scion and rootstock.



> J Agric Food Chem. 2004 Jan 28;52(2):324-31. doi: 10.1021/jf0304775.

Effect of the rootstock and interstock grafted in lemon tree (Citrus limon (L.) Burm.) on the flavonoid content of lemon juice

Angel Gil-Izquierdo [1], María T Riquelme, Ignacio Porras, Federico Ferreres

ELSEVIER

Scientia Horticulturae

Volume 19, Issues 3–4, April 1983, Pages 229-235

An evaluation of the interaction between interstocks and rootstocks on the yield and tree size of ‘Valencia’ orange

M.T. Treeby [1], I.R. Thornton

PAPER • OPEN ACCESS

The Effect of Interstock on The Development of Huanglongbing Disease and Vegetative Growth of Three Commercial Citrus Varieties in Indonesia

Mutia Erti Dwiastuti[1], Agus Sugiyatno[1], Nirmala F Devy[1] and Hardiyanto[1]

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DOI 10.1088/1755-1315/1172/1/012034

Original Articles

Orange varieties as interstocks increase the salt tolerance of lemon trees

V. Gimeno, J. P. Syvertsen, M. Nieves, I. Simón, V. Martínez & F. Garcia-Sanchez

Pages 625-631 | Accepted 08 Jun 2009, Published online: 07 Nov 2015

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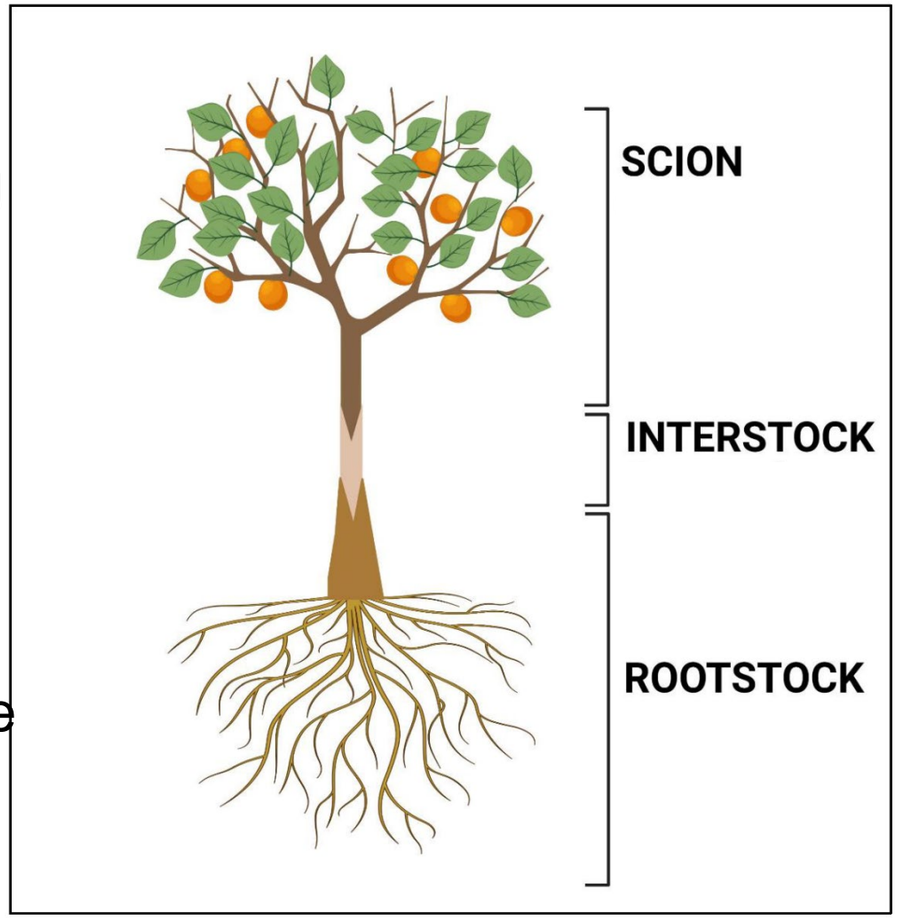
PLANT BREEDING

INTERSTOCKS FOR CITRUS IMPROVEMENT

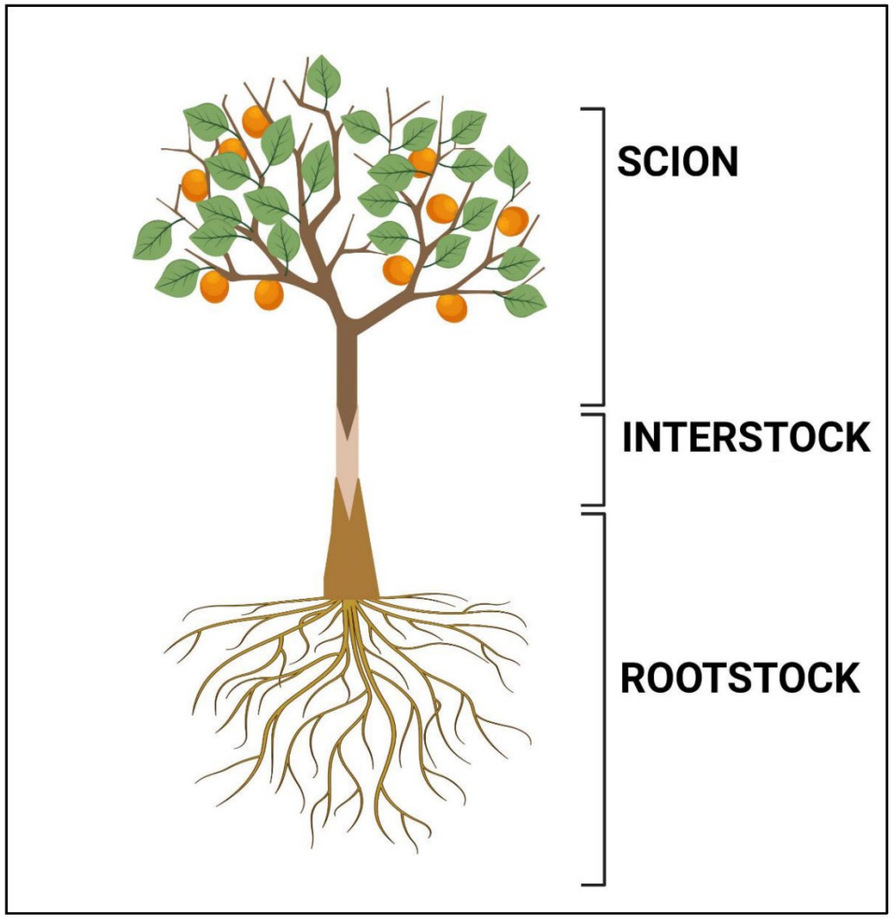
Pros:

1. **Compatibility:** Interstocks can be used to bridge the compatibility gap between the rootstock and scion, allowing for the successful grafting of otherwise incompatible combinations.
2. **Disease Resistance:** Interstocks possess resistance or tolerance to specific diseases or pests, providing added protection to the scion. This can contribute to improved overall health and productivity of the tree.
3. **Vigor Regulation:** Interstocks can influence the vigor of the scion, helping to balance the growth of the tree. This can be particularly useful in managing overly vigorous scions or rootstocks, leading to better tree structure and more manageable growth.



INTERSTOCKS FOR CITRUS IMPROVEMENT

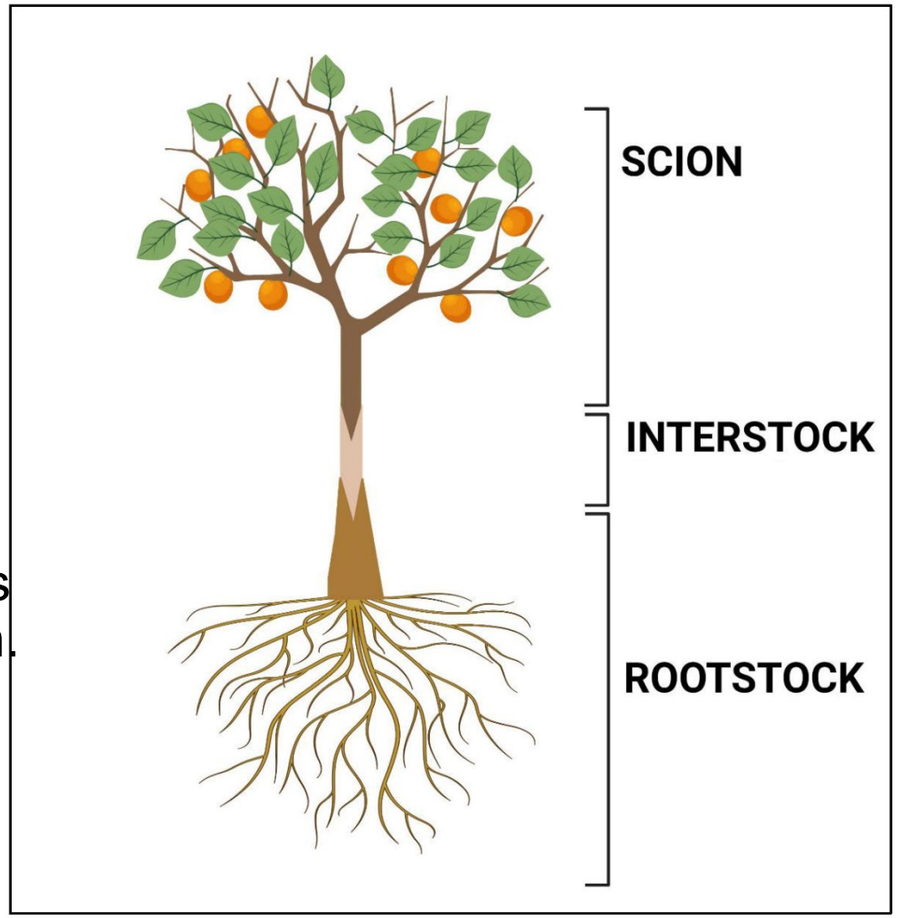
4. **Precocity:** Interstocks have been shown to promote earlier fruiting or flowering in the scion, which can be advantageous in commercial groves where early production is desirable.
5. **Improved Fruit Quality:** Interstocks have been shown to influence fruit quality characteristics such as size, color, flavor, and shelf life.



INTERSTOCKS FOR CITRUS IMPROVEMENT

Cons:

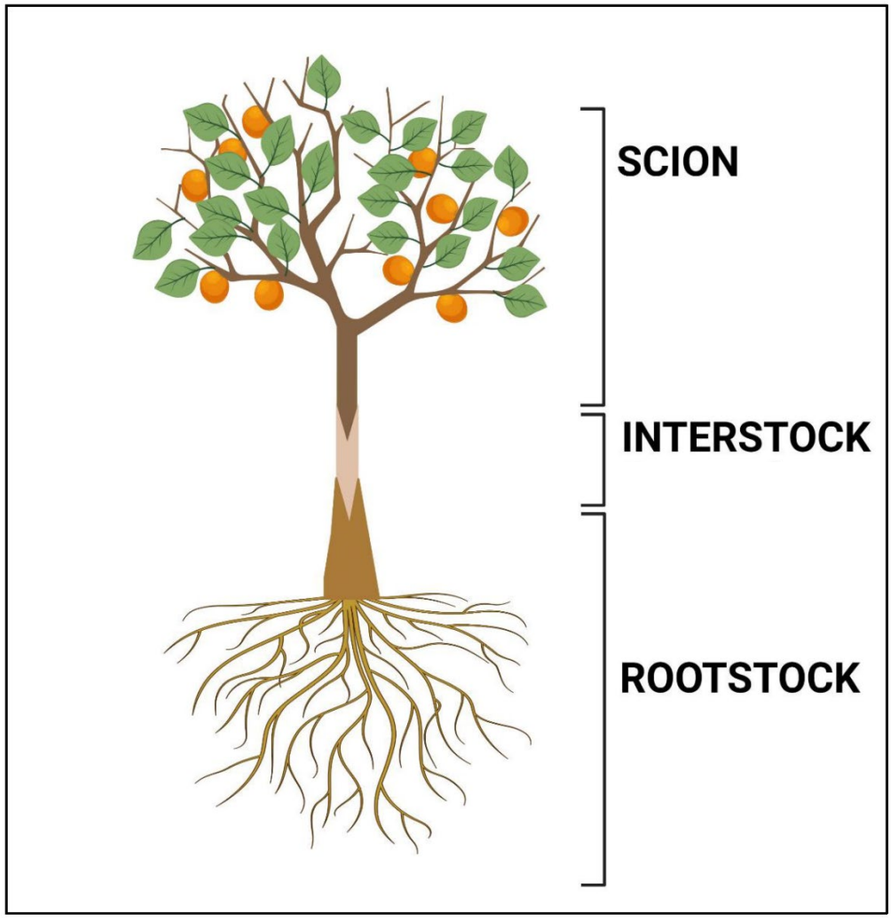
1. **Increased Cost:** Introducing an interstock adds to the overall cost of tree production due to the additional materials, labor, and expertise required for grafting.
2. **Potential for Unintended Effects:** Introducing a new element into the grafting process introduces the potential for unintended consequences, such as changes in tree growth habits, fruit characteristics, or susceptibility to certain stresses. These effects may not become apparent until after several years of tree growth.
3. **Limited Availability of Suitable Interstocks :** Finding interstocks that meet the desired criteria (e.g., compatibility, disease resistance, vigor regulation) can be challenging.



INTERSTOCKS FOR CITRUS IMPROVEMENT

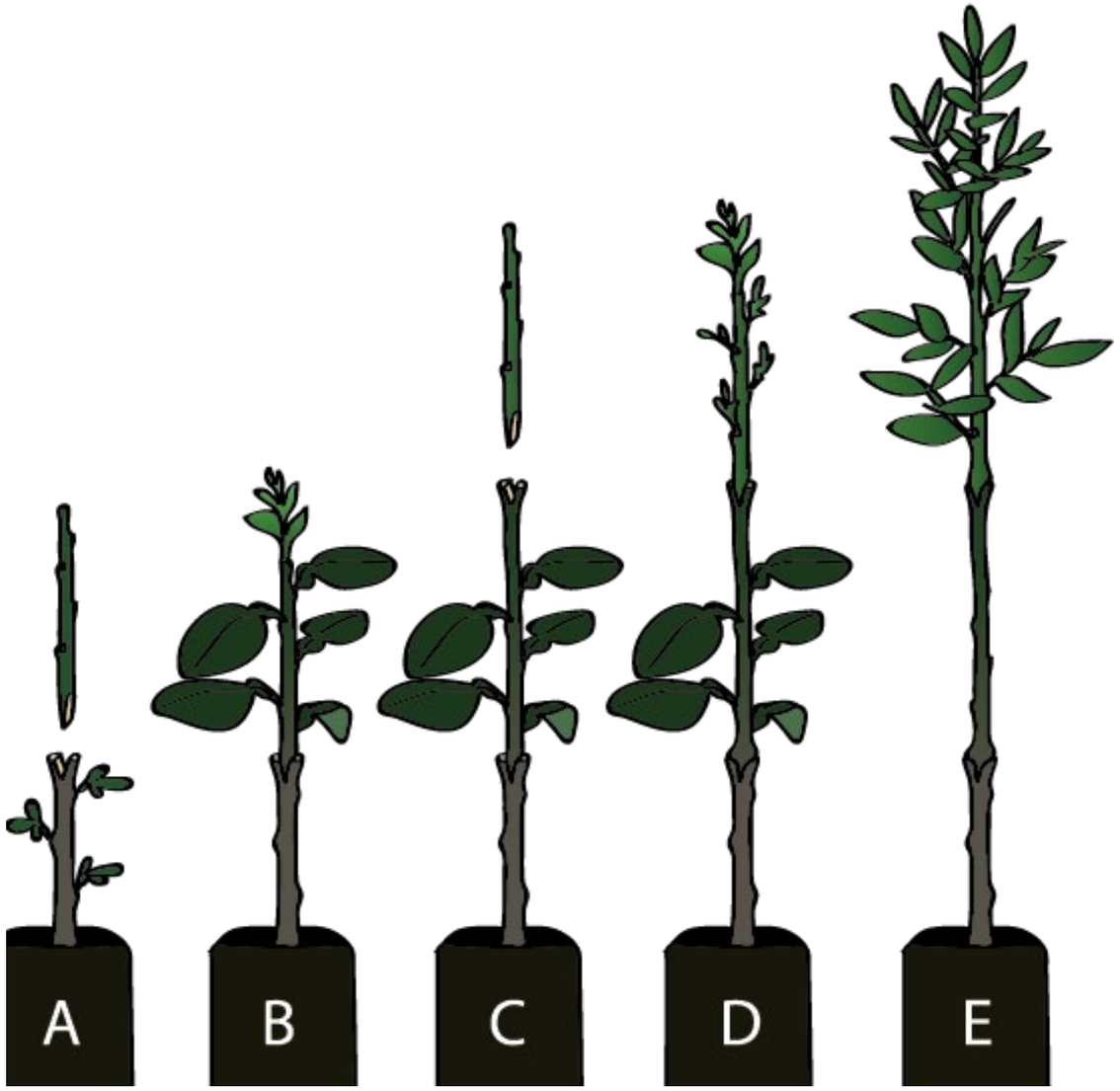
Hypothesis behind the use of interstocks :

HLB-tolerant interstocks would allow growers to use the rootstocks they liked prior to HLB becoming a problem.



EXPERIMENTAL DESIGN

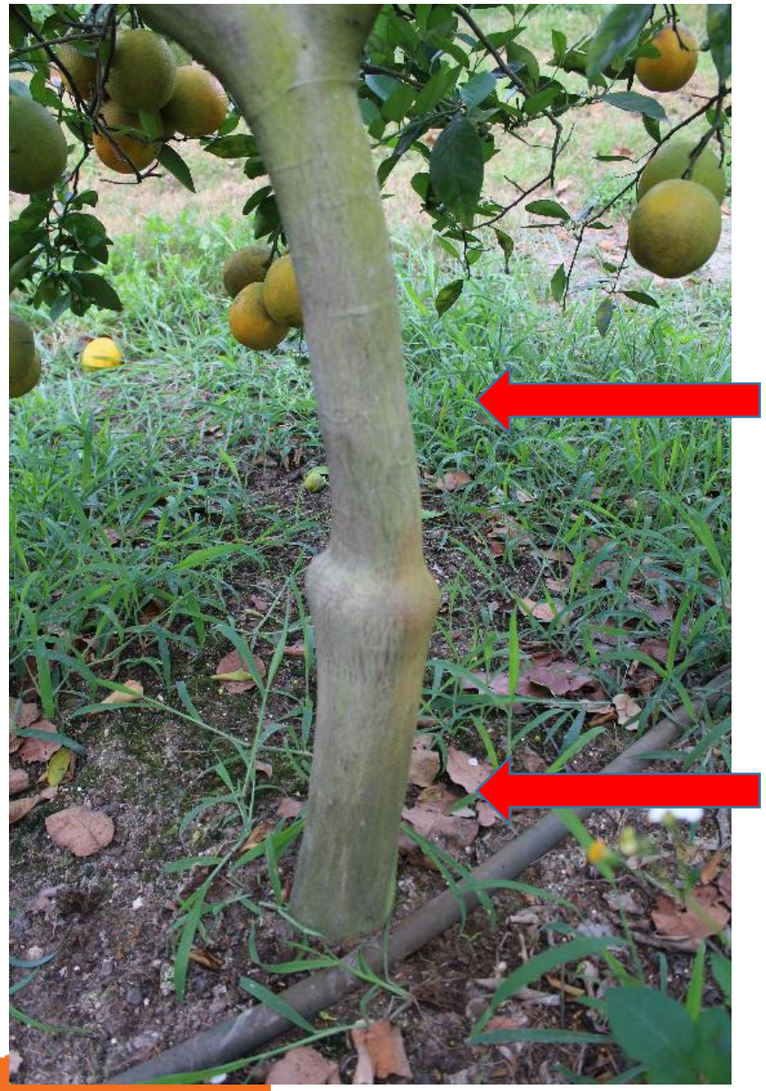
- Interstock candidates were selected based upon their field performance showing low or no HLB symptoms.
- The Swingle rootstock was cleft grafted with 6 inch interstock sticks obtained from the field trees.
- The interstock was subsequently cleft grafted with HLB infected ‘Valencia’ scion.
- A year following grafting, trees were planted out in the field.
- There were 9 pummelo selections with 10 replications each.
- Swingle interstock served as the control in this study.



EXPERIMENTAL MATERIAL

INTERSTOCK	PARENTAGE
UKP-1	OP seedling of Unknown Parentage
HBJL-1	OP seedling of Hirado Buntan pummelo
HBJL-4	
5-1-99-3	
5-1-99-2-S5	
5-4-99-3	OP seedling of Red shaddock Pummelo
5-4-99-7	
7-2-99-11	OP seedling of Large pink pummelo
8-1-99-1B	OP seedling of Liang ping Yau pummelo
Swingle	Control

Valencia/Interstock /Swingle



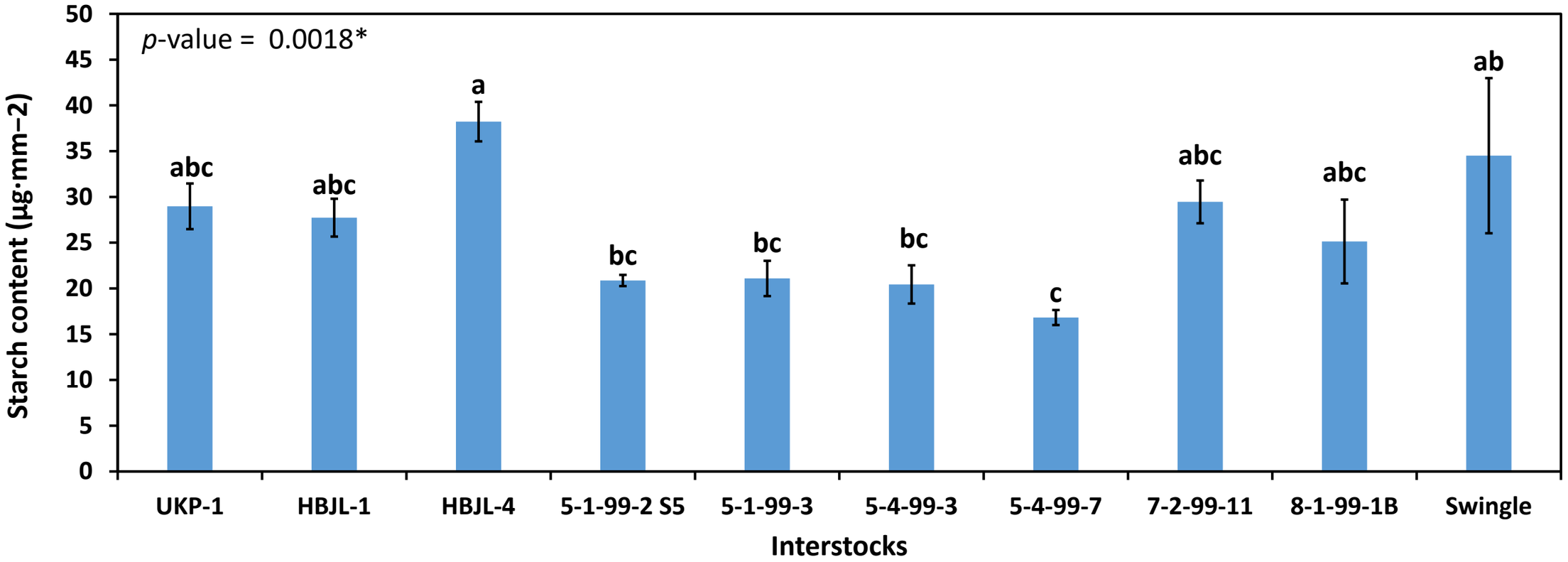
TREE CHARACTERISTICS

Interstock	n	Height (cm)	SD	Rootstock Diameter (mm)	SD	Interstock Diameter (mm)	SD	Scion Diameter (mm)	SD	Ct Value	SD
UKP-1	9	127.85 abc	172.27	11.33 abcd	0.72	9.07 ab	0.69	6.91 abcd	1.39	25.8388 de	4.21
HBJL-1	10	142.56 abc	135.57	12.02 ab	1.16	8.58 abcd	0.6	7.20 ab	0.56	33.2531 a	3.65
HBJL-4	10	134.79 abc	207.89	12.20 a	1.2	9.25 ab	0.97	7.28 ab	0.86	26.851 bcde	4.12
5-1-99-2 S5	10	126.79 abc	319.18	10.92 abcde	1.14	9.08 ab	1.22	7.12 abc	0.83	26.1782 cde	3.08
5-1-99-3	10	121.16 bc	216.89	11.21 abcd	0.92	9.05 ab	0.73	6.53 abcd	0.86	28.2957 bcde	3.71
5-4-99-3	8	122.40 abc	230.8	10.83 abcde	1.44	8.45 abcd	1.04	6.14 bcd	1.28	25.7139 de	4.67
5-4-99-7	8	130.02 abc	226.09	10.19 cde	0.89	8.37 abcd	0.53	6.32 bcd	0.88	29.6398 abcd	3.65
7-2-99-11	10	120.71 bc	276.86	11.07 abcd	0.97	9.11 ab	0.99	6.86 abcd	1.13	25.7278 e	1.91
8-1-99-1B	9	139.35 abc	215.27	11.13 abcd	0.72	8.90 abc	0.66	7.23 ab	1.19	27.6208 bcde	3.41
5-4-99-4	10	129.48 abc	286.04	10.25 de	1.13	8.07 bcd	1.27	5.55 d	1.49	25.3789 e	3.19
Swingle	8	112.40 c	207.61	9.29 e	1.19	7.19 d	1.54	5.48 cd	0.85	24.8944 e	2.08

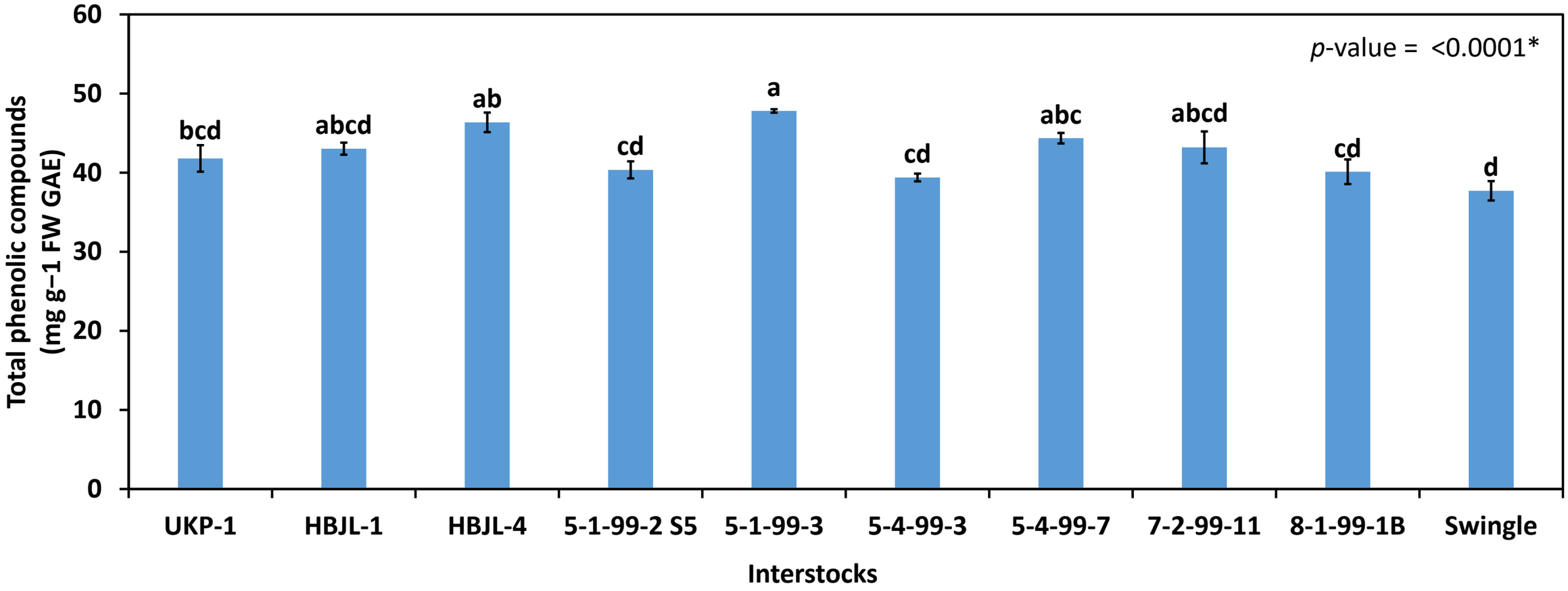
Foliar chlorophyll content

Interstock	Chlorophyll a	Chlorophyll b	Total chlorophyll
	$mg^{-1}g$ FW	$mg^{-1}g$ FW	$mg^{-1}g$ FW
UKP-1	3.68 a	2.76 ab	6.44 c
HBJL-1	4.47 a	3.22 a	7.70 a
HBJL-4	4.07 a	2.57 b	6.65 bc
5-1-99-2 S5	4.19 a	3.04 ab	7.23 abc
5-1-99-3	4.09 a	3.03 ab	7.13 abc
5-4-99-3	4.61 a	2.89 ab	7.50 ab
5-4-99-7	3.90 a	2.80 ab	6.71 bc
7-2-99-11	4.44 a	3.07 ab	7.51 ab
8-1-99-1B	4.50 a	3.28 a	7.78 a
Swingle	4.61 a	2.84 ab	6.71 bc
p-value	ns	0.0057*	0.0313*

FOLIAR STARCH CONTENT



FOLIAR TOTAL PHENOLIC COMPOUNDS CONTE



LEAF MINERAL NUTRIENT CONTENT OF VALENCIA TREES

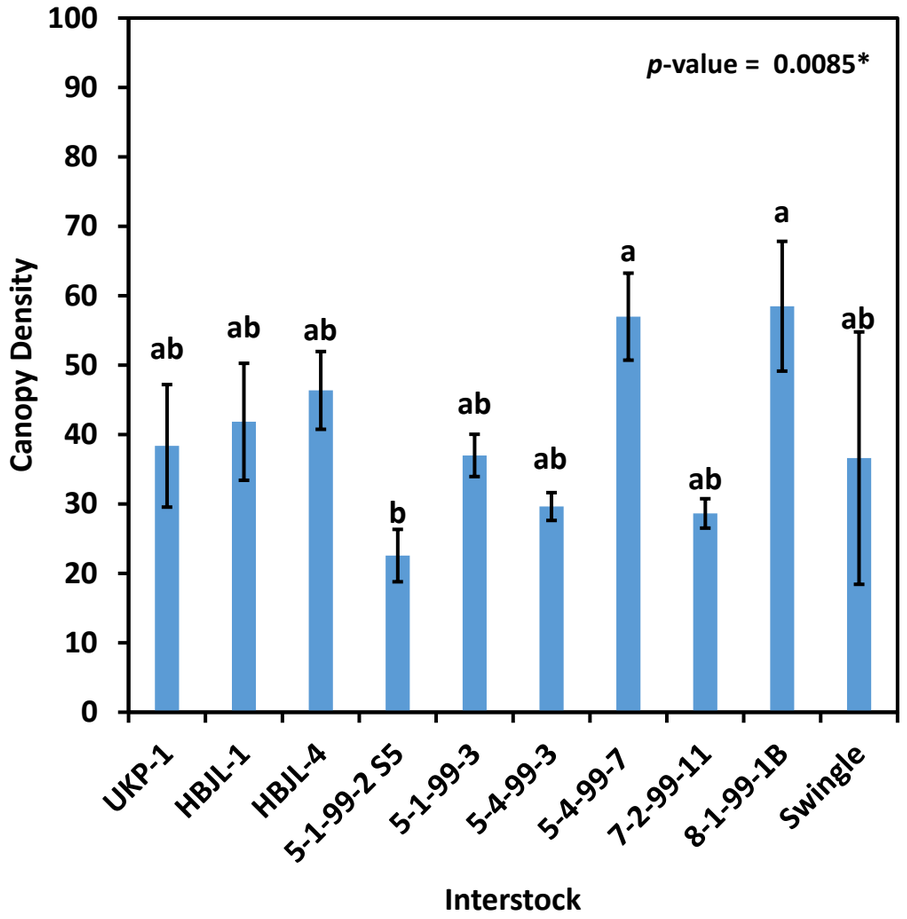
Interstocks	N*	P	K	Mg	Ca
UKP-1	2,066 ab	729.09 a	579 ab	113 bcd	542 ab
HBJL-1	1,987 ab	749.11 a	595 a	125 abc	496 ab
HBJL-4	2,154 a	771.07 a	612 a	122 abc	504 ab
5-1-99-2 S5	2,011 ab	654.83 b	520 b	109 bcd	463 b
5-1-99-3	1,893 b	760.74 a	604 a	136 a	533 ab
5-4-99-3	1,851 b	650.31 b	516 b	105 d	553 a
5-4-99-7	1,960 ab	720.70 a	572 ab	124 abc	551 a
7-2-99-11	2,049 ab	727.16 a	577 ab	118 bcd	546 ab
8-1-99-1B	2,073 ab	740.07 a	588 a	127 ab	518 ab
Swingle	2,127 a	754.28 a	599 a	114 bcd	532 ab
p-value	**0.0009***	**<.0001***	**0.0376***	**<.0001***	**ns**

***Nutrient concentrations were expressed as mM/L.**

LEAF MINERAL NUTRIENT CONTENT OF VALENCIA TREES

Interstocks	S	B	Zn	Mn	Fe	Cu
UKP-1	88 abc	5.07 b	0.36 b	0.38 ab	1.33 b	0.17 bc
HBJL-1	89 ab	5.20 b	0.36 b	0.36 ab	1.17 b	0.13 bc
HBJL-4	89 ab	5.38 b	0.38 b	0.34 ab	1.02 b	0.15 bc
5-1-99-2 S5	80 c	4.87 b	0.29 b	0.31 b	0.99 b	0.10 c
5-1-99-3	88 abc	5.20 b	0.36 b	0.38 ab	1.35 b	0.14 bc
5-4-99-3	83 bc	5.16 b	0.43 ab	0.35 ab	1.59 ab	0.42 a
5-4-99-7	85 abc	6.57 a	0.39 b	0.48 a	1.21 b	0.22 b
7-2-99-11	93 a	5.55 b	0.76 a	0.42 ab	2.94 a	0.18 bc
8-1-99-1B	86 abc	5.18 b	0.32 b	0.32 b	1.15 b	0.14 bc
Swingle	91 ab	5.62 ab	0.41 b	0.44 ab	1.38 b	0.20 bc
p-value	**ns**	**ns**	**ns**	**0.0161***	**ns**	**<.0001***

TREE CANOPY



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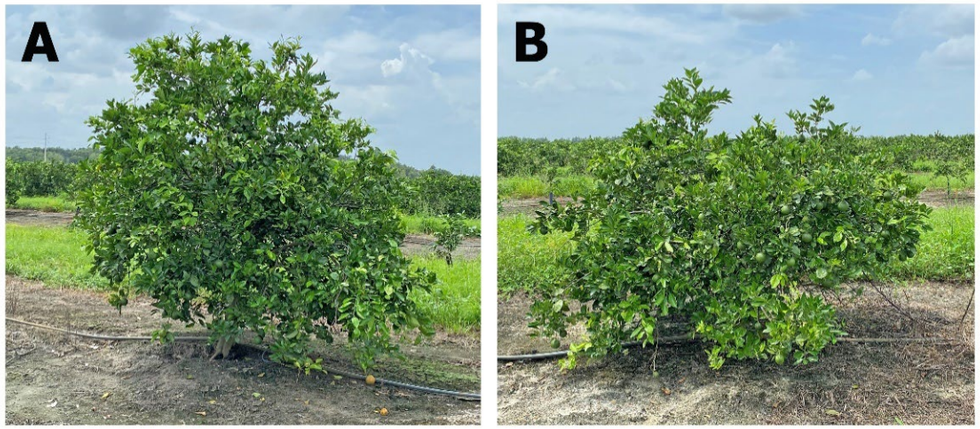
HLB DIAGNOSIS OF FIELD TREES

Interstocks	Ct Values
UKP-1	27.06± 0.34 ab
HBJL-1	27.09 ± 0.07 ab
HBJL-4	25.88 ± 0.96 b
7-2-99-11	26.87 ± 0.95 ab
5-4-99-3	26.10 ± 0.20 ab
5-4-99-7 S2	26.15 ± 0.61 b
5-1-99-2	27.14 ± 0.12 ab
5-1-99-3	27.82 ± 0.46 a
8-1-99-1B	25.91 ± 0.57 b
Swingle	27.06 ± 0.49 ab

qPCR diagnosis by the Southern Gardens Diagnostic Laboratory

- Sampling in early March
- Most interstock lines had similar bacterial titer.



A) "Valencia" sweet orange tree on 5-4-99-7 interstock
B) "Valencia" sweet orange tree on Swingle interstock.

JUICE ANALYSES

Sample ID	Acid	Total Brix	Ratio	Lbs. Solids Per Box	Juice Color
V/UKP-1/SW	0.88	10.68	12.14	6.15	36.7
V/HBJL-1/SW	0.70	9.06	12.94	4.76	36.0
V/HBJL-4/SW	0.92	9.92	10.78	5.55	35.5
V/7-2-99-11/SW	0.66	10.40	15.76	5.75	36.1
V/5-1-99-2-S5/SW	0.60	8.11	13.52	3.97	35.6
V/5-4-99-3/SW	0.91	11.00	12.09	5.97	37.3
V/5-4-99-7/SW	0.75	10.08	13.44	5.52	36.9
V/8-1-99-1B/SW	0.72	9.52	13.22	5.15	36.1
V/SW/SW	0.77	9.82	12.75	5.35	35.7
VAL/SW	0.70	8.86	12.66	4.63	36.6

CONCLUSIONS

- All interstocks influenced tree growth rate (either positively or negatively) in the field.
- Most trees were visually healthy with minimal HLB symptoms even after 5 years in the field.
- Some of theinterstock combinations resulted in higherlb solids.
- HLB tolerantinterstocks can be used to provide enhanced tolerance to the susceptible scions.

WHATSIN THE FUTURE?

- **Development of trees with robust HLB tolerant interstocks from the UF/IFAS citrus breeding program**
  - Sugar Belle
  - Australian Lime hybrids
  - *Citrus latipes* hybrids
  - Pummelo hybrids




- **Screening of trees in well replicated field trials to understand horticultural performance.**

ACKNOWLEDGEMENTS

- Tamiami Citrus and Ed Leotti
- Numerous Student Interns

USDA

CRDF Citrus Research and Development Foundation

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