

Indian River 'Marsh' Grapefruit Rootstock Trial, Vero Beach

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CREC Citrus Plant Improvement*

Indian River 'Marsh' Grapefruit Rootstock Trial - Description

Citranges are an important group of rootstocks utilized worldwide. Trees on citrange rootstocks generally feature robust growth, good disease resistance, heavy production and good fruit quality. The purpose of this replicated trial, planted in 2007 west of Vero Beach, was to assess the performance of 'Marsh' grapefruit on a collection of 42 promising rootstock candidates (mostly citranges from California and the CREC breeding program), under typical Indian River grapefruit conditions. Disease ratings and yield and fruit quality data from this trial were used in the decision to release citrange rootstocks UFR-7, 8, 9, 10, 11 & 12.

Indian River 'Marsh' Grapefruit Rootstock Trial - Summary

- Site: Vero Beach, Indian River County
- Scion - Rootstocks:
 - Red grapefruit (8 rootstocks)
 - White grapefruit (42 rootstocks)
- Date Planted: March 2007
- Design: Randomized complete-block
 - 3 replications
 - Plot size: 4 – 7 trees
 - Spacing: 15 x 25 ft. or 116 trees/acre
- Data ['Marsh' grapefruit trial only]
 - 2010/11: Juice quality, yield
 - 2011/12: Juice quality, yield
 - 2014/15: HLB rating [see details on HLB Special Field Day]
 - 2015/16: Juice quality, yield
 - 2016/17: HLB rating
- Trial status: **TERMINATED**

Table 1. Indian River ‘Marsh’ grapefruit rootstock trial – List of rootstocks: parentage and number of trees.

Rootstock	Parentage	Number of Trees
1584	Poncirus trifoliata x Milam	12
1586	Poncirus trifoliata x Milam	12
5030	Sunki x FDT [PLN 1700]	6
5032	Sunki x FDT [PLN 1702]	13
5040	Sunki x FDT [PLN 1707]	10
5041	Sunki x FDT [PLN 1708]	10
5042	Sunki x FDT [PLN 1709]	4
16R1T31	Sanford Swt x FDT	7
16R1T59	Sanford Swt x Argentine	14
16R2T19	Kona swt. Org. x Argentine TF	14
16R2T40	Sanford Swt x FDT	10
16R2T43	SFB 16R2T43	10
16R2T46	SFB 16R2T46	14
16R2T54	Sanford Swt x Argentine	8
16R2T60	Sanford Swt x Argentine	14
17R1T58	Ruby orange x Argentine trifoliolate orange	14
17R2T40	Ruby x FDT	12
17R2T52	Ruby x Argentine	12
4R1T37	Tahiti x Argentine	12
4R2T42	Tahiti x Argentine	14
4R2T51	Tahiti x Argentine	14

Rootstock	Parentage	Number of Trees
4R2T53	Tahiti x Argentine	8
4R2T75	Kona x Swingle TF	6
5R2T88	Fiwicke x Swingle TF	14
6R1T70	Fiwicke x FDT	7
6R2T32	Fiwicke x Argentine	14
6R2T34	Fiwicke x Argentine	10
6R2T40	Fiwicke x Argentine	14
6R2T45	Fiwicke x Argentine	14
6R2T63	Fiwicke x FDT	12
7R1T72	Tahiti x FDT	6
7R1T89	Fiwicke x Flying Dragon	11
7R2T89	Fiwicke x FDT	14
CS-146	Sunki x Swingle TF	5
CS-22	Sunki x Swingle TF	11
CS-54	Sunki x Swingle TF	8
UFR 10: 7R1T68	Tahiti swt org x FDT	14
UFR 11: 7R1T58	Sanford swt org x Argentine	14
UFR 12: 16R2T21	Kona x Argentine	5
UFR 7: 6R2T19	Fiwicke swt org x Argentine TO	12
UFR 8: 16R1T3	Ruby x Argentine	14
UFR 9: 16R1T21	Kona x Argentine	7

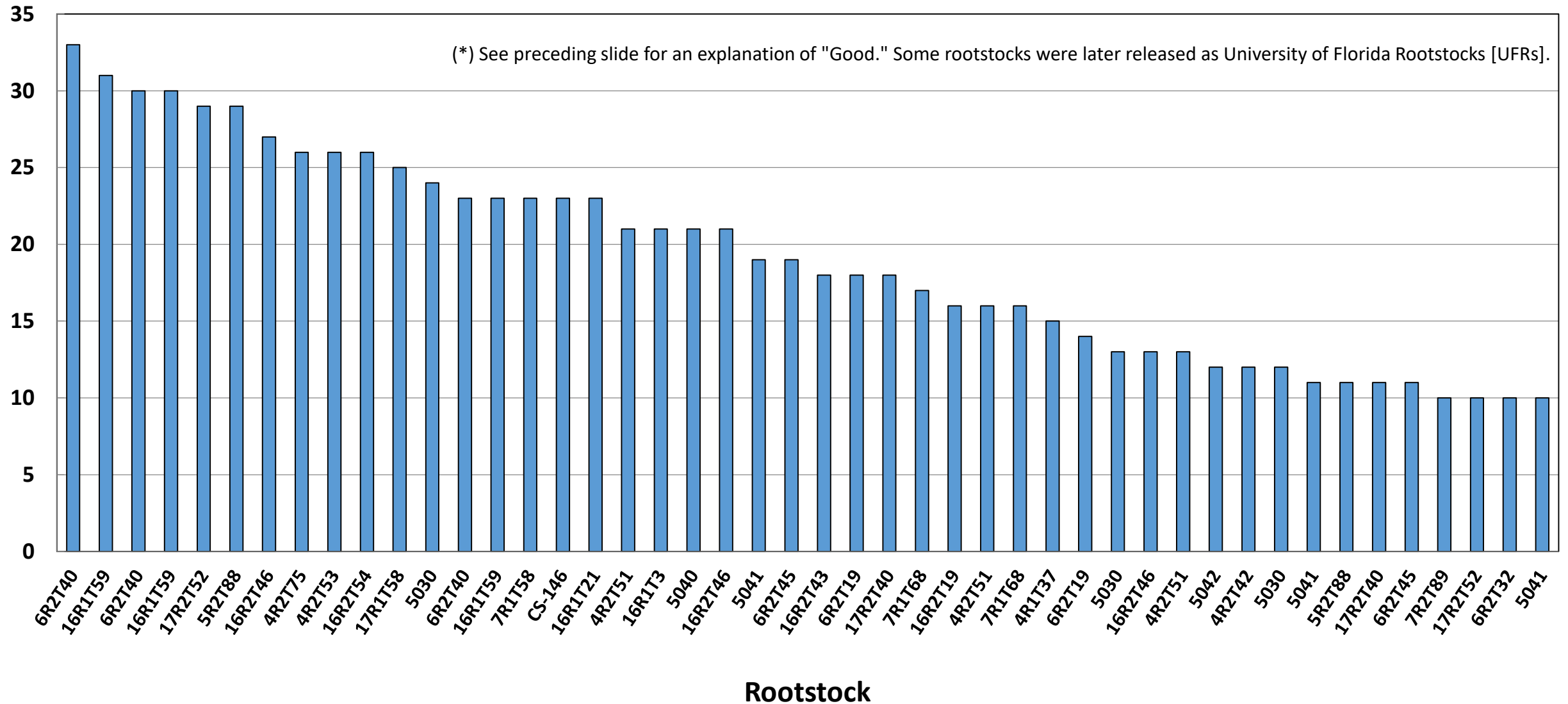
PLN – Castle propagation log number.

Indian River 'Marsh' grapefruit rootstock trial – HLB Special Field Day, October 22, 2014

At this special field day, the primary objectives were to show attendees the types of rootstock-HLB responses the researchers experienced in a field trial; and to see how independent grower ratings matched those of the researchers. There were about 50 attendees who were invited to walk the trial with a map and record any trees that rated "good", i.e., clearly better appearing than surrounding trees. Forty maps were returned.

- **Overall rootstock rating.** How many trees of each rootstock selection were noted as “good” at least one time? For example, if there were a total of 12 trees in the trial on a particular rootstock selection and 6 trees were marked “good” at least once, that equals 50%. **Results:** The range was 9 to 100%. One rootstock had all trees [100%] and four other selections had 80% or more of the trees marked as “good.”
- **Individual trees within rootstock selections,** basically a quantitative assessment, i.e., what was the average number of times that each “good” tree was marked within a rootstock? For example, let’s say there were 12 trees on Rootstock A, but only 2 trees among those 12 were noted as “good.” If the total “good” marks on those 2 trees was 30, then $30/2 = 15 \text{ marks/tree}$. In contrast, there were also 12 trees on Rootstock B. There were 6 trees considered noteworthy, but only 6 “good” marks total were recorded: $6/6 = 1 \text{ mark/tree}$. **Results:** 9 rootstock selections averaged 10 or more “good” marks/tree. The range was 1-15.
- **Individual trees.** Regardless of rootstock, what individual trees got the highest marks? **Results:** Some trees received 25 to 33 marks each; others received fewer. All trees that had 10 or more marks are shown in the following graph.

Fig. 1. Indian River ‘Marsh’ grapefruit rootstock trial. No. of times an individual tree was marked “Good”* in relation to HLB by 40 participating growers in a special field day exercise, October 2014.



Indian River 'Marsh' grapefruit rootstock trial – Interpretive Summary:

Juice quality. Given that many of the rootstocks were citranges, the juice quality results among them were similar with no or few statistical differences. Overall, Brix values were low.

Yield. The productivity among the trees was one of the more discriminating rootstock factors. The 3-year cumulative yield when the trees were 3, 4 and 8 years old showed that those on rootstocks C-146, UFR 10, UFR 12 and 5030 had the highest values [about 6 boxes/tree] followed by about 10 other rootstocks with yields between 5 and 6 boxes.

HLB. There were clear differences among rootstocks in tree appearance in relation to HLB. The outcomes are discussed in the preceding Special Field Day material. Those differences were sufficient such that several rootstocks were later released as UFRs.

Table 2. Indian River ‘Marsh’ grapefruit rootstock trial – Yield: 2010/11, 2011/12 & 2015/16 [boxes/tree].

Rootstock	Yield [boxes/tree]		
	2010/11*	2011/12**	2015/16**
CS-146	3.0 ^a	2.1	1.3
UFR-12: 16R2T21	2.8 ^{a,b,c}	2.9	0.3
UFR-10: 7R1T68	2.7 ^{a,b}	2.3	1.1
UFR-8: 16R1T3	2.7 ^{a,b}	1.9	1.0
UFR-7: 6R2T19	2.6 ^{a,b,c}	2.2	0.8
5040	2.5 ^{a,b,c}	2.1	0.6
5041	2.4 ^{a,b,c}	2.1	0.9
1586	2.3 ^{a,b,c,d}	2.1	1.3
6R2T45	2.2 ^{a,b,c,d}	1.7	0.8
4R2T53	2.2 ^{a,b,c,d}	2.1	0.9
UFR-9: 16R1T21	2.2 ^{a,b,c,d}	2.2	1.1
CS-22	2.2 ^{a,b,c,d}	1.9	0.4
5030	2.1 ^{a,b,c,d}	2.7	1.2
17R1T58	2.1 ^{a,b,c,d}	1.9	0.7
UFR-11: 7R1T58	2.1 ^{a,b,c,d}	2.4	1.1
1584	2.0 ^{a,b,c,d}	1.8	0.5
16R1T31	2.0 ^{a,b,c,d}	1.6	0.5
6R2T40	2.0 ^{a,b,c,d}	2.1	1.1
6R1T70	2.0 ^{a,b,c,d}	2.1	0.5
7R1T72	1.9 ^{a,b,c,d}	1.8	0.6
CS-54	1.8 ^{a,b,c,d}	2.3	0.5

Rootstock	Yield [boxes/tree]		
	2010/11*	2011/12**	2015/16**
16R2T60	1.8 ^{a,b,c,d}	1.8	0.6
16R1T59	1.8 ^{a,b,c,d}	1.7	1.3
16R2T46	1.8 ^{a,b,c,d}	2.0	1.2
6R2T34	1.8 ^{a,b,c,d}	2.2	0.4
4R2T42	1.7 ^{a,b,c,d}	1.7	0.6
6R2T63	1.7 ^{a,b,c,d}	1.4	0.5
6R2T32	1.7 ^{a,b,c,d}	1.3	0.8
7R2T89	1.6 ^{a,b,c,d}	1.5	0.5
4R2T51	1.5 ^{a,b,c,d}	2.0	0.6
4R1T37	1.5 ^{a,b,c,d}	1.8	0.7
16R2T19	1.5 ^{a,b,c,d}	2.1	0.9
16R2T40	1.5 ^{a,b,c,d}	1.7	0.3
5R2T88	1.3 ^{a,b,c,d}	1.4	0.8
17R2T40	1.3 ^{a,b,c,d}	1.5	0.7
17R2T52	1.2 ^{a,b,c,d}	1.3	0.5
5042	1.2 ^{b,c,d}	1.0	0.0
7R1T89	1.1 ^{c,d}	1.1	0.1
5032	1.1 ^{b,c,d}	1.3	0.1
16R2T43	1.0 ^{b,c,d}	1.5	0.9
4R2T75	0.9 ^{c,d}	1.5	0.4
16R2T54	0.1 ^d	0.3	1.5

(*) Numbers not connected by the same letter are significantly different.

(**) NS – no significant differences.

Fig. 2. Indian River ‘Marsh’ grapefruit rootstock trial – 3-year cum. yield: 2010/11, 2011/12, 2015/16 [boxes/tree] & 2016/17 HLB rating [Apr/17].

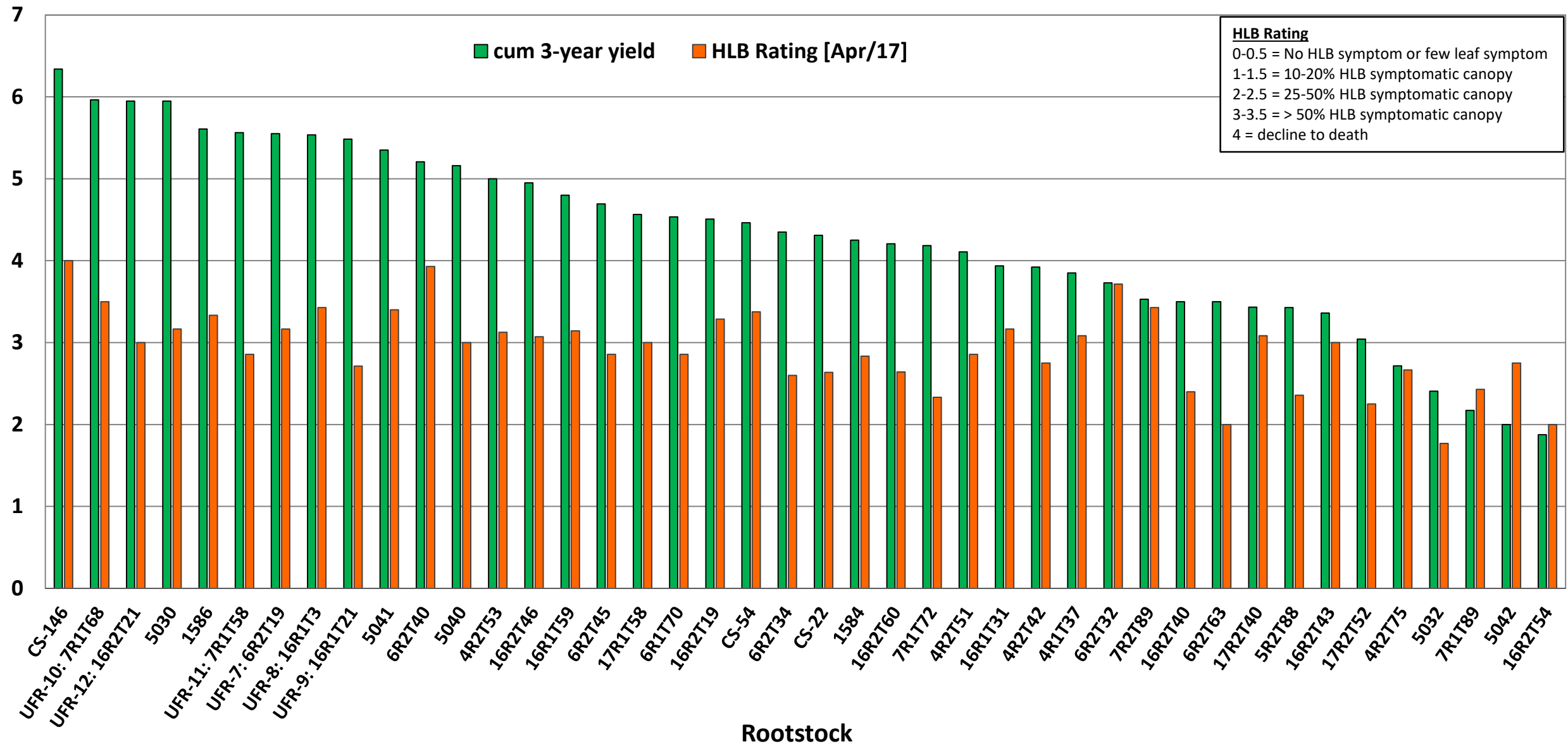


Fig. 3. Indian River ‘Marsh’ grapefruit rootstock trial – PS/box [2010/11, 2011/12, 2015/16].

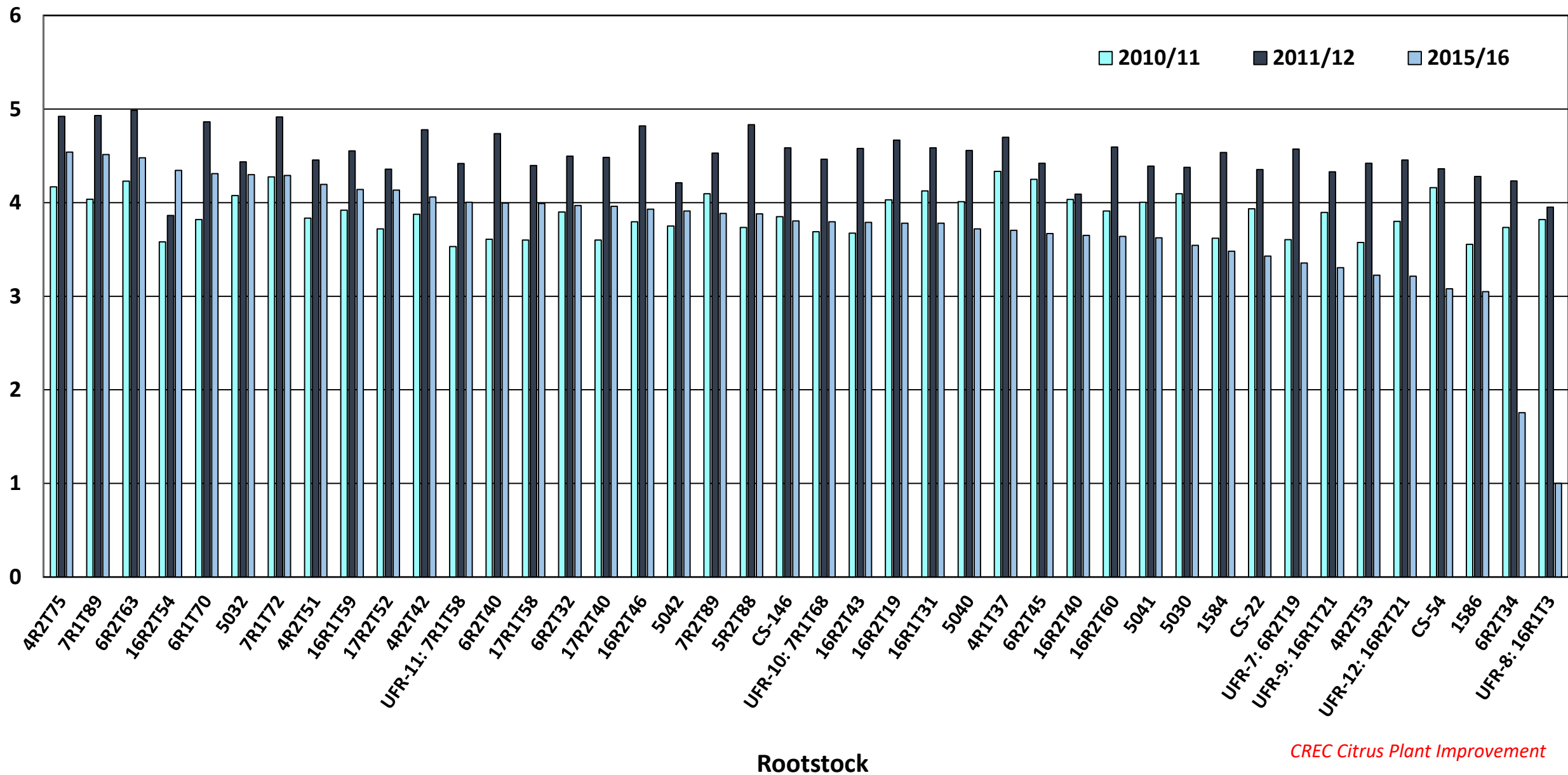


Table 3. Indian River ‘Marsh’ grapefruit rootstock trial – Juice quality for season 2010/11.

Rootstock	Acid*	Brix**	Ratio**	PS/Box**
1584	0.97 ^{a,b,c}	7.9	8.2	3.6
1586	0.93 ^{a,b,c}	7.8	8.4	3.6
5030	1.03 ^{a,b}	9.0	8.8	4.1
5032	0.96 ^{a,b,c}	8.8	9.1	4.1
5040	0.95 ^{a,b,c}	8.7	9.2	4.0
5041	0.93 ^{a,b,c}	8.4	9.1	4.0
5042	0.95 ^{a,b,c}	8.7	9.1	3.8
UFR 9: 16R1T21	1.00 ^{a,b,c}	8.8	8.8	3.9
UFR 8: 16R1T3	0.91 ^{b,c}	8.4	9.2	3.8
16R1T31	0.96 ^{a,b,c}	9.0	9.4	4.1
16R1T59	0.90 ^{b,c}	8.5	9.5	3.9
16R2T19	0.94 ^{a,b,c}	8.7	9.3	4.0
UFR 12: 16R2T21	0.91 ^{b,c}	8.2	9.0	3.8
16R2T40	0.99 ^{a,b,c}	8.6	8.7	4.0
16R2T43	0.93 ^{a,b,c}	8.3	8.9	3.7
16R2T46	0.90 ^{b,c}	8.3	9.3	3.8
16R2T54	0.84 ^c	7.7	9.2	3.6
16R2T60	0.92 ^{a,b,c}	8.3	9.1	3.9
17R1T58	0.94 ^{a,b,c}	8.3	8.9	3.6
17R2T40	0.96 ^{a,b,c}	8.1	8.4	3.6
17R2T52	0.93 ^{a,b,c}	8.5	9.2	3.7

Rootstock	Acid*	Brix**	Ratio**	PS/Box**
4R1T37	0.96 ^{a,b,c}	9.1	9.6	4.3
4R2T42	0.98 ^{a,b,c}	8.4	8.7	3.9
4R2T51	0.95 ^{a,b,c}	8.4	8.9	3.8
4R2T53	0.93 ^{a,b,c}	7.9	8.5	3.6
4R2T75	0.96 ^{a,b,c}	8.9	9.3	4.2
5R2T88	0.93 ^{a,b,c}	8.1	8.7	3.7
6R1T70	0.94 ^{a,b,c}	8.3	8.9	3.8
UFR 7: 6R2T19	0.91 ^{b,c}	8.2	9.1	3.6
6R2T32	0.94 ^{a,b,c}	8.7	9.3	3.9
6R2T34	0.89 ^{b,c}	8.0	9.0	3.7
6R2T40	0.95 ^{a,b,c}	8.1	8.6	3.6
6R2T45	0.95 ^{a,b,c}	9.1	9.6	4.3
6R2T63	0.98 ^{a,b,c}	9.3	9.5	4.2
UFR 11: 7R1T58	0.96 ^{a,b,c}	7.9	8.3	3.5
UFR 10: 7R1T68	0.97 ^{a,b,c}	8.2	8.5	3.7
7R1T72	1.00 ^{a,b,c}	9.0	9.1	4.3
7R1T89	1.00 ^{a,b,c}	8.7	8.7	4.0
7R2T89	0.89 ^{b,c}	8.6	9.7	4.1
CS-146	1.05 ^a	8.6	8.2	3.9
CS-22	0.96 ^{a,b,c}	8.5	8.9	3.9
CS-54	0.94 ^{a,b,c}	8.6	9.2	4.2

(*) Numbers not connected by the same letter are significantly different.

(**) NS – no significant differences.

Table 4. Indian River ‘Marsh’ grapefruit rootstock trial – Juice quality for season 2011/12.

Rootstock	Brix*	Acid**	Ratio**	PS/box**
1584	8.8 ^{a,b}	0.87	10.2	4.5
1586	8.0 ^b	0.81	9.9	4.3
5030	8.8 ^{a,b}	0.95	9.4	4.4
5032	9.0 ^{a,b}	0.84	10.8	4.4
5040	8.6 ^{a,b}	0.82	10.5	4.6
5041	8.9 ^{a,b}	0.87	10.2	4.4
5042	8.7 ^{a,b}	0.98	8.9	4.2
UFR 9: 16R1T21	8.7 ^{a,b}	0.78	11.2	4.3
UFR 8: 16R1T3	8.5 ^{a,b}	0.85	10.1	4.0
16R1T31	8.8 ^{a,b}	0.81	11.0	4.6
16R1T59	9.0 ^{a,b}	0.80	11.3	4.6
16R2T19	8.7 ^{a,b}	0.76	11.5	4.7
UFR 12: 16R2T21	8.1 ^{a,b}	0.82	9.9	4.5
16R2T40	8.3 ^{a,b}	0.83	10.1	4.1
16R2T43	8.7 ^{a,b}	0.81	10.8	4.6
16R2T46	9.0 ^{a,b}	0.80	11.3	4.8
16R2T54	7.6 ^b	0.71	10.8	3.9
16R2T60	8.7 ^{a,b}	0.80	11.0	4.6
17R1T58	8.4 ^{a,b}	0.79	10.7	4.4
17R2T40	9.0 ^{a,b}	0.88	10.3	4.5
17R2T52	8.7 ^{a,b}	0.80	10.8	4.4

Rootstock	Brix*	Acid**	Ratio**	PS/box**
4R1T37	8.7 ^{a,b}	0.8	10.5	4.7
4R2T42	8.9 ^{a,b}	0.8	10.8	4.8
4R2T51	8.8 ^{a,b}	0.8	10.8	4.5
4R2T53	8.5 ^{a,b}	0.8	10.3	4.4
4R2T75	9.2 ^{a,b}	0.9	10.8	4.9
5R2T88	9.5 ^{a,b}	0.9	10.5	4.8
6R1T70	9.0 ^{a,b}	0.8	11.7	4.9
UFR 7: 6R2T19	8.6 ^{a,b}	0.7	11.9	4.6
6R2T32	8.7 ^{a,b}	0.8	11.1	4.5
6R2T34	8.1 ^b	0.7	10.9	4.2
6R2T40	8.6 ^{a,b}	0.8	10.8	4.7
6R2T45	9.1 ^{a,b}	0.9	9.8	4.4
6R2T63	9.7 ^{a,b}	0.8	11.5	5.0
UFR 11: 7R1T58	8.7 ^{a,b}	0.9	10.2	4.4
UFR 10: 7R1T68	8.4 ^{a,b}	0.8	10.9	4.5
7R1T72	9.1 ^{a,b}	0.9	10.2	4.9
7R1T89	9.8 ^a	0.9	10.8	4.9
7R2T89	8.9 ^{a,b}	0.8	10.7	4.5
CS-146	8.9 ^{a,b}	0.9	10.4	4.6
CS-22	8.7 ^{a,b}	0.9	9.7	4.4
CS-54	8.9 ^{a,b}	1.0	9.3	4.4

(*) Numbers not connected by the same letter are significantly different.

(**) NS – no significant differences.

Table 5. Indian River ‘Marsh’ grapefruit rootstock trial – Juice quality for season 2015/16.

Rootstock	PS/box*	Brix**	Acid**	Ratio**
1584	3.5 ^{a,b}	7.6	0.70	10.9
1586	3.1 ^{a,b}	7.1	0.77	9.2
5030	3.5 ^{a,b}	7.8	0.75	10.5
5032	4.3 ^{a,b}	9.3	0.81	11.6
5040	3.7 ^{a,b}	8.0	0.87	9.3
5041	3.6 ^{a,b}	7.6	0.71	10.7
5042	3.9 ^{a,b}	8.3	0.75	11.1
UFR 9: 16R1T21	3.3 ^{a,b}	7.6	0.71	10.8
UFR 8: 16R1T3	1.7 ^{a,b}	4.5	0.36	6.3
16R1T31	4.0 ^{a,b}	8.5	0.70	12.2
16R1T59	4.1 ^{a,b}	8.8	0.70	12.6
16R2T19	3.8 ^{a,b}	8.1	0.70	11.6
UFR 12: 16R2T21	3.2 ^{a,b}	7.2	0.72	10.1
16R2T40	3.7 ^{a,b}	8.0	0.81	10.0
16R2T43	3.8 ^{a,b}	7.8	0.67	11.7
16R2T46	3.9 ^{a,b}	8.4	0.71	11.9
16R2T54	3.9 ^{a,b}	8.3	0.69	12.0
16R2T60	4.2 ^{a,b}	9.0	0.78	11.6
17R1T58	3.6 ^{a,b}	7.9	0.73	10.9
17R2T40	4.2 ^{a,b}	8.6	0.72	12.0
17R2T52	4.1 ^{a,b}	8.8	0.78	11.3

Rootstock	PS/box*	Brix**	Acid**	Ratio**
4R1T37	3.8 ^{a,b}	8.1	0.73	11.1
4R2T42	3.9 ^{a,b}	8.1	0.71	11.4
4R2T51	4.2 ^{a,b}	8.6	0.74	11.7
4R2T53	3.7 ^{a,b}	7.7	0.71	10.9
4R2T75	4.1 ^{a,b}	8.4	0.80	10.4
5R2T88	4.0 ^{a,b}	8.2	0.69	12.0
6R1T70	4.0 ^{a,b}	8.7	0.75	11.5
UFR 7: 6R2T19	4.1 ^{a,b}	8.8	0.75	11.6
6R2T32	3.4 ^{a,b}	7.6	0.72	10.6
6R2T34	3.8 ^{a,b}	7.9	0.74	10.7
6R2T40	1.9 ^{a,b}	3.8	0.36	5.3
6R2T45	4.0 ^{a,b}	8.5	0.72	11.8
6R2T63	4.0 ^{a,b}	8.4	0.73	11.5
UFR 11: 7R1T58	4.1 ^{a,b}	8.7	0.80	10.9
UFR 10: 7R1T68	4.0 ^{a,b}	8.4	0.71	12.0
7R1T72	4.1 ^{a,b}	8.4	0.70	12.0
7R1T89	4.4 ^a	9.2	0.77	11.9
7R2T89	3.9 ^{a,b}	8.2	0.67	12.2
CS-146	3.8 ^{a,b}	8.1	0.75	10.8
CS-22	3.4 ^{a,b}	7.4	0.67	11.0
CS-54	3.1 ^{a,b}	6.9	0.68	10.2

(*) Numbers not connected by the same letter are significantly different.

(**) NS – no significant differences.

Fig. 4. Indian River ‘Marsh’ grapefruit rootstock trial – juice Brix: 3-year mean + std. dev. for seasons 2010/11, 2011/12 & 2015/16. Samples collected in February.

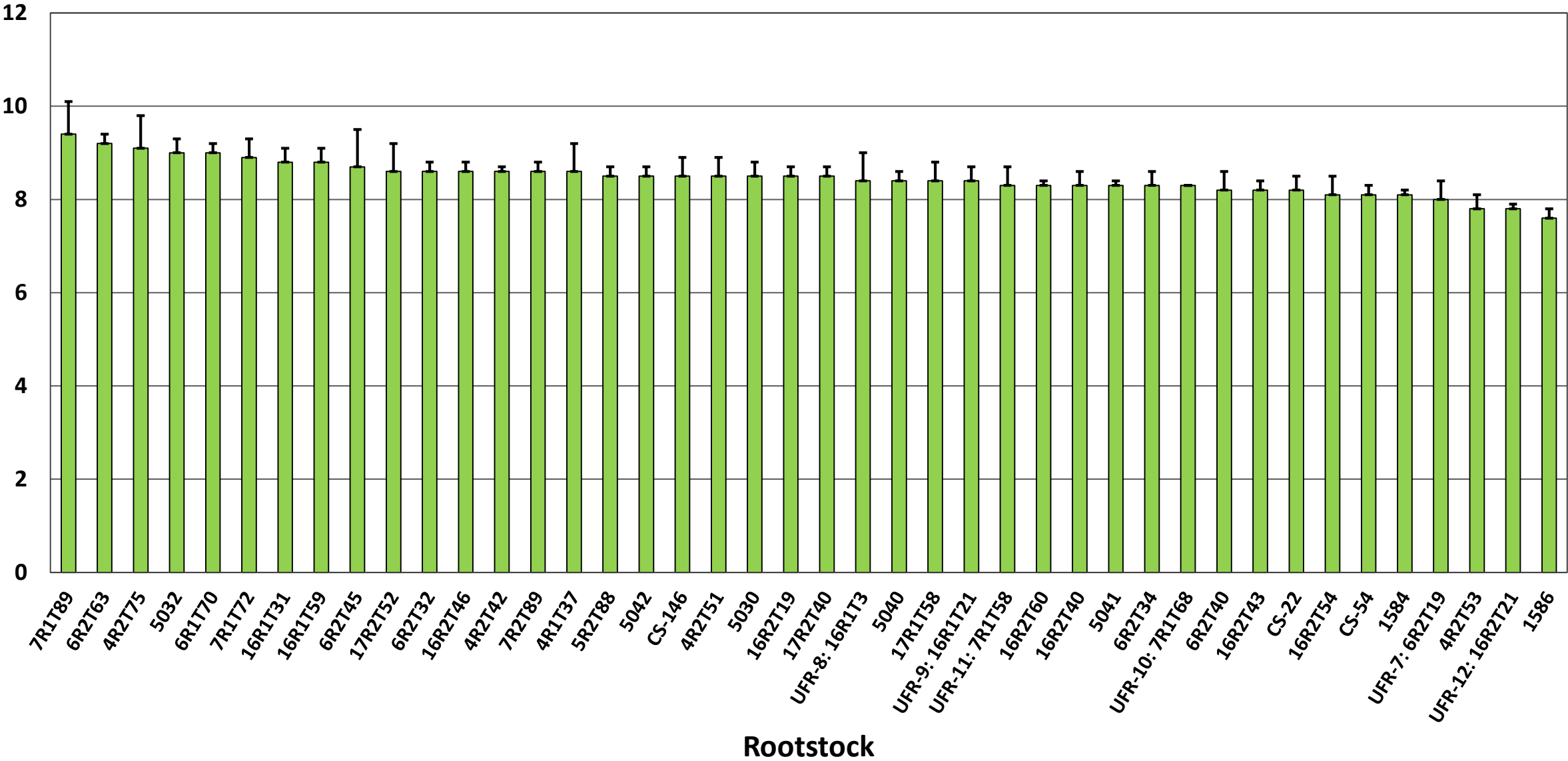


Fig. 5. Indian River ‘Marsh’ grapefruit rootstock trial – juice acid: 3-year mean + std. dev. for seasons 2010/11, 2011/12 & 2015/16. Samples collected in February.

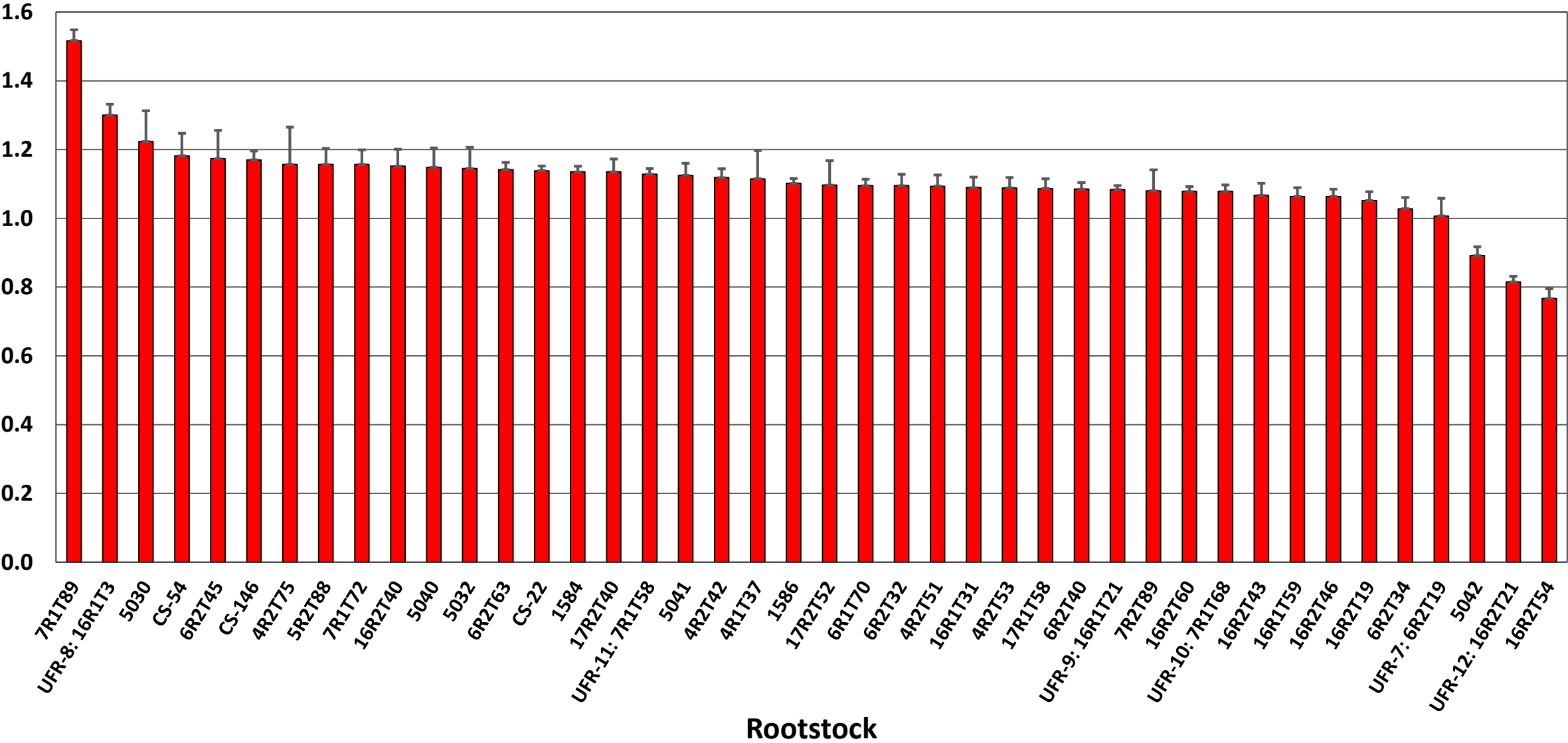


Fig. 6. Indian River ‘Marsh’ grapefruit rootstock trial – juice Ratio: 3-year mean + std. dev. for seasons 2010/11, 2011/12 & 2015/16. Samples collected in February.

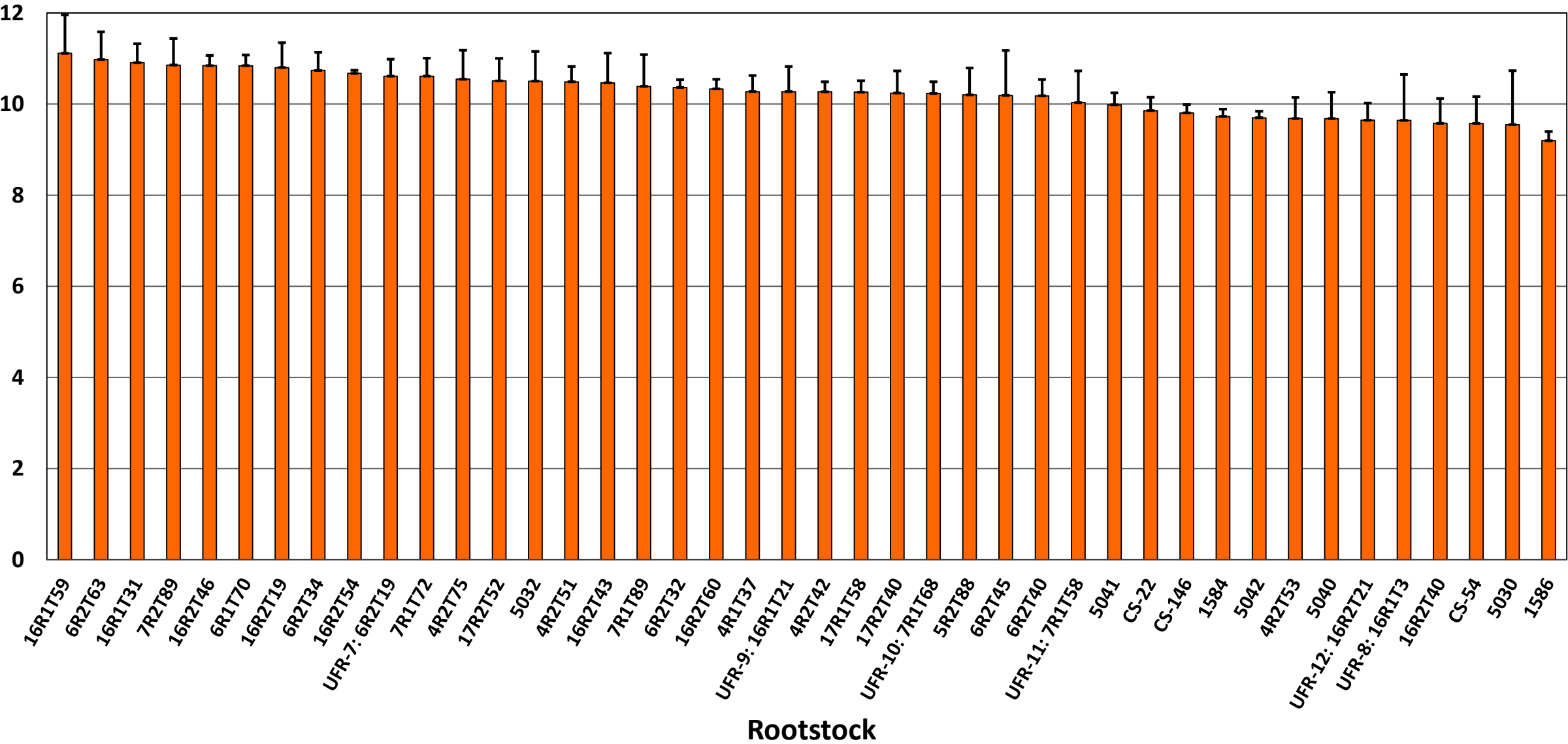


Fig. 7. Indian River ‘Marsh’ grapefruit rootstock trial – PS/box: 3-year mean + std. dev. for seasons 2010/11, 2011/12 & 2015/16. Samples collected in February.

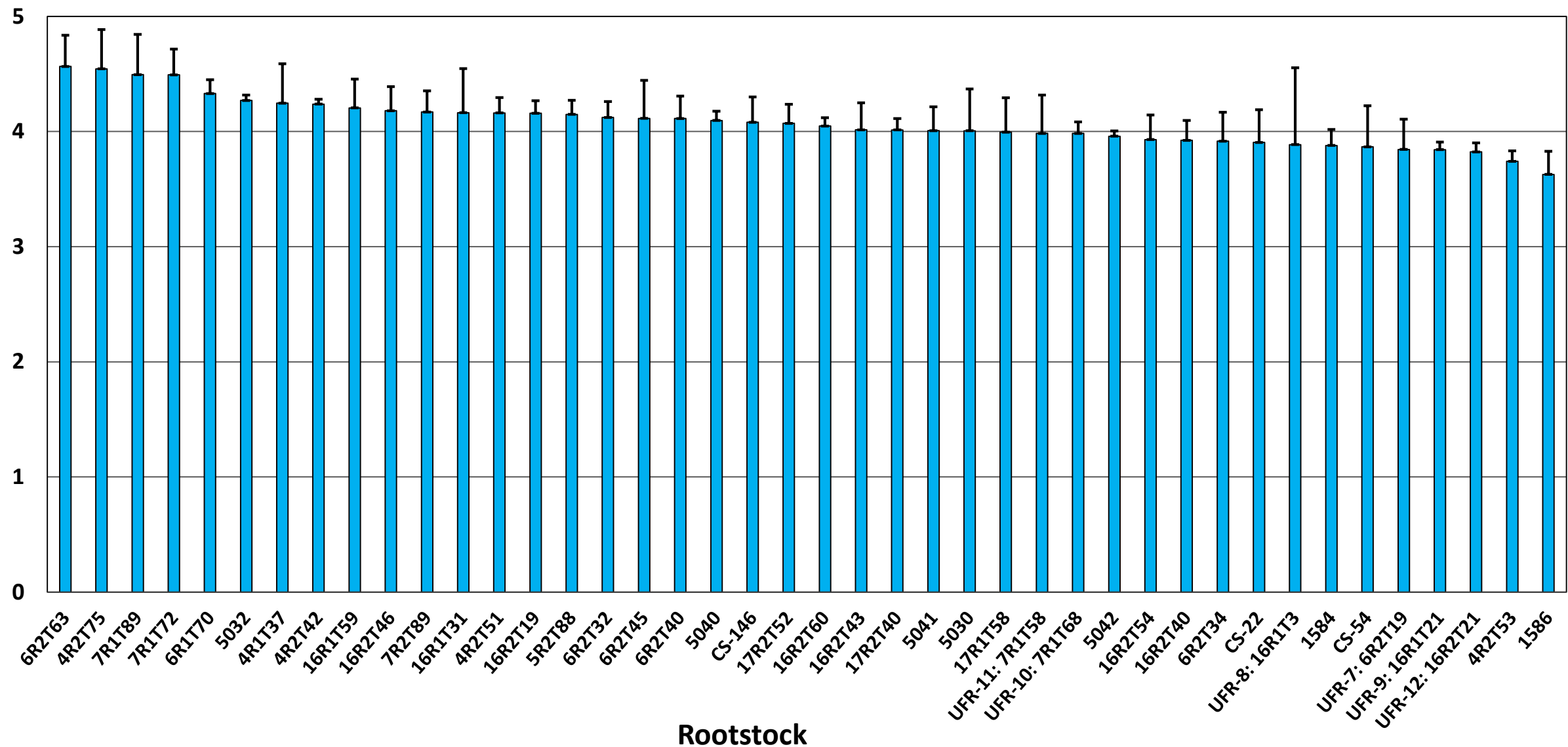


Fig. 8. Indian River ‘Marsh’ grapefruit rootstock trial – juice color: 3-year mean + std. dev. for seasons 2010/11, 2011/12 & 2015/16. Samples collected in February.

