

Star Ruby grapefruit on seven different rootstocks



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Star Ruby is a red grapefruit cultivar that originated in Texas by irradiating Hudson grapefruit seeds.
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In 1972, 12 seeds were imported to SA and nucellar seedlings were introduced to the industry in 1982. Star Ruby is now the primary grapefruit planted in Southern Africa.
The citricultural performance of Star Ruby grapefruit was assessed on seven rootstocks in a semi-desert production region, on virgin soil with a soil pH (KCl) ranging from 6.3–7.5. Yield performance was assessed over eight years starting from 2016, the fourth year after planting.

Materials and method

Details of the trial planted in Kakamas, Northern Cape, in 2012 are summarised in Table 1.

The data collected included rootstock compatibility, canopy volumes, yield and fruit size distribution, fruit external characteristics and standard internal quality parameters.



Johan Joubert

Results and discussion

Overall, no significant differences were observed in the internal quality and juice percentages between rootstocks (Table 2), apart from a few exceptional seasons where some rootstocks were associated with sub-optimal values. But these scenarios were not always associated with the same rootstocks. In the 2018 and 2020 seasons, aggressive pruning resulted in lower yields but larger fruit, which consequently led to a decline in internal quality. The juice percentages remained low overall during the 2021 season. And during the trial period some rootstocks, such as C35, TB, and US-812, exhibited slightly higher acid levels, resulting in a decrease in the Brix:acid ratio, which did not meet US export standards.
Fruit from trees of all rootstocks complied with EU export standards over the nine

seasons, except for BC, due to the low juice percentage in the 2021 season. Thus, a greater number of rootstocks failed to meet US export standards. The °Brix was below nine in both 2018 and 2020 for SC and similarly for CC and X639 in 2018, 2020 and 2021. The juice content fell below 45% with these three rootstocks. For C35, BC, TB, and US-812 the 2018, 2020, and 2021 seasons presented similar challenges but fruit remained within the parameter of specifications for the respective markets. However, during the 2019 and 2022/3 seasons, C35, BC, TB, and US-812 displayed higher acid percentages, ranging from 1.48% for BC and C35 to 1.62% for US-812 and TB. Despite having °Brix levels around 10, the Brix:acid ratio of seven was not achieved. The lowest total acids over the eight years were recorded for CC and X639,

Though all trialled rootstocks proved compatible with Star Ruby grapefruit, US-812 is not advised as a rootstock for this grapefruit.

Table 1. Synopsis of the Star Ruby grapefruit trial outlay and soil composition

Tree spacing	Plant direction	Shade netting	Soil			Irrigation
6 x 3m	North to south	2021	Sandy soils "buitegrond"	pH (KCl) 6.36 - 7.28	High pH calcareous soil	Micro-irrigation
Rootstocks and number of trees						
X639 citrandarin (control)	Swingle citrumelo (SC)	Carrizo citrange (CC)	C35 citrange	Benton citrange (BC)	Terra Bella citrumelo (TB)	Sunki x Beneke US-812 (SxB) citrandarin
5	6	6	6	6	6	6

Table 2. Average internal quality with some export standards for Star Ruby grapefruit on different rootstocks

Treatment	Production date (2016–2024)	Juice (%)	°Brix	Acid (%)	Ratio	Avg. seed	Colour
SC	Average	54.7	10.1	1.33	7.6	0.1	T1
CC	Average	53.8	9.9	1.29	7.8	0.0	T1
X639	Average	54.7	9.8	1.30	7.6	0.1	T1
C35	Average	53.8	10.0	1.37	7.4	0.0	T1
BC	Average	52.9	9.9	1.36	7.3	0.0	T1
TB	Average	52.9	10.0	1.44	7.0	0.0	T1
US-812	Average	55.0	10.5	1.40	7.5	0.1	T1
EU export standards		>40	>7		>5.5:1		
USA export standards		>45	>9		>7:1		

Table 3. Average tonnes/ha vs. tonnes/ha packable fruit vs. % packable fruit (2016-2024)

Rootstock	Tonnes/ha	Tonnes/ha packable fruit	% Packable fruit
CC	62	53	86
SC	57	50	87
TB	56	44	79
X639	53	47	89
C35	48	39	82
BC	42	33	77
US-812	38	31	81



SC bud union



CC bud union

Star Ruby is now the primary grapefruit planted in Southern Africa.



Bearing pattern X639

alongside slightly higher °Brix for SC. These three rootstocks achieved the best Brix:acid ratios. As the trees matured, there were no issues regarding colour development.

The average production figures, along with the percentage of packable fruit, are presented in **Table 3**. Throughout the trial, CC achieved the highest production of 62 tonnes/ha and over the last three seasons under nets, the kg/tree were 174 (2022), 166.7 (2023), and 177.5 kg/tree (2024). The second highest average yield was SC at 57 tonnes/ha, closely followed by TB at 56 tonnes/ha, and X639 with 53 tonnes/ha. The highest average yield for the dwarfing rootstock, C35, was 48 tonnes/ha. The kg/tree over the last three seasons (2022–24) for SC were 149.8, 134, 136.7 and X639, as control were 131.3, 131.5, and 138.4 kg/tree, respectively.

After seasons of aggressive pruning, the pack-out percentages decreased due to fewer but larger fruit. During the trial period, X639 had the highest packable fruit percentage at 89%, followed by SC at 87%, and CC at 86%. C35 achieved 82%, which resulted in CC having an average of 53 tonnes/ha of packable fruit, followed by SC at 50 and X639 with 47 tonnes/ha. The number of packable 15 kg boxes/ha on CC was 3533, on SC it was 3333, and X639

The top-performing rootstocks were associated with the largest tree canopies.

Table 4. Percentage packable fruit (excluding the 2021 season, following the aggressive pruning). The data were averaged for seven- to eight-year-old trees (prior to netting) and 10-12-year-old trees (after netting).

Treatment	Netting status	Packable fruit %
SC	None	88
SC	Nets	98
CC	None	76
CC	Nets	96
X639	None	89
X639	Nets	98
C35	None	96
C35	Nets	93
BC	None	94
BC	Nets	90
TB	None	92
TB	Nets	88
US-812	None	91
US-812	Nets	92

3133. Post net structure and with the more mature trees, SC and X639 achieved the highest packable fruit percentage at 98%, closely followed by CC at 96%. Over the last three seasons all rootstocks yielded above 90% Class one fruit except BC, TB and US-812. X639 had the highest Class 1 fruit percentage at 94%.

As for the yield data, average fruit size distribution was determined for the same pre- and post-netting seasons (**Figure 1**). Favourable fruit size distribution for grapefruit destined for the EU and US markets are between 95–108 mm diameter. The best-performing rootstock prior to netting was X639, which produced the most fruit in the medium to large fruit size category, at 41% of total yield. X639 exhibited a favourable distribution between small and large fruit. CC had the least amount of fruit within the medium to large fruit size distribution at 33%. After netting, the top-performing rootstocks with favourable fruit size distribution were SC at 61%, CC at 54%, and X639 at 59%, on average. After netting, X639 still had the

best fruit size distribution, with only 24% small and 15% large fruit. In comparison, the percentages of small fruit for SC and CC were 11% and 9%, respectively, while the large fruit percentages were 26% for SC and 34% for CC.

Average tree canopy volumes (m³) were determined pre- (2020) and post-netting (2024) (**Figure 2**). The smallest tree canopy volumes pre-netting were as expected for trees on the two dwarfing rootstocks, C35 and BC. C35 trees were the smallest, but the growth of trees on BC after netting was slower and BC trees were the smallest at the end of the trial. Trees on SC did not grow after netting and canopy volumes remained mostly unchanged. Trees on CC were the largest throughout the trial, and trees on X639 showed the greatest growth after netting and were the second largest trees at the end of the trial.

SC and CC are sensitive to high-pH soils and SC can tolerate slightly higher pH levels than CC. Therefore, performance of these rootstocks will differ under these conditions compared to more conducive soil parameters.

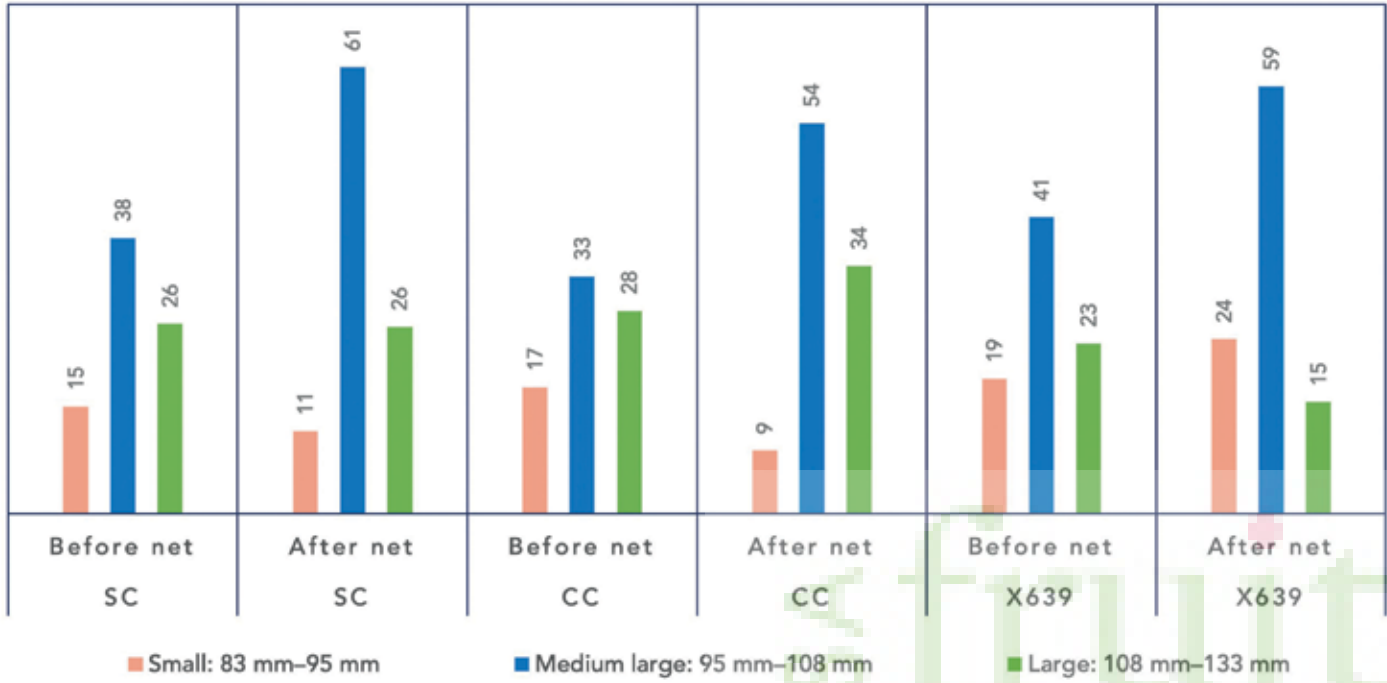


Figure 1. Average percentage fruit size distribution for pre-netting seasons (2018-20) and post-netting seasons (2021-24)

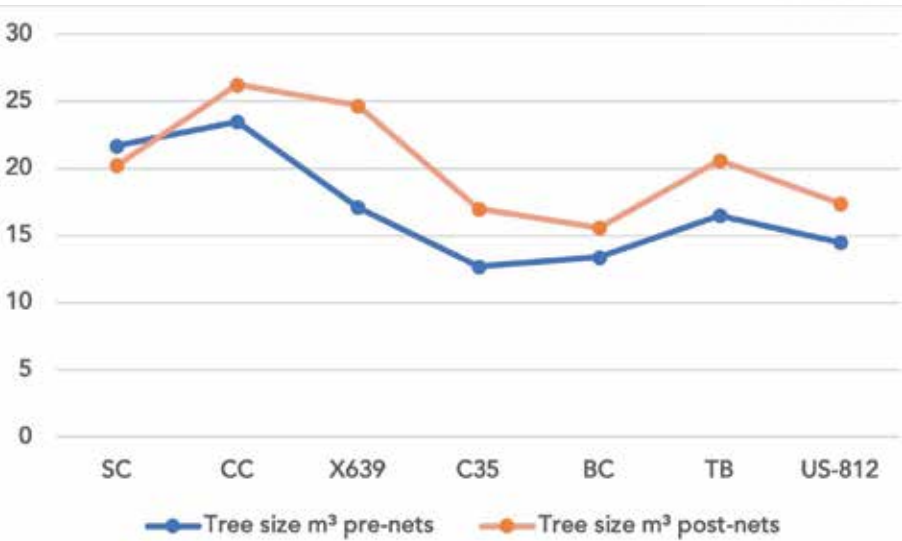


Figure 2. Average tree canopy volume (m³) pre-(2020) and post-netting (2024)



Conclusions

None of the trialled rootstocks showed incompatibility with Star Ruby grapefruit, although US-812 is not advised as a rootstock for this cultivar. Star Ruby on US-812 have small tree canopies, trees appear stressed and crop production is not good. The best performing rootstocks

in terms of internal quality were SC, CC, and X639. These three rootstocks can be used to prolong the harvesting period, as timing of fruit maturity differed. Maturity began with CC, followed by X639, and concluded the season with SC. Throughout the trial, yields and percentage packable fruit were the highest for SC, CC, and X639, outperforming the other rootstocks. The top-performing rootstocks were also associated with the largest tree canopies. X639 yielded the most Class one fruit and the best fruit size distribution before and after netting. This rootstock is recommended for high-pH soils and is, therefore, the preferred rootstock for production in this area, in combination with Star Ruby. CC and SC also remain good alternatives for soil pH conditions within their recommended norms. For future rootstock trials in the region, X639 should be used as the control, together with CC and SC. 🍊



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