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Avocado Clonal Rootstock Trial

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Progress Report

The project is designed to evaluate the performance of ten avocado rootstocks with two scions, 'Hass' and 'Gwen', at South Coast Field Station. The 'Hass' segment of the study was planted on April 1986, and the 'Gwen' portion was planted in August 1987.

'Hass' Planting

Tree Size and Leaf Analysis.

Tree height and trunk circumference have been measured annually since planting. Average tree height three and four years after planting, respectively, is shown in Figure 1. The 'D9' was significantly shorter (< 0.01) after three years than the three 'G755' rootstocks: 'Duke 7', 'Borchard', and 'Toro Canyon'. The 'Thomas' and 'G1033' rootstocks which were planted one year after the remainder were slightly shorter than the other rootstocks, with the exception of the 'D9', three years after planting. The difference between the 'D9' and the other rootstocks largely disappeared after the fourth year of growth, and trees on this rootstock are now only significantly shorter than the 'Borchard' rootstock ($P<0.01$).

In July 1990, when we measured tree height, we also collected canopy diameter measurements to allow us to calculate canopy volume (cubic meters of canopy). The data are presented in Figure 2. There were no significant differences between the rootstocks with respect to canopy volume. Averages for the rootstocks ranged from 26.1 m^3 ('D9') to 31.8 m^3 ('G755C').

Trunk circumference has been annually measured 10 cm above the bud union since planting. The average trunk circumference per rootstock three or four years after planting, respectively, is reported in Table 1. There was a 2.7 cm (1.06 inch) range in trunk circumference between 'G755B' (37.4 cm) and 'G1033' (31.7 cm) three years after planting. Following four years of growth, we observed a 4.2 cm (1.65 inches) difference in circumference between 'G755C' (49.3 cm) and 'Toro Canyon' (45.1 cm).

During the April 1990 harvest, we observed that some of the rootstocks displayed a definite bulge at the bud union. To quantify this, we also measured the trunk circumference of the tree below the bud union. The ratio of the trunk circumference above versus below the bud union is also reported in Table 2. A value of 1.0 denotes a

smooth bud union. Values greater than 1.0 denote a greater girth above the bud union. For the most part, the trees exhibited nearly smooth bud unions three years after planting, with the exception of the 'G1033' which has a noticeable bulge. The ratios changed somewhat during the fourth year of growth, at which time the 'G755A', G755B', and 'Borchard' trees had significantly greater bud union ratios than the other five rootstocks, whose values were close to 1.0. In July 1990, we also visually ranked the bud unions for all trees on a 0-5 scale, where 0 = smooth and 5 = severe overgrowth above the union. The data are shown in Figure 3. Visual rankings confirmed that the 'G755A', 'G755B', 'G1033', and 'Borchard' rootstock-scion unions were significantly different than the other rootstocks. It is interesting to note that there are visual differences between the three 'G755' selections, with trees on 'G755C' having very smooth bud unions. We plan to continue monitoring the trees in future years.

Figure 1. 'Hass' Rootstock Trial. Average Tree Height.

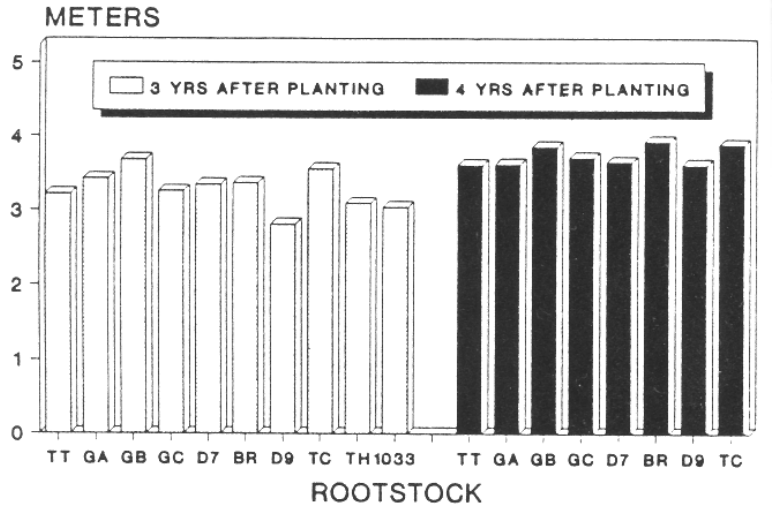
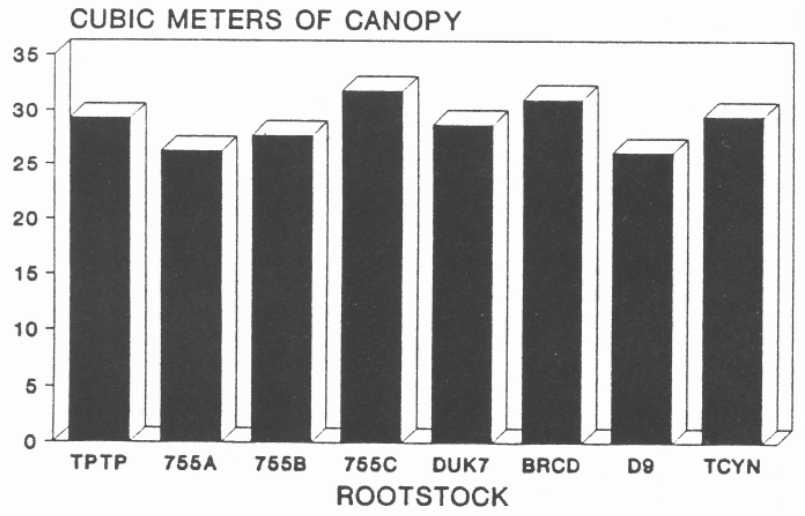


Figure 2. 'Hass' Rootstock Trial. Canopy Volume - 4 Years After Planting.



ISamples for leaf analysis were collected in October 1989 for a second time. The results of this second sampling are presented in Table 2. The values for nitrogen, phosphorus, and potassium are within the adequate range based on UC recommendations; however, the zinc levels are within the deficient range. There are no visual symptoms of zinc deficiency, however, in the planting.

We reported in 1989 that there were no significant differences between rootstocks on the basis of the September 1988 leaf collection. Based on the results of the 1989 leaf analysis, however, there are significant differences between rootstocks for all four elements analyzed. Nitrogen values ranged from a high of 2.46% in 'Borchard' to a low of 1.97% in 'G755B'. As a rule, the 'G755' trees tend to look "more yellow" than the others.

The differences due to rootstock are slight in regard to phosphorus. Values range from 0.16% ('G1033') to 0.13% ('G755B', 'G755C, and 'Tore Canyon'). For the most part, there is little difference between rootstocks with regard to potassium, although the 'G1033' rootstock had significantly higher levels. The same is true for zinc concentration, since, with the exception of the 'G1033', there is little difference between rootstocks.

Tree Yield, Fruit Size, and Yield Efficiency.

In April 1990, we collected the third year of harvest data. The cumulative yield collected thus far is presented in Figure 4. Total yield from years 2-4 show the highest yields obtained from 'Hass' planted on 'Duke 7' (37.1 kg/tree), and the lowest from 'G755C' (1.5 kg/tree). The yield of 'Thomas' and 'G1033' three years after planting is within the range of what we observed with the other rootstocks in 1989. There were no significant differences in fruit size due to rootstocks. The 'Borchard' rootstock had the largest fruit (288 g per fruit, or 10.1 ounces), as compared to 'G755B' (214 g per fruit, or 7.5 ounces).

Table 1. 'Hass' Rootstock Trial. Trunk Circumference and Bud Union Ratio.

	Trunk Circumference (cm)[z] Yrs from Planting		Bud Union Ratio Yrs from Planting	
	3	4	3	4
Topa Topa	35.0 ab[x]	46.9 ab	0.89 d	0.97 d
G755A	34.9 ab	48.0 ab	0.99 bc	1.17 a
G755B	37.4 a	49.1 ab	1.02 cd	1.18 a
G755C	34.4 ab	49.3 a	0.91 cd	1.04 c
Duke 7	35.1 ab	47.1 ab	0.93 bcd	1.05 c
Borchard	37.0 a	48.6 ab	1.00 bc	1.12 b
D9	32.9 ab	45.4 ab	0.96 bcd	1.02 c
Toro Canyon	36.6 a	45.1 b	0.98 bc	1.05 c
Thomas[w]	33.7 a	--	1.02 b	--
G1033	31.7 b	--	1.14 a	--

[z] Measured 10 cm above the bud union.
[y] Ratio of trunk circumference above the bud union divided by trunk circumference below the bud union.
[x] Mean separation using Duncan's Multiple Range Test at $P \leq 0.01$.
[w] All trees were planted in 4/86 except Thomas and G1033, which were planted in 5/87.

Table 2. 'Hass' Rootstock Trial. Fall 1989 Leaf Analysis[z].

Rootstock	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Zinc (ppm)
Topa Topa	2.34 abc[y]	0.14 bc	1.23 c	15.5 bc
G755A	1.99 de	0.14 bc	1.27 bc	15.7 bc
G755B	1.97 e	0.13 c	1.23 c	15.6 bc
G755C	2.12 d	0.13 c	1.22 c	15.6 bc
Duke 7	2.26 c	0.14 bc	1.36 b	15.0 c
Borchard	2.46 a	0.14 bc	1.31 bc	15.4 bc
D9	2.29 bc	0.15 ab	1.37 b	15.7 bc
Toro Canyon	2.27 bc	0.13 c	1.22 c	15.3 bc
Thomas[x]	2.41 ab	0.14 abc	1.38 b	16.6 b
G1033	2.37 abc	0.16 a	1.50 a	19.4 a

[z] Leaf samples were collected October 18, 1989.
[y] Mean separation using Duncan's Multiple Range Test at $P \leq 0.01$.
[x] All trees were planted in 4/86 except Thomas and G1033, which were planted in 5/87.

Figure 3. 'Hass' Rootstock Trial. Bud Union rating - 1990.

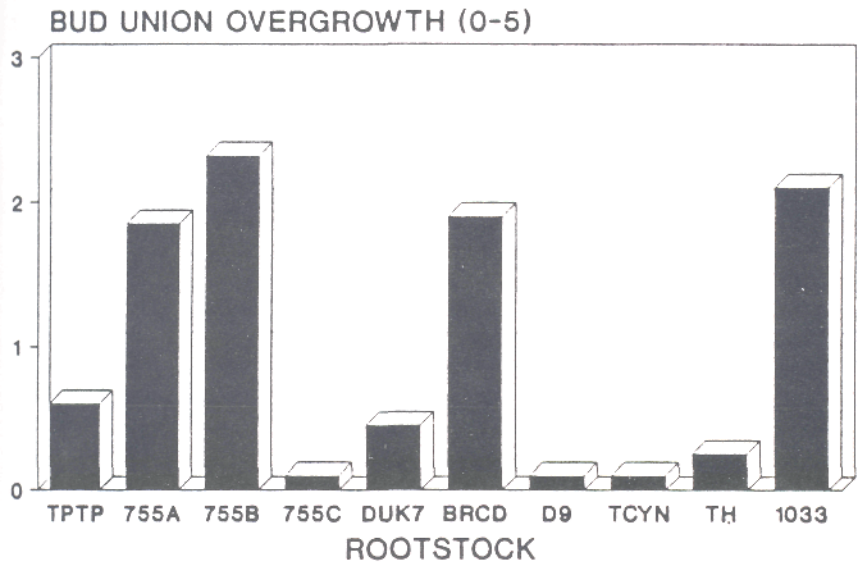
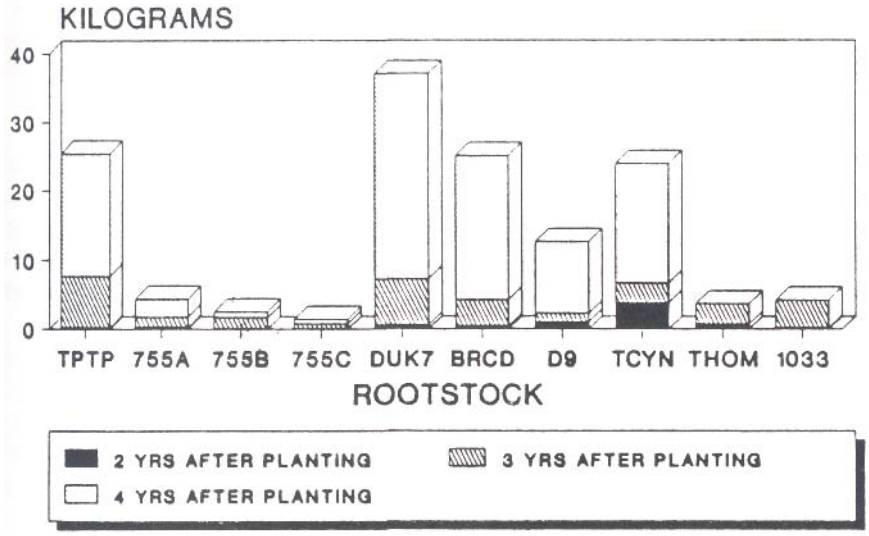


Figure 4. 'Hass' Rootstock Trial. Average Cumulative Yield Per Tree.



Since we collected data to calculate canopy volume, we can also determine the relative yield efficiency of the rootstocks four years after planting. The differences observed with regard to average yield per tree in April 1990 are reflected in the values calculated in yield efficiency (kg/m^3 of canopy). The rootstocks basically can be grouped into three groups:

The 'Duke 7' in 1990 produced an average of 1.1 kg fruit per cubic meter of canopy

(Figure 5), which was significantly greater than all the other rootstocks ($P<0.01$).

The second group is composed of the 'Topa Topa', 'Borchard', and 'Toro Canyon' rootstocks with intermediate yield efficiencies.

The third group is composed of the three 'G755' rootstocks. The 'D9' rootstock is between the second and third group.

We plan to continue evaluating the yield efficiency of the rootstocks in the same manner in future years.

'Gwen' Planting'

Tree Size and Yield.

We have not yet collected yield data from this trial. Due probably to the timing of the planting (August 1987), we have experienced difficulty in adequately establishing the trees. The 'Thomas' rootstock trees were planted in April 1990 in spaces which were allotted to them at the time of the original planting. We had originally planned to have 'Barr Duke' included in this trial; however, due to unavailability, this rootstock has been dropped from the experiment. The planting overall has made good progress during the last year, and we look forward to collecting meaningful data beginning next year.

Tree height and circumference have also been measured yearly since planting in August 1987. Trunk circumference has been measured as previously described for the 'Hass' trial. In 1990, there were slight but significant differences ($P< 0.01$) between rootstocks. There was a 4.33 (1.70 inch) range in trunk circumference between 'Toro Canyon' (10.20 cm) and 'Topa Topa' (14.53 cm) three years after planting.

Average tree height two and three years after planting, respectively, is shown in Figure 6. The 'D9' was again significantly shorter ($P<0.01$) than all rootstocks with the exception of the 'G755C' two years after planting. The differential between the 'D9' and the other rootstocks was not as great following three years of growth. At this time, the 'D9' was only significantly ($P<0.01$) shorter than 'G755A', 'G755B', and 'Borchard' rootstocks.

Figure 5. 'Hass' Rootstock Trial. Yield Efficiency - 4 Years After Planting.

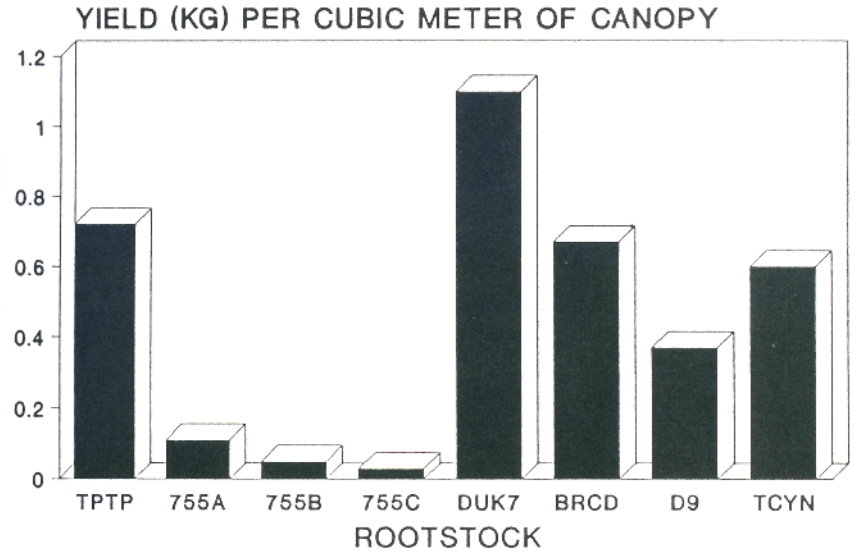
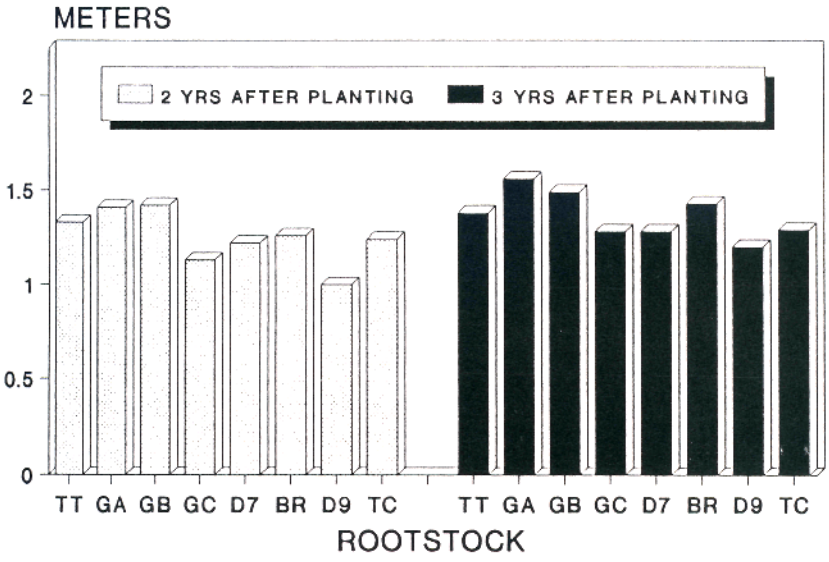


Figure 6. 'Gwen' Rootstock Trial. Average Tree Height.



Practical Applications and Summary

This project will supply the avocado industry horticultural information pertaining to

vegetative vigor and productivity for selected clonal rootstocks in the absence of *Phytophthora cinnamomi.* We already have an idea from data collected over four years on the performance of 'Hass' on selected rootstocks that there may be differences due to rootstock on early productivity. The information generated from this project will be useful to the California avocado industry as an aid in rootstock selection.