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# Early Results from the Phase-II Avocado Cultivar Selections

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## ABSTRACT

Both cultivars commercially in use, as well as newly imported avocado selections are being evaluated in the phase-ll avocado evaluation project of the ARC-ITSC. The first orchards were planted in 1993, and subsequent plantings were made in October 1993 and January 1994 at Levubu and Burgershall respectively. Data from the first plantings (three-year-old trees) indicate that Gwen, a cultivar under consideration for release to the industry, is currently performing best on a ranking points system, followed by Pinkerton, Mass and Ryan. From the new imported selections, only BL 135 and BL 149 (and possibly I 373) show promise as new introductions. However, the orchards are now in their second and third years after planting, and no specific recommendations can be made at this early stage.

## INTRODUCTION

The ARC-ITSC has been conducting phase-II avocado scion evaluations since 1992, and in 1993 the first orchards were planted for this purpose. A second planting, mainly of imported selections from California, was made in October 1993 at Levubu, and in January 1995 at Burgershall. In 1995 initial tree differences were reported, and the first small yields were obtained from the first orchards planted. These orchards are now in their third year, and the later plantings are in their second year. The first good yields are now on the trees, but at the time of writing yield can be reported only on a fruit number basis, because harvesting had not yet started.

## MATERIALS AND METHODS

Orchards established in March 1993, November 1993 and January 1994 at the Burgershall and the Levubu Experimental Stations, have been evaluated. Measurements taken were tree height stem circumference, tree radius at the four compass points, and number of fruits on the tree. At Burgershall this data was taken during November, one week after a severe hailstorm damaged the trees and the crop on them. At the affected orchards fruit knocked off the trees by hail was also counted to determine the extent of the damage. At Levubu data was gathered during February so as to minimize the effect of fruit fall on the number of fruits counted. Tree height and average radius were used to calculate tree volume using the formula: Volume = $\pi r^2$ (0,33r). Tree volume was then used to express tree productivity as the number of fruits per cubic meter (fruits/$m^3$). In order to compare various selections and cultivars with one

another, a performance ranking system was devised. Trees were ranked firstly on their growth and tree volumes (least growth and smallest being best), secondly on number of fruits (most being best), and lastly on number of fruits per cubic meter (highest being best). Where two selections performed equally, the one with the better production was given the better ranking.

## RESULTS

### Levubu — Orchard A2

This orchard compares with the Burgershall B6-N orchard. The trial planted at Levubu grew exceptionally well with an average tree height of around 2,5 m. Trees of the Ryan cultivar were noticeably smaller on all three rootstocks. The local introductions in this trial have outgrown the rest of the trees with an average height of around 3 m. The average tree radius was 1,16 m. This was exceeded by Fuerte, Hass and the two local selections, with Gwen being visibly more upright than the rest of the trees.

### Volume

The average volume for the orchard was 9,35 $m^3$ (table 1). This was well exceeded by Hass on Duke 7 at 13,59 $m^3$, and by the two local selections on Thomas and Barr-Duke. Gwen produced the smallest trees (average 3,57 $m^3$), followed by Ryan (5,91 $m^3$) and Pinkerton at (7,51 $m^3$).

**Table 1**
Mean tree volumes ($m^3$) of the phase-II avocado scion trial on three different rootstocks at Levubu (A2; 05/02/1996), compared to the overall mean at Burgershall (B6-N; 24/01/96)

| *Scions* | *Rootstocks* | | | *Mean* | |
|---|---|---|---|---|---|
| | *Duke 7* | *Thomas* | *Barr-Duke* | *Levubu* | *B/Hall* |
| Fuerte 1 | 8,83 | 7,77 | 11,19 | 9,26 | 6,32 |
| Fuerte 2 | 7,36 | 13,47 | 10,16 | 10,33 | 11,28 |
| Fuerte 3 | 13,62 | 8,14 | 11,57 | 11,11 | 8,95 |
| Fuerte 4 | 8,23 | 11,08 | 9,74 | 9,68 | 7,56 |
| Hass | 13,59 | 11,01 | 10,05 | 11,55 | 6,88 |
| Pinkerton | 6,20 | 8,14 | 8,19 | 7,51 | 3,21 |
| Ryan | 6,13 | 6,78 | 4,82 | 5,91 | 1,17 |
| Gwen | 4,12 | 4,58 | 2,00 | 3,57 | 2,51 |
| 87–7–1 | 7,81 | 17,73 | 14,42 | 13,32 | 5,05 |
| 87–17–1 | 6,48 | 17,17 | 16,91 | 13,52 | 0,00 |
| *Mean* | 8,24 | 10,59 | 9,91 | | |

## Fruits per tree

The previous season (1994/95) produced an average of 6,5 fruits per tree. This season's (third year since planting) average for the orchard was 36,8 fruits per tree (table 2). The four Fuerte clones average 10,3, Hass 54,5, Pinkerton 67,3, Ryan 31,8 and Gwen at 41,7. The two local selections produced better on average than Fuerte.

## Fruits per volume

The average for the orchard was 5,28 fruits/$m^3$. Gwen, at 12,58 fruits/$m^3$ outperformed Pinkerton at 9,01 fruits/$m^3$ (table 3). Ryan averaged 5,26 fruits/$m^3$, followed by Hass at 4,76 fruits/$m^3$, and Fuerte at 1 fruit/$m^3$.

Fuerte showed no rootstock differences, but Hass on Thomas performed better than the rest. Pinkerton on Barr-Duke produced up to 11,23 fruits/$m^3$, but on Thomas it did not perform well. With Ryan, the best rootstock was Duke 7, and with Gwen it was Barr-Duke. On the points system Gwen performed best, followed by Pinkerton, Ryan and Hass (table 4).

## Burgershall — Orchard B6-N

This orchard at Burgershall was hit by a hailstorm during November 1995. This resulted in an average of 28,5 % fruit drop due to the hail. Comparison of individual trees within the orchard, and of this orchard with the similar orchard (A2) at Levubu, is therefore very difficult.

**Table 2**
Mean number of fruits per tree of the phase-II avocado scion trial on three different rootstocks at Levubu (A2; 05/02/1996), compared to Burgershall (B6-N; 24/01/96)

| *Scions* | *Rootstocks* | | | *Mean* | |
|---|---|---|---|---|---|
| | *Duke 7* | *Thomas* | *Barr-Duke* | *Levubu* | *B/Hall* |
| *Fuerte 1* | 8,5 | 2,0 | 11,0 | 7,2 | 6,5 |
| *Fuerte 2* | 10,0 | 5,5 | 8,5 | 8,0 | 14,7 |
| *Fuerte 3* | 14,5 | 32,0 | 21,0 | 22,5 | 26,5 |
| *Fuerte 4* | 3,5 | 3,5 | 4,0 | 3,7 | 22,5 |
| *Hass* | 55,0 | 65,0 | 43,5 | 54,5 | 59,7 |
| *Pinkerton* | 59,5 | 50,5 | 92,0 | 67,3 | 21,0 |
| *Ryan* | 39,0 | 38,5 | 18,0 | 31,8 | 3,5 |
| *Gwen* | 47,5 | 44,5 | 33,0 | 41,7 | 26,0 |
| *87–7–1* | 7,0 | 8,5 | 56,0 | 23,8 | 1,8 |
| *87–17–1* | 28,5 | 7,5 | 47,5 | 27,8 | 0 |
| *Mean* | 27,3 | 25,75 | 33,45 | | |

**Table 3**
Mean fruits per cubic meter per tree of the avocado phase II scion trial on three different rootstocks at Levubu (A2; 05/02/1996), compared to Burgershall (B6-N; 24/01/96)

| *Scions* | *Rootstocks* | | | *Mean* | |
|---|---|---|---|---|---|
| | *Duke 7* | *Thomas* | *Barr-Duke* | *Levubu* | *B/Hall* |
| Fuerte 1 | 0,96 | 0,26 | 0,98 | 0,73 | 0,80 |
| Fuerte 2 | 1,36 | 0,41 | 0,84 | 0,87 | 1,28 |
| Fuerte 3 | 1,06 | 3,93 | 1,82 | 2,27 | 3,22 |
| Fuerte 4 | 0,42 | 0,32 | 0,41 | 0,38 | 2,68 |
| Hass | 4,05 | 5,90 | 4,33 | 4,76 | 8,64 |
| Pinkerton | 9,60 | 6,20 | 11,23 | 9,01 | 6,61 |
| Ryan | 6,36 | 5,68 | 3,73 | 5,26 | 2,99 |
| Gwen | 11,53 | 9,72 | 16,50 | 12,58 | 19,91 |
| 87–7–1 | 0,90 | 0,48 | 3,88 | 1,75 | 0,35 |
| 87–17–1 | 4,40 | 0,44 | 2,81 | 2,55 | 0 |
| *Mean* | 4,06 | 3,33 | 4,65 | | |

### Volume

The average tree volume of the trees is shown in table 1. Ryan is the smallest, followed by Gwen and Pinkerton. Scions on Barr Duke tended to be smaller than those on Duke 7, and scions on Thomas were about 70 % larger than those on Duke 7.

### Fruits per tree

Based on the number of fruits on the tree before the hail storm, Hass performed very well with an average of nearly 60 fruits per tree (table 2). This is followed by Fuerte 3 and Gwen at around 26 fruits per tree.

### Fruits per volume

Gwen was again the most productive 19,91 fruits/$m^3$, followed by Hass, Pinkerton, and Fuerte 3 (table 3).

### Burgershall — Orchard B3

This orchard was also damaged by the hailstorm, with an average loss of fruit up to 43,5 %.

### Volume

Tree volumes of these trees are very comparable with those at Levubu (Orchard Al — table 4). The smallest trees are those of the BL 135 selection, followed by the known

dwarf selection Colin-V-33. Edranol as the control was the third smallest.

**Table 4**
Mean tree volumes of the phase-II avocado scion trial on three different rootstocks at Burgershall (B3; 24/01/1996), compared to Levubu (A1; 05/02/96)

| *Scions* | *Rootstocks* | | | *Mean* | |
|---|---|---|---|---|---|
| | *Duke 7* | *Thomas* | *Barr-Duke* | *B/Hall* | *Levubu* |
| Edranol | 6,35 | 3,29 | 0,80 | 3,48 | 5,26 |
| BL 149 | 7,59 | 7,74 | 0,61 | 5,31 | 2,38 |
| BL 135 | 3,15 | 3,45 | 0,75 | 2,45 | 2,49 |
| NA 37 | 6,96 | 7,83 | 4,31 | 6,37 | 8,91 |
| NA 526 | 10,07 | 10,14 | 11,34 | 10,52 | 11,24 |
| OA 184 | 6,76 | 7,36 | 8,51 | 7,54 | 6,64 |
| I 373 | 7,22 | 7,00 | 8,20 | 7,47 | 9,03 |
| Hayes | 5,67 | 6,19 | 4,29 | 5,38 | 5,30 |
| Reed | 6,93 | 5,94 | 4,61 | 5,83 | 6,78 |
| Colin V–33 | 2,91 | 4,32 | 2,40 | 3,21 | — |
| Eksteen | 11,37 | 12,06 | 7,57 | 10,33 | 7,09 |
| # 86 | 7,33 | 8,26 | 6,77 | 7,45 | 9,13 |
| TX 531 | 4,77 | 5,80 | 5,04 | 5,20 | 7,59 |
| H 222 | — | — | — | — | 9,20 |
| *Mean* | 6,70 | 6,87 | 5,02 | | |

**Fruits per tree**

Without considering rootstock effects, the BL 135 selection, also being the smallest, performed the best at this site with an average of 27,1 fruits per tree (table 5). This is followed by the control Edranol at 26,8 and I 373 at 24,5 fruits per tree. The next best was Colin V-33 with an average of 10,9 fruits per tree.

**Fruits per volume**

BL 135 performed the best at 8,18, followed by Edranol at 4,94, Colin V-33 at 3,38 and I 373 at 3,26 (table 6).

**Levubu — Orchard AI**

This orchard compares with that of Burgershall B3, except that H 222 was planted here instead of Colin V-33. The H 222 trees, which were planted seven months later than the first batch of trees at Levubu (Orchard A2), grew exceptionally well and on average caught up with the trees planted before the winter. Their average height is 2,3 m compared to 2,5 m for the first planting and their average radius was 1,04 m (compared to 1,16 m.)

## Volume

At this site the BL 149 selections were on average the smallest, followed by the BL 135 selections. Edranol again, was third smallest (table 4).

## Fruits per tree

Table 5 shows that TX 531 did the best, followed by Edranol, I 373 and H 222.

## Fruits per volume

Taking into account the average production per cubic metre on all three rootstocks of each cultivar, the control trees of Edranol did second best (6,4 fruits/$m^3$). The best was BL 149 with 9,2 fruits/$m^3$. The only other cultivars that warrant mentioning are TX 531 with 5,14 fruits/$m^3$,1 373 with 3,33 fruits/$m^3$ and BL 135 with 3,27 fruits/$m^3$ (table 6).

**Table 5**
Mean potential number of fruits per tree of the phase-II avocado scion trial on three different rootstocks at Burgershall (B3; 24/01/1996), compared to Levubu (A1; 05/02/96)

| *Scions* | *Rootstocks* | | | *Mean* | |
|---|---|---|---|---|---|
| | *Duke 7* | *Thomas* | *Barr-Duke* | *B/Hall* | *Levubu* |
| Edranol | 65,6 | 14,8 | 0 | 26,8 | 33,5 |
| BL 149 | 12,2 | 2,6 | 0 | 4,9 | 13,3 |
| BL 135 | 34,6 | 46,8 | 0 | 27,1 | 9,5 |
| NA 37 | 0,6 | 0 | 0,8 | 0,5 | 0,2 |
| NA 526 | 1,6 | 3,0 | 2,6 | 2,4 | 3,3 |
| OA 184 | 11,6 | 7,4 | 5,8 | 8,3 | 7,5 |
| I 373 | 29,6 | 15,8 | 28,0 | 24,5 | 30,5 |
| Hayes | 0,8 | 3,4 | 0 | 1,4 | 0 |
| Reed | 16,6 | 5,2 | 9,0 | 10,3 | 8 |
| Colin V–33 | 9,6 | 15,2 | 8,0 | 10,9 | — |
| Eksteen | 0,6 | 8,0 | 4,6 | 4,4 | 0,2 |
| # 86 | 4,0 | 1,8 | 14,4 | 6,7 | 12,7 |
| TX 531 | 1,0 | 0,4 | 3,4 | 1,6 | 38 |
| H 222 | — | — | — | — | 14,2 |
| *Mean* | 14,5 | 9,6 | 5,9 | | |

**Table 6**
Mean fruits per cubic meter per tree of the phase-II avocado scion trial on three different rootstocks at Burgershall (B3; 24/01/1996), compared to Levubu (A1; 05/2/96)

| *Scions* | *Rootstocks* | | | *Mean* | |
|---|---|---|---|---|---|
| | *Duke 7* | *Thomas* | *Barr-Duke* | *B/Hall* | *Levubu* |
| Edranol | 10,33 | 4,50 | 0 | 4,94 | 6,4 |
| BL 149 | 1,61 | 0,34 | 0 | 0,65 | 9,2 |
| BL 135 | 10,98 | 13,57 | 0 | 8,18 | 3,27 |
| NA 37 | 0,09 | 0 | 0,19 | 0,09 | 0,02 |
| NA 526 | 0,16 | 0,3 | 0,23 | 0,23 | 0,29 |
| OA 184 | 1,72 | 1,01 | 0,68 | 1,14 | 0,89 |
| I 373 | 4,10 | 2,26 | 3,41 | 3,26 | 3,33 |
| Hayes | 0,14 | 0,55 | 0 | 0,23 | 0 |
| Reed | 2,40 | 0,88 | 1,95 | 1,74 | 1,17 |
| Colin V–33 | 3,30 | 3,52 | 3,33 | 3,38 | — |
| Eksteen | 0,05 | 0,66 | 0,61 | 0,44 | 0,02 |
| # 86 | 0,55 | 0,22 | 2,13 | 0,97 | 1,49 |
| TX 531 | 0,21 | 0,07 | 0,67 | 0,32 | 5,14 |
| H 222 | — | — | — | — | 1,57 |
| *Mean* | 2,74 | 2,14 | 1,02 | | |

## DISCUSSION

### Levubu (A2) and Burgershall (B6-N)

The trees at Burgershall were on average smaller than those at Levubu, except for the Fuerte 2 clonal selection. At Levubu Gwen was the smallest, followed by Ryan, but at Burgershall the trend was reversed. At both sites Pinkerton came third. However, on number of fruits per tree, Pinkerton did best at Levubu and Hass at Burgershall. Gwen performed consistently at both sites, earning itself first place on the ranking points system (table 7).

At Levubu second place goes to Pinkerton, followed by Ryan and Hass. One of the ARC-ITSC local selections are in fifth place, preceding the four Fuerte clonal selections. At Burgershall Gwen is followed by Hass, Pinkerton and Fuerte 3 (table 7).

**Table 7**
Performance (ranking) points allocated to the various scions in the phase-II avocado scion trials at Burgershall (B6-N) and Levubu (A2)

| | *Levubu* | *B/Hall* |
|---|---|---|
| Fuerte 1 | 9 | 9 |
| Fuerte 2 | 8 | 7 |
| Fuerte 3 | 6 | 4 |
| Fuerte 4 | 10 | 6 |
| Hass | 4 | 2 |
| Pinkerton | 2 | 3 |
| Ryan | 3 | 5 |
| Gwen | 1 | 1 |
| 87–7–1 | 7 | 8 |
| 87–17–1 | 5 | — |

**Table 8**
Performance (ranking) points allocated to the new imported selections in the phase-II avocado scion trials at Burgershall (B3) and Levubu (A1)

| | *B/Hall* | *Levubu* |
|---|---|---|
| Edranol | 2 | 3 |
| BL 149 | 6 | 1 |
| BL 135 | 1 | 2 |
| NA 37 | 13 | 12 |
| NA 526 | 12 | 10 |
| OA 184 | 7 | 8 |
| I 373 | 4 | 5 |
| Hayes | 11 | 13 |
| Reed | 5 | 7 |
| Colin V-33 | 3 | — |
| Eksteen | 10 | 11 |
| # 86 | 8 | 9 |
| TX 531 | 9 | 4 |
| H 222 | — | 6 |

## Burgershall (B3) & Levubu (A1)

These orchards consist mainly of the new imported selections from California. Very few of the selections are doing better than the control, Edranol. At Burgershall the BL 135 and Colin-V-33 are both smaller than the Edranol, and only the BL 135 are producing better than the control. On the ranking points system, BL 135 did best, followed by Edranol and Colin-V-33. I 373 a did well and was followed by Reed (which is commercially produced in Israel).

At Levubu both BL 149 and BL 135 are smaller than the Edranol, but only BL 149 produces better than Edranol on a fruits-per-cubic-meter basis. At Levubu the BL 149 achieved the highest score on the ranking points system (table 8), followed by BL 135 and then the control. The TX 531 selection also did well on the ranking system, followed by I 373.

## CONCLUSION

Gwen compares very favourably with the commercial cultivars in the first plantings that were made. This can be attributed to the very upright, relatively compact growth habit of these trees, as well as its good production. The two local selections are not performing that well: one of these is only marginally better than the Fuerte clonal selections. Fuerte 3 seems to perform better than the other Fuerte clonal selections.

Of the new introductions only BL 135, BL 149, and possibly of I 373, show promise. None of the rest performed better than the control, Edranol. However, it must be stressed that these orchards are only in their second and third years of production, and no conclusive recommendations can be made at this early stage.