

Non-Destructive Avocado Fruit Firmness Measurement

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ABSTRACT

Of the various instruments evaluated in this study, the hand-held densimeter gave the best results. The densimeter measured avocado fruit firmness 5 times faster than the conventional firmometer. On Fuerte, the densimeter also proved more accurate than the firmometer. On Hass, however, the repeatability of two densimeter readings on one fruit was slightly lower than that of two firmometer readings. The densimeter is recommended for non-destructive avocado fruit firmness measurement.

INTRODUCTION

For the past 15 years avocado fruit firmness has been measured nondestructively by means of a firmometer developed in South Africa by Swarts (1981). The firmometer is a very bulky instrument and the operator takes approximately 30 seconds to measure one fruit.

The aim of this study was to obtain a hand-held instrument for fast and non-destructive determination of avocado fruit firmness. Of the instruments evaluated, the firmometer and the hand-held densimeter are compared here.

MATERIAL AND METHODS

In this experiment, 270 Fuerte and 174 Hass fruits were used. Two readings per fruit were taken with each instrument. Measurements were taken at the maximum circumference of the fruit, turning the fruit slightly after each measurement.

The firmometer (figure 1) measures by means of a contact that is pressed onto an avocado by a 300g weight for duration of 10 seconds (Swarts, 1981). The scale ranges from 0 (hard) to 120 (soft). The hand-held densimeter (Bareiss, Germany; figure 2) measures fruit firmness by means of a metal ball (diameter 5mm) that is pressed onto the fruit. The scale ranges from 100 (hard) to 0 shore (soft).

RESULTS AND DISCUSSION

There was a very strong correlation between two firmometer measurements in Fuerte (figure 3) and in Hass (figure 4). Fruit in the category 'very soft' had the highest variation between two measurements in both cultivars.

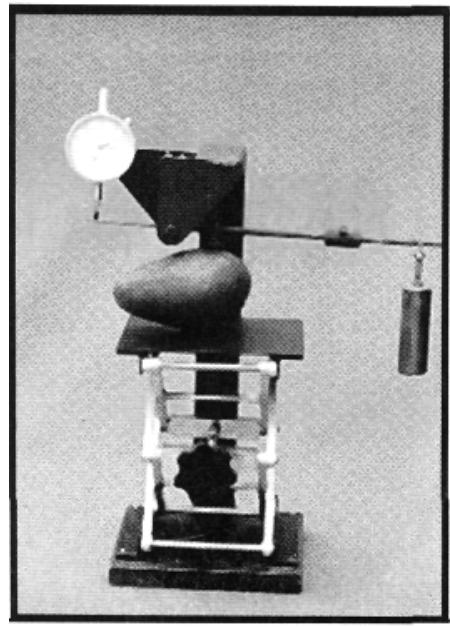


Figure 1. Firmometer

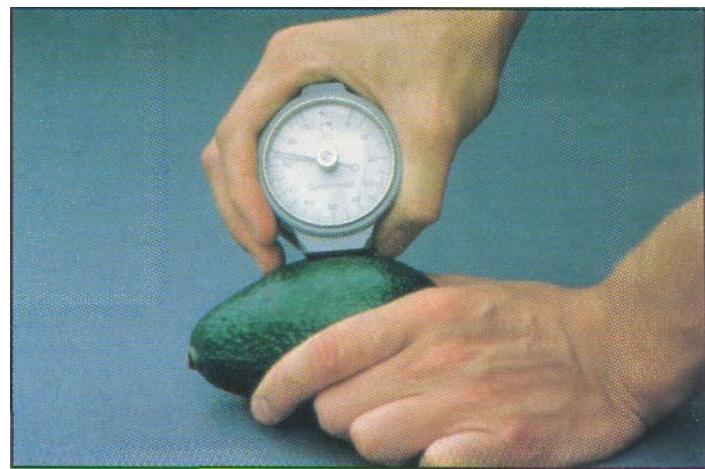


Figure 2. Hand-held densimeter

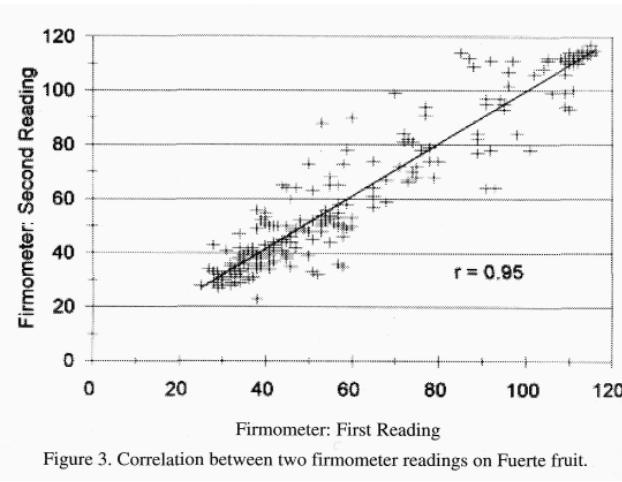


Figure 3. Correlation between two firmometer readings on Fuerte fruit.

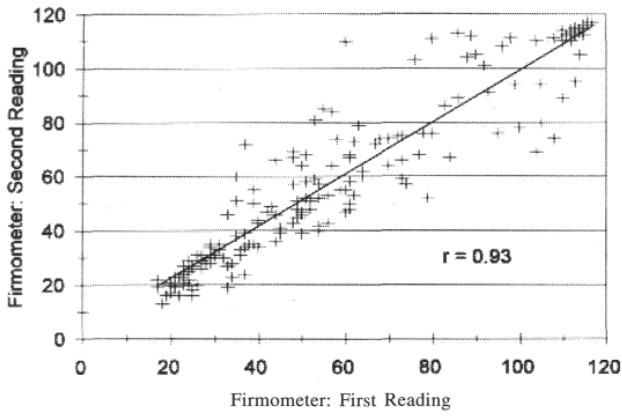


Figure 4: Correlation between two firmometer readings on Hass fruit.

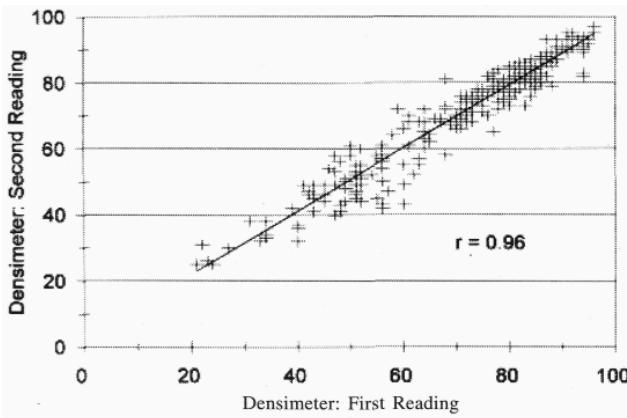


Figure 5: Correlation between two densimeter readings on Fuerte fruit

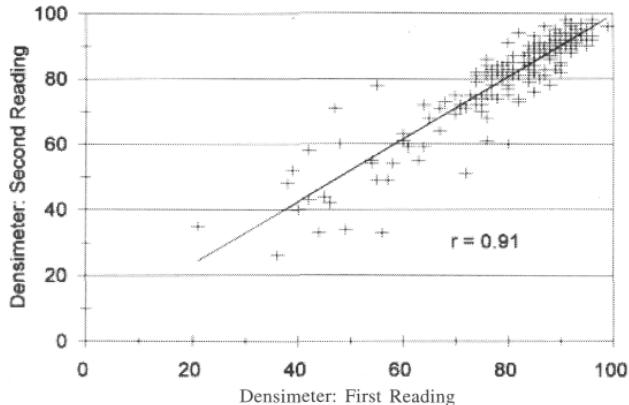


Figure 6: Correlation between two densimeter readings on Hass fruit

The correlation between two densimeter readings on Fuerte (figure 5) was slightly better than that between two firmometer readings. On Hass, however, the correlation between two densimeter readings (figure 6) was slightly lower than that between two firmometer readings. This was caused by the pebbly skin of the Hass fruit that influences the metal ball of the densimeter. With the densimeter, it took 5-10 seconds to measure one fruit, i.e. the densimeter measured avocado fruit firmness about 5 times faster than the firmometer.

The linear correlations between firmometer and densimeter readings on Fuerte and Hass are shown in figures 7 and 8. Firmness categories as measured by firmometer and densimeter are shown in table 1.

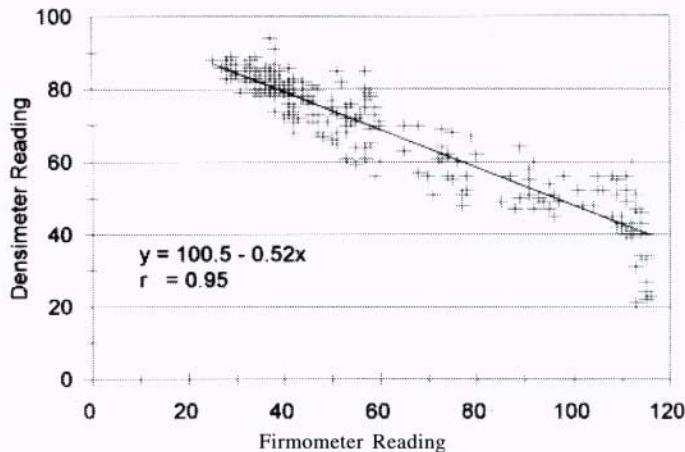


Figure 7: Relationship between firmometer and densimeter readings (Fuerte)

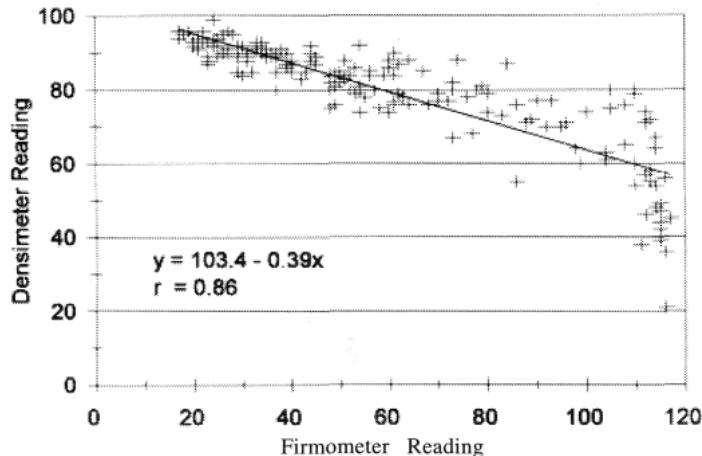


Figure 8: Relationship between firmometer and densimeter readings (Hass)

Table 1: Firmness categories as measured by Firmometer and Densimeter

Category	Firmometer	Densimeter (Fuerte)	Densimeter (Hass)
very hard	<20	>90	>96
hard	21-30	85-89	92-95
firm	31-35	82-84	90-91
breaking	36-45	77-81	86-89
soft	46-75	61-76	74-85
very soft	76-99	49-60	65-73
eat-ripe	>100	<48	<64

It should be noted that the trade is interested in measuring avocado fruit firmness in the categories from very hard to soft only. Both the firmometer and the densimeter measure fruit firmness more accurately in the categories very hard to soft than in the categories very soft and eating ripe.

In conclusion, the hand-held densimeter measures avocado fruit firmness faster, and in Fuerte more accurately, than the firmometer. Therefore, the densimeter has been introduced successfully to the South African avocado trade. Major prepackers, supermarkets and the SAAGA overseas technical officer are now using this handy instrument.

REFERENCES

- SWARTS, D.H. 1981. Fermometer ondersoek by avokado's. *South African Avocado Growers' Association Yearbook* 4: 42 - 46.