

Effect of Fruit Position and Weight on Percentage of Oil in Lula Avocados in Florida¹

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Present maturity regulations established by the Florida Avocado Administrative Committee are based on minimum fruit weights and earliest picking dates for each variety (1), while California law requires a minimum oil content of 8 per cent for all varieties (3). Fruit from some Florida avocado shippers was rejected in California because it did not contain at least 8 per cent of oil. This is especially true for the Lula variety, the leading variety grown in Florida and the one usually shipped to California.

Information that would assist growers in selecting fruit with a minimum of 8 per cent of oil would be beneficial. Furthermore, any additional facts about percentage of oil in Florida avocados that indicate whether the percentage can be used in determining maturity of Florida avocados should be helpful. Therefore, investigations were undertaken to determine the relation between percentage of oil and fruit weight and the effect on the percentage of oil, of fruit position on the tree. Variations in the percentage of oil from different trees were also studied.

EVALUATION OF OIL DETERMINATION METHODS

The oil-determination method which was adopted was developed by Harkness (4) and was a modification of that used by Shannon (5). Shannon's method was standardized with the ether extraction method. Both methods are based on the change in refractive index of avocado oil when mixed with Halowax (chlorinated naphthalenes). Halowax is used as the refractive standard. A Bausch and Lomb Abbe refractometer was employed.

In the Shannon procedure the oil is extracted by grinding a mixture of Halowax and avocado flesh in the ball-grinder. In the Harkness procedure Halowax, water, and avocado flesh are placed in a Waring Blender for maceration; the resulting mixture is centrifuged to separate the Halowax-avocado-oil mixture from the aqueous solution. Hereafter in this paper the two methods are referred to as the ball-grinder and the blender method. Only hard fruit were used in these investigations.

Comparisons between the ball-grinder method and the blender method were made. Individual fruit of the Lula variety were used and the methods were compared many times. Samples of avocado flesh were ground in the ball-grinder at various intervals of three to 20 minutes and oil determinations were made for each sample. Samples were also macerated in the blender for three periods, three, five, and ten minutes. Readings for samples ground for different periods in the ball-grinder showed that the maximum percentage of oil is obtained by grinding 15 minutes (Fig. 1). Five minutes in the

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blender resulted in readings approximately equal to those obtained by grinding 15 minutes in the ball-grinder (Fig. 1). Increasing the blending time to ten minutes did not result in higher percentages of oil. Since most laboratories are equipped with Waring Blender and centrifuge, the blender method appears to be the most practical, especially since the ball-grinder is an expensive and uncommon item. Henceforth, the blender procedure is the method used in this paper.

OIL CONTENT OF AVOCADOS

Grove A.—Four trees were selected in the middle of a 28-year-old grove. Twenty-five fruit were picked from random positions on each tree. Individual fruit were then weighed and oil determinations were made for each. The first tree was picked December 14 and the fourth tree December 22, 1955. Because of the irregular shape of the old trees in this grove, the recording of location of fruit on the trees was not practical.

A correlation coefficient (r) of 0.237 (98 degrees of freedom) was obtained between fruit weight and percentage of oil for all fruit from this grove. This coefficient was significant at the 5 per cent level. The coefficient of determination (r^2) of 0.0562 indicated that less than 6 per cent of the variation in oil could be attributed to variation in weight. When correlation coefficients were determined from the data for each tree no significance was found except for one tree which had a correlation coefficient of 0.593 (23 degrees of freedom). This was highly significant at the 1 per cent level. The significance for the grove as a whole could be attributed to the highly significant effect of weight on percentage of oil in fruit of the one tree.

An analysis of variance showed that there were highly significant differences in both fruit weight and percentage of oil for fruit among trees even after covariance adjustment for weight.

Groves B and C.—Four trees were selected in the middle of Grove B and of Grove C. Grove B was ten years old and Grove C was seven years old. Fruit positions on each tree were recorded for compass direction, top half and bottom half; otherwise the same procedure as for Grove A was followed. All fruit were picked from December 28, 1955, to January 16, 1956, a period of less than three weeks.

Correlation coefficients were computed between fruit weight and percentage of oil for both Grove B and Grove C. Neither was significant, indicating that the effect of weight on percentage of oil was not significant.

An analysis of variance showed that there were highly significant differences for both fruit weight and percentage of oil of fruit from different trees in both groves. After covariance adjustment for weight, the percentage of oil for fruit from trees was still significantly different. Table 1 shows the mean percentage of oil for the fruit from each tree in Groves B and C. There were significant differences among trees in percentages of oil.

Table 1.—Mean percentage of oil (fresh-weight basis) in Lula avocado fruit per tree and top and bottom halves, Groves B and C.

Grove and tree number	Top half ^a	Bottom half ^a	L.S.D. at 5 per cent between top and bottom half	Tree means ^b
Grove B:				
1.....	13.3	13.2	0.4	13.2 ^e
2.....	12.1	12.0	0.4	12.0
3.....	15.6	13.0	0.4	14.2
4.....	14.4	13.3	0.4	13.8
mean.....	13.9	12.9	0.2	13.3
Grove C:				
1.....	13.5	12.8	0.6	14.2 ^d
2.....	15.5	14.5	0.6	14.9
3.....	15.1	13.9	0.6	14.5
4.....	16.3	15.2	0.6	15.7
mean.....	15.1	14.1	0.3	14.6

^aEach mean represents 12 fruit.

^bEach mean represents 25 fruit.

^cL.S.D. at 5 per cent between tree means = 0.8

^dL.S.D. at 5 per cent between tree means = 0.9.

Values for the one fruit from each tree with the highest percentage of oil, and for the one with the lowest, were averaged. The average for the highest was 15.8 per cent oil and for the lowest 11.1 per cent. For the two groves, the range in percentage of oil for individual fruit was 9.7 to 19.1 per cent.

Similarly, values for the one fruit from each tree with the highest and for the one with the lowest weight were averaged. The average for the highest was 26.5 ounces and for the lowest 15.7 ounces. For the two groves, the range in weight for individual fruit was 14.2 to 29.1 ounces.

Fruit for the four compass directions on the trees showed no significant difference in percentage of oil. However, the fruit from the top halves of the trees were higher in percentage of oil than were those from the bottom halves (Table 1). A covariance adjustment for weight did not change this difference.

DISCUSSION

Avocado growers have maintained that large fruit of a given variety generally contain higher percentages of oil than do small fruit. This relation may exist if extremes in size represent different bloom dates. Harkness (4) found with various midseason varieties that a 0.6 per cent increase in oil content corresponds to a 4-ounce increase in size. However, in the present investigation little correlation existed between percentage of oil and fruit weight of avocados taken from three groves. The highest coefficient of determination for any grove was less than 6 per cent. This would indicate that the picking of Lula avocados by weight to obtain fruit of specific percentages of oil is impractical at the present time.

The results of these tests indicate that a higher percentage of oil would be obtained if fruit were picked from the top half of the trees than if they were picked from the bottom half. Thus considerable variation in percentage of oil exists among fruit from the same tree and this variation is greater among fruit from different trees.

Data accumulated by various workers (2, 6) show that avocado fruit increases in oil percentage as it develops, but that a leveling-off or even a decrease in percentage of oil occurs late in the season. According to Harkness (4), avocados increase approximately 1 per cent in oil in three weeks. The present investigation

was carried out during the middle of the Lula season, when most individual fruit contained more than 8 per cent of oil. Similar tests should be undertaken earlier in the harvest season when the percentages of oil are lower.

SUMMARY

The correlation between weight and percentage of oil in Lula avocado fruit was determined. Variations in fruit on different trees within groves and variations in position on trees were studied. There were differences in percentage of oil to fruit between trees and these differences remained after covariance adjustment for weight were made. A low correlation between weight and percentage of oil indicated that Lula fruit cannot be selected by weight alone during midseason for a specific percentage of oil.

Fruit from the top halves of the trees had higher percentages of oil than did those from the bottom halves. There was little difference in percentage of oil in fruit selected from different compass directions on the tree.

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