**California Avocado Society 1945 Yearbook 30: 101-103**

# Nitrogen, Potassium, and Phosphorus Content of Fuerte Avocado Fruits from Different Orchards

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At the present time there are no data available to indicate whether differences exist in the nitrogen, potassium, or phosphorus content of the pulp of avocado fruits collected from various orchards and whether these can be related in any way with the fertilization of the soil. Recent data[1] for leaf blades and petioles of avocado trees have shown quite a variation in their potassium and phosphorus content according to the particular orchard in which the samples were taken. It seemed desirable to learn whether variations in these constituents also occurred in the pulp of the mature fruits[2] collected from the same trees from which the leaf samples had been taken.

The fruit samples were obtained on April 10, 1945, and a selection was made of the fruits desired for analysis. After being lightly brushed in running distilled water, these fruits were wiped dry and the stem buttons removed. The fresh weight of each fruit complete with seed and also that of the seed alone (complete with seeds coats) were then recorded.

Previous studies[3] have shown that gradients occur in the distribution of inorganic constituents in avocado fruits. Hence, samples cut from the button or stem half of the fruit may differ markedly in composition from samples cut from the blossom or tip half of the fruit. Accordingly after the removal of the skin and seed only the middle portion (a thin transverse slice) about one-half inch in thickness was saved for analyses. Narrow segments from each of these median slices in a sample of fruit were cut and weighed and then were placed in Kjeldahl flasks or weighed dishes. All of these were then dried in a large ventilated oven maintained at 65°C. and the dry matter in the dishes was then determined. Distilled water containing 1 ml. of concentrated sulfuric acid was added to the dry matter in the dishes selected for the potassium determinations in order to guard against losses of potassium during the ignition of the dry matter. Likewise magnesium nitrate was used in the ignitions for the total phosphorus determinations. The chlorplatinic acid method was used in determining potassium and the colorimetric molybdic acid method was used in determining phosphorus.

In table 1 are given the orchard (as also was designated by Fullmer[1]) and its location together with data regarding the fertilization, cultivation and irrigation. The average yield in tons per acre per year is given in approximate terms. The table gives the weights of the fruits selected for these tests and also the weights of the seeds.

The chemical analyses were carried on in triplicate and the averages of closely agreeing results are reported in Table 2, A1 and A2, C1 and C2, X1 and X2 represent fruit samples respectively from trees in two locations in the same orchards. The trees in

E1 and E2, though in a single orchard area, represent two age groups of trees each group of which has been fruit-sampled.

The fruit of orchards A and X were typical of these excellent orchards and as the data in the table reveal, they are highest in nitrogen, potassium, and phosphorus content. In orchard B both the nitrogen and potassium in the pulp of the fruit was low while phosphorus was also relatively low. In C likewise the nitrogen and potassium were low with fair amounts of phosphorus.

**TABLE 1**
**The culture and yield of Fuerte avocado orchards from which fruit samples were obtained**

| Orchard[4] and location | Fertilization | Culture | Average yield (tons per acre per year) | Fresh wt. per fruit without buttons (grams) | Total Wt. of seeds | |
|---|---|---|---|---|---|---|
| | | | | | Fresh (grams) | Dry (grams) |
| A1, Vista | 25 to 35 lbs. of 6-9-6 and 4-10-10 per tree per year for 12 years | Noncultivated; sprinklers | 4 to 6 | 218.0<br>231.5 | 88.2 | 41.5 |
| A2, Vista | | | 4 to 6 | 236.5<br>190.9<br>199.5 | 107.3 | 48.4 |
| B, Vista | Nitrogenous fertilizer prior to 1943; since 1943, 15 to 20 lbs. of 8-8-4 per tree per year | Cultivated; furrow-irrigated | Since 1938, 4 to 5 | 218.0<br>193.3 | 73.1 | 34.1 |
| C1, Escondido | 2 to 3 lbs. of nitrogen per tree per year plus heavy applications of manure, | Cultivated; portable sprinklers | Not available | 250.5<br>233.0 | 74.2 | 32.2 |
| C2, Escondido | | | | 224.6<br>233.2<br>212.9 | 91.0 | 40.0 |
| D, Escondido | 2 lbs. of nitrogen per tree per year for the past 14 years; past 4 years 1 lb. phosphoric acid per tree per year additional; old trees | Cultivated; furrow-irrigated | Since 1936, 4 | 230.3<br>252.4<br>200.0 | 157.2 | 76.5 |
| E1, Escondido | 20 to 30 lbs. of mixed and nitrogenous fertilizers per tree per year; old trees | Noncultivated; permanent sprinklers | Since 1937, 4 to 6 | 276.4 | 39.8 | 17.2 |
| E2, Escondido | 6 year old trees | Cultivated; furrow-irrigated | Not available | 201.3 | 47.4 | 23.9 |
| F. Vista | Nitrogenous fertilizer and manure | Cultivated; furrow-irrigated | Low | 274.3<br>188.3 | 102.0 | 45.7 |
| X1, Escondido | 20 to 30 lbs. of mixed fertilizer per tree during the past 8 to 10 years | Noncultivated; sprinkler | 4 to 6 | 180.5<br>210.6 | 58.8 | 26.4 |
| X2, Escondido | | | 4 to 6 | 201.0<br>228.0 | 72.9 | 30.9 |

4. Orchards have been given the same designation by Fullmer in his data except X1, X2, C2, and E2.

Fruits from orchards D and E contained fair amounts of each of the three elements. The fruits from orchard F were an outstanding case in which the phosphorus content is markedly low, while the potassium content is fairly high.

Avocado leaf analysis data[1] in general are in agreement with the results obtained for the same constituents in the fruit pulp. The fruits of orchards A, F, and X thus are high in potassium while those of orchards B, C, D, and E are fairly low in potassium. Likewise the fruits of orchards A, El, and X are high in phosphorus while those of B, C, and D are only fair or moderate as regards phosphorus content while those of orchard F are extremely low in available phosphorus.

Thus the state of nutrition of the avocado tree is indicated not only in the composition of the leaves (vegetative phase) but also in the composition of the fruit (reproductive phase). It is not known at present how to interpret such differences in composition in

relation to the sugar or oil content, extremes of temperature, or to the vitality or storage life of the fruit. The data do, however, afford us a starting point in studying the mineral nutrition of the avocado fruit.

**TABLE 2**

**The dry matter, total nitrogen, potassium, and phosphorus content of a narrow median slice or cross section of the pulp (without skin) in mature Fuerte avocado fruits collected from various orchards**

| Orchard[4] | Dry matter in pulp (per cent) | Total nitrogen in: | | Total potassium in: | | Total phosphorus (P) in: | |
|---|---|---|---|---|---|---|---|
| | | Fresh pulp (per cent) | Dry pulp (per cent) | Fresh pulp (per cent) | Dry pulp (per cent) | Fresh pulp (parts per million) | Dry pulp (parts per million) |
| A1 | 32.67 | 0.42 | 1.26 | 0.67 | 2.07 | 1060 | 3243 |
| A2 | 32.21 | 0.36 | 1.12 | 0.66 | 2.05 | 1007 | 3125 |
| B | 37.23 | 0.08 | 0.21 | 0.44 | 1.18 | 768 | 2063 |
| C1 | 35.86 | 0.10 | 0.27 | 0.49 | 1.35 | 855 | 2385 |
| C2 | 37.39 | 0.07 | 0.23 | 0.51 | 1.38 | 883 | 2361 |
| D | 32.09 | 0.31 | 0.96 | 0.52 | 1.57 | 753 | 2345 |
| E1 | 36.28 | 0.34 | 0.95 | 0.60 | 1.65 | 1122 | 3092 |
| E2 | 36.27 | 0.32 | 0.88 | 0.50 | 1.38 | 883 | 2434 |
| F | 31.02 | 0.25 | 0.81 | 0.65 | 2.04 | 509 | 1642 |
| X1 | 30.42 | 0.56 | 1.82 | 0.71 | 2.33 | 981 | 3225 |
| X2 | 30.31 | 0.44 | 1.46 | 0.67 | 2.22 | 863 | 2912 |

4. Orchards have been given the same designation by Fullmer in his data except X1, X2, C2, and E2.

## Summary

The data reveal the fact that the composition of avocado fruits (as in leaves) can be altered by means of applications of fertilizer to the soil. The trees with the lowest phosphorus content in the fruit pulp were somewhat stunted. The potassium content was relatively low in the fruits from trees in certain orchards. Some of the outstanding orchards were those in which nitrogen, potassium, and phosphorus were all fairly high in the fruit.

NATURE'S MISTAKE—AN AVOCADO ABNORMALITY

*The illustrations show front and back views of the same specimen of a freak avocado growth. This is an example of nature gone "haywire"—a disorder termed "fasciation" by the botanist. The hammer head appearing in one illustration indicates relative size; the specimen weighed slightly more than ten pounds. Growth abnormalities such as this are not uncommon, but appear to be cause for no concern. So far as known, they are not evidence of any disease nor do they cause any trouble. This particular example was "harvested." from a Fuerte tree in the Vista district, which then and subsequently has borne excellent crops of normal fruit.*
*—From Calavo Growers*

[1.] Fullmer, Forrest, in cooperation with the American Potash Institute, Inc., kindly loaned me unpublished data on the potassium and phosphorus content and changes in avocado leaf blades and petioles.
[2.] Thanks are due Mr. Forrest Fullmer, The American Potash Institute, Inc.. and generous avocado growers for the collection of these fruits.
[3.] Haas. A. R. C., Chemical composition of avocado fruits, Jour. Agr. Res. 54 (No. 9): 669-687, 1987.