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FRUIT GROWTH IN THE ORIENTAL PERSIMMON

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The general nature of fruit growth as determined by size measurements, volume changes, and increase in dry weight has been reported for a number of fruits. The present preliminary study of fruit growth patterns in the Oriental persimmon was undertaken to obtain basic information which might be helpful to understand the problem of fruit shedding. Shedding of immature fruit at nearly all stages infrequently is excessive in persimmon (7,11), especially in the variety Hachiya, the most important grown commercially in California. Included also for comparison only was the variety Fuyu, a non-astringent type which is very important in Japan but of little commercial importance at present in California. The trees of the two varieties used in the investigation were grown on **Diospyros kaki** rootstock in the orchard of the Department of Horticultural Science on the Los Angeles campus. Measurements of average cross-sectional diameters were made of fruits collected at approximately three-week intervals throughout two seasons. Samples consisted of three to a dozen fruits at each collection. Nitrogen content was determined by the Kjeldahl method and expressed on the basis of dry weight.

The persimmon fruit develops from flowers borne on a relatively large leafy inflorescence of current season's growth. The fruit sets parthenocarpically under conditions existing in southern California, hence is normally seedless in the varieties Hachiya and Fuyu, both of which are pollen sterile. When pollen is available from other varieties, however, fruits of Hachiya and Fuyu may develop seed.

The persimmon fruit is a botanical berry which consists of a rather homogeneous parenchymatous pericarp surrounded by a thin and fragile skin.

The fruit growth data shown graphically in Figure 1 indicate that fresh weight measurements in this fruit exhibit the general sigmoid curve pattern for a typical botanical berry, with only slight deviation. The final collections in the present study were made when commercial horticultural maturity had been attained; thus the fruit was fully colored and ready to soften. Actually the persimmon fruit will soften and often actually dry and shrivel on the tree if not harvested. Absolute dry weight determinations likewise indicate a gradual and continuous increase of dry material throughout the period of fruit development. The percentage of dry weight decreases gradually during the first half of the growing season and eventually attains approximately 17.5 per cent in the mature fruit. The moisture content, however, closely follows the curve pattern for fresh weight.

The nitrogen analysis represented graphically in Figure 2 indicates that total nitrogen varies during the development of the fruit approximately as does the fresh weight, but with some irregularities. During the latter part of July and early August the rate of

increase of total nitrogen falls off slightly, but rises sharply as the fruit approaches maturity in October. While the fruit of Hachiya is of greater volume than fruit of Fuyu at all times, this difference also is reflected in total nitrogen in the two fruits, though differences in total nitrogen do not parallel differences in volume. The percentage of total nitrogen on dry weight basis decreases rapidly early in the life of the fruit, less so in half mature fruit, and rises abruptly as the fruit approaches full maturity. This latter rise has been confirmed by repeated analysis and has been reported previously (8).

The persimmon fruit exhibits two general periods of development, the first extending over two months, during which fresh weight and diameter increase while the percentage of nitrogen decreases rapidly, followed by a second period of approximately 2½ months' duration, in which increase in diameter is somewhat slower. Fresh weight increases at a lesser rate during the second period, and the percentage of nitrogen decreases slowly for a time and abruptly increases as maturity is approached. Dry weight during the second period increases rather rapidly. Between 70-75% of total dry weight is accumulated in the second period.

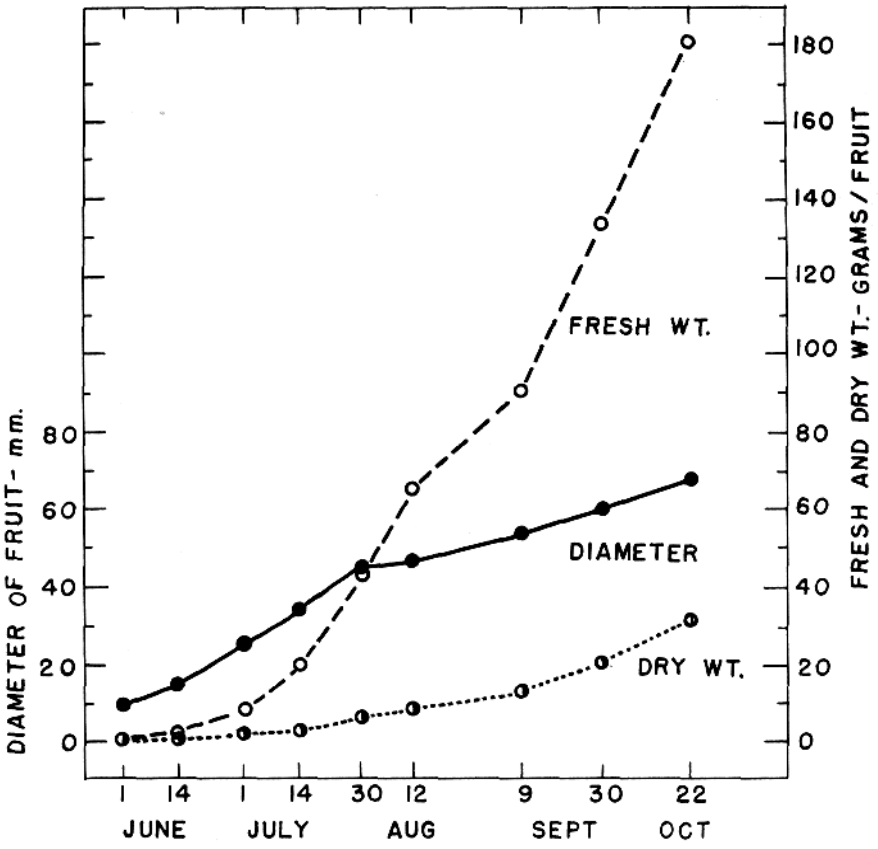

Figure 1. Growth in the fruit of the Hachiya persimmon as represented by changes in diameter and fresh and dry weight.

DISCUSSION

Growth studies of various fruits based primarily on dimensions, weight or volume indicate that each botanical fruit type exhibits a characteristic mode of development, depending somewhat upon its basic morphology. Thus the stone fruits, as typified by the peach or cherry (9), follow a general pattern of dimensional growth which consists of three rather distinct periods from flower to mature fruit. Rapid growth of all tissues characterizes the first period. Very little growth can be detected during the second or "rest period," during which the endocarp hardens. The third period is marked by a very rapid increase in size as fruit maturity is approached. The almond, also a drupaceous fruit, does not exhibit the pronounced third period of dimensional growth as does the peach, because the mesocarp remains as a "dry-tissue." (3). The apple, a pome, exhibits a different type of dimensional growth, which is nearly constant in rate during the entire period of fruit development. Summer apple varieties show a lesser growth rate during the early season, while late varieties decrease in growth rate toward the end of the season when the mean temperature falls. The pear exhibits the same growth pattern as the apple. Citrus fruits, such as lemon or orange, each of which is morphologically a specialized berry, the hesperidium, exhibits a continuous increase in volume throughout the season, provided water is available (2,12). Shrinkage of citrus fruits may occur during the growing season when a water deficit occurs within the plant (2). The fig, morphologically a fleshy receptacle which contains many true botanical fruits, achenes, follows the growth pattern of the stone fruits with two periods of size increase based on diameter measurements (4). The olive, a drupe, however, has three periods of increase in volume (7). Fresh fruit weight and fruit length increases in the pericarp of the date (1,5), a berry, are represented by simple "S" curves which reach a maximum in late summer, sometime before full fruit maturity, and fall off as maturity is attained. Dry weight, however, continues to increase throughout the fruit life and reaches a maximum following the peak attained by fresh weight. Tomatoes and muskmelon, soft-fleshed botanical berries, follow the typical "S" curve growth pattern of simple berries based on volume measurements (10). While the persimmon is similar in some of the trends exhibited by these fruits, it is distinct in others.

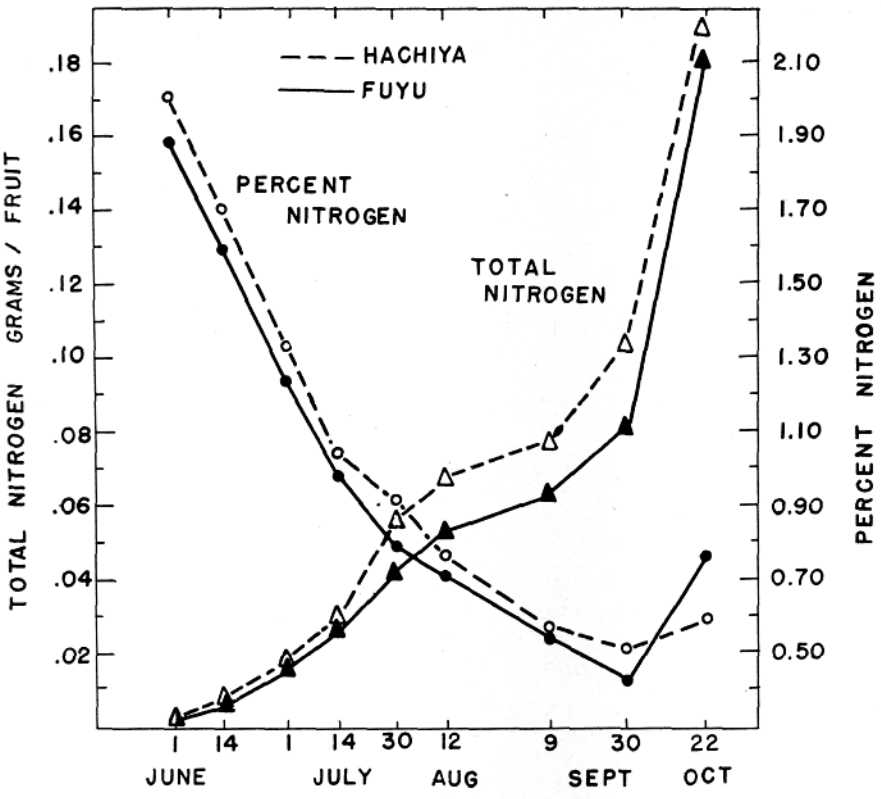

Figure 2. Fluctuation in total nitrogen and per cent nitrogen on dry weight basis in fruits of Hachiya and Fuyu persimmons during development.

In summary it can be stated that fruit development in the persimmon follows the general pattern exhibited by other simple botanical berries, with slight variations from the sigmoid curve. Two general periods of development appear to exist, each of about two months' duration. Most of the dry weight is accumulated during the second month of the last period. There is a sudden increase in nitrogen content as horticultural maturity is approached.

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