

Effect of temperature and pollen source on fertilization, fruit-set and abscission in avocado (*Persea americana* Mill.)

Argaman, E. (1983) Unpublished MSc Thesis, The Hebrew University of Jerusalem, Israel

One of the main problems in avocado growing countries is the low yield exhibited by commercial cultivars. It is commonly believed that the temperatures prevailing during the time of flowering and fruit set greatly influence yield in avocado. The main purpose of the present work was to investigate influence of several different temperature regimes on flower development, pollination, fertilization, fruit set and early development of the fruitlets.

At first, we found that the percentage of flowers (of 'Ettinger' and 'Hass' cultivars) setting was considerably higher than the percentage of normal flowers, according to earlier criteria. To cope with this contradiction and other data, improved, less severe; anatomical criteria of the functionality of avocado flower gynoecium were suggested. Though severe degenerations and abnormalities were observed in the ovary, embryo sac and the egg apparatus, never has the percentage of defective flowers surpassed 15-30% in 'Hass' and 'Fuerte' or 40-50% in 'Ettinger'. Furthermore 12-18% of the flowers were in doubt as to their gynoecial functionality, and were therefore classified in a separate group.

Most of the experiments on temperature regime effects were conducted with small 2-4 years old nursery plants in the phytotron. A small number of experiments were performed on detached flowers in agar, and the rest of the experiments were conducted in the orchard.

A temperature regime of 32-35°C day and 21-23°C night temperature lasting for a whole week, was found to cause damage to ovules and especially to the pollen of 'Fuerte'. Tubes growing from such pollen, hardly ever penetrated the ovary or reached the embryo sac. 'Ettinger' pollen on the other hand, was unaffected by temperatures almost as high.

A low temperature regime of 17°-24°C day and 9°-12°C night, did not cause any detectable damage to the ovules and pollen of any of the experimental cultivars.

Hand pollinated avocado flowers were observed for temperature effect on pollination and fruit set. 9°C prevailing for several hrs did not inhibit growth of pollen tube from 'Ettinger' and a West-Indian cultivar, nor did these conditions impair penetration of the pollen tube into the embryo sac of 'Fuerte'. 'Hass' flowers exposed to night temperatures (9-8°C) during several nights did not decrease orderly fruit-set. Pollination and fruit-set of 'Reed' and 'Ettinger' were almost completely unaffected by low temperatures as above. In flowers of 'Reed' and 'Benik' cultivars grown under temperature regimes as above, penetration of pollen tube into the ovule was observed. Avocado flowers that have just finished their female opening were kept at 1°C for several hrs. This treatment did not affect their pollen germinability. These series of results led us to conclude that the processes of pollination and fruit set are much less liable to damage by low temperature than formerly believed.

Nonetheless, it should be pointed out that prolonged periods in low temperature (9-12°C night and 17-24°C day) during much of the fertilization and fruit-set period, slightly decreased fruit-set

percentages ('Fuerte' and 'Ettinger'). In 'Fuerte', a parallel rise in number of degenerate fruitlets was observed in the low temperature treatments. These results suggest that prolongation of low temperature treatments may greatly accentuate their harmful effect.

A high temperature regime (22-24°C night and 32-35°C day) was detrimental to fruit-set in 'Fuerte'. 'Ettinger' and 'Reed' did set fruit at such temperatures only that it was reduced compared to a more temperate regime (15-17°C night and 22-24°C during the day). After a week long pre-treatment of high temperature considerable reduction in setting of hand pollinated flowers was observed ('Reed'). The hot temperature treatment expressed its effect mainly through damaging fertilization processes and those immediately following.

Observations made outside the phytotron during hot spells were in accordance with the controlled temperature experiments. A hot spell in which temperature reached 39°C has probably damaged fertilization in 'Fuerte'. A hot spell in which temperatures went up as high as 45.5°C damaged all experimental fruitlets (in May 1980) and caused the abscission of almost all of them.

Those few (out of hundreds) which did not abscise showed acute signs of degeneration. We concluded as a result of this experiment and other data that the serious failure in avocado yield in the year 1980 resulted from the two intensely hot spells that occurred at that year in May.

To summarize both controlled climate and out-of-doors experiments we can point out a conspicuous feature of avocado flower and fruitlet functionality which is the sensitivity to high temperatures.

Fruitlets, at the age of 16 to 21 days, were checked anatomically. In addition to the well known embryo endosperm defects we found and described nucellar defects for the first time. These defects were manifested in strong staining by safranin of internal nucellar tissue. A statistically significant correlation between the above phenomenon and the appearance of defects in the embryo and endosperm was found. It seems that nucellar defects precede those in the embryo and endosperm.

Under favourable conditions percentages of normal fruitlets, at the age of 16-21 days reached 30-35% in 'Hass' and 'Ettinger' and 13-15% in 'Fuerte'.

We concluded therefore, that the processes involved in fruit-set do not, as a rule, govern the yield of avocado trees. Nevertheless, the low percentages of flowers setting in 'Fuerte' may point at faults occurring in the above mentioned processes in 'Fuerte'.

Apart from temperature effects, the influence of pollen origin on the fertilization and fruit-set was studied. We could see a considerable effect of pollen source on setting of fruit. 'Ettinger' and a West Indian pollen were found to be much more effective than 'Hass' pollen.

Self pollination in 'Ettinger' did not decrease setting of fruit, but nevertheless increased numbers of defective fruitlets as compared with fruitlets obtained with 'Hass' pollen. This phenomenon might be indicative of partial self incompatibility resulting in a weakness of seed tissue.