Carbohydrate partitioning between fruitlets and young vegetative growth as a possible factor involved with fruitlet abscission in avocado

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Low productivity is the main problem in the avocado orchards in Israel. However, a much bigger yielding potential is known in avocado. An avocado tree may carry almost one million flowers, many more than are left on the trees as a satisfactory yield. In spite of difficulties in pollination and fertilization that may occur, there is generally a sufficient number of fruitlets left. However, most of these fruitlets tend to abscise during the first month after set. Prevention of only a small portion of that abscission may result in greater yields.

High temperatures are considered to be injurious to the processes of fruit set, and to the development of the fruitlets. A high positive correlation exists between fruitlet abscission and signs of denaturation in the seed coat and nucellus of those fruitlets.

A real success in improving yields in 'Fuerte' has been attained by the suppression of the young vegetative growth, which is developing at the same time as the bloom and fruit set. Thus, the supposition that competition between fruit-set and young vegetative growth is involved in fruitlet abscission, has been established. The object of this work is to examine whether the antagonism between reproductive and vegetative growth is a result of a competition for carbohydrates.

Large amounts of C7 sugars have been found in avocado. We have found that the C7 sugar alcohol perseitol, is the major translocated sugar, although sucrose takes part in translocation too.

Determinate inflorescences, which lack vegetative growth, are found to be more productive than indeterminate inflorescences. This fact is expressed in primary fruit-set, but mainly in the amount of fruits at the harvest. The frequency of determinate inflorescences is a variable characteristic depending on the cultivar. Nevertheless, that characteristic does not necessarily correlate with high productivity of a cultivar.

Leaves from the previous year senesce and abscise shortly before spring bloom. It seems, therefore, that that blossom is maintained mainly by carbohydrate reserves, accumulated during the previous season. Using 14C02 label in the autumn, we have been able to trace the partitioning of those carbohydrates in the spring between fruitlets and developing leaves. Furthermore, we have been able to determine the stage of transition from sink to source during leaf development.

In most of the commercial cultivars, excluding 'Fuerte', the overlapping period of fruit-set and vegetative growth, is very short if it exists at all. We have found that young vegetative growth changes very fast, within a month, from being a sink to being a source of carbohydrates. In some cases, this can be even before fruit-set. In spite of that, we have found that removal of the young vegetative growth, at any stage of development., even after becoming mature and an exporter of assimilates, results in a persistence of comparatively many more fruitlets. We have also found that a large portion of those fruitlets are seedless, which is in agreement with previous work.

These findings may reflect on important factors other than carbohydrates, which may be involved with the antagonism between reproductive and vegetative growth.

An examination of the assimilate partitioning between fruitlets and young developing leaves has shown that it is not strongly affected by the removal of the latter. That is true, as far as late stages of development of the young shoot are concerned. The senescence and abscission of the older leaves during the period of bloom prevent study of the situation at earlier stages. Nevertheless, fruit set also occurs late, relative to the young shoot development. However, it is most likely that competition between reproductive and vegetative growth may pre-determine the fate of the fruitlets to abscise shortly after fertilization. Removal of the young vegetative growth at these stages indeed results in a higher percentage of primary fruit set.

We have found extreme differences among the population of the fruitlets during the abscission period, concerning sink strength, mainly of the seed coat. The weakening of sink capacity in the seed coat is characteristic of abscising fruitlets. The nucellus may play a dominant role in sugar metabolism and in the nutrition of the embryo, and therefore, in fruitlet abscission. However, we assume that involvement of carbohydrates has a secondary effect, in addition to other factors such as water and phytohormones, which may play a more important role in the induction of fruitlet abscission. An indication for that may be the improvement of 'Fuerte' avocado yields, using a GA inhibitor such as PP333, even though the correct mechanism is not yet known.

The involvement of C7 sugars in translocation in avocado, as it has been found in this work, opens a wide field for biochemical and physiological research, especially in the metabolic aspects of source-sink relations in avocado.