

The effect of girdling on flowering, fruit setting and abscission in avocado trees

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The effect of girdling on different processes related to fertility in the avocado was examined. Within this context the effect of girdling was tested on flowering behaviour, pollination, fertilization, fruit set and fruit abscission. In addition, vegetative growth processes, mature leaf abscission and chemical composition of different tissues were examined and evaluated. The major objective of the study was to elucidate the mode of action of girdling in augmenting the fruitfulness of the avocado.

The effect of girdling on flowering

Girdling did not affect the number of flowers on the girdled part of the tree, but decreased the number of flowers on the ungirdled part of girdled trees, as compared with control trees.

Girdling advanced the time of flowering. This effect was strongest when girdling was performed in autumn, less so with girdling in winter, and non-existent when done in spring. Girdling had no influence on the timing or sequence of female and male flower opening.

Anatomical examination of avocado flowers revealed a high proportion of ovule defects. Degeneration was found most frequently in the egg apparatus, especially in the egg cell, less frequent was degeneration of the polar nucleus. Other defects, of lesser frequency, were lack of embryo sac, immature embryo sac, and extra-ovary ovules. The percentage of normal ovules in the varieties 'Fuerte', 'Hass' and 'Tovah' was about 20%, and in the variety 'Ettinger' - 2%. Girdling did not alter the percentage of the above-mentioned defects, nor did climatic conditions during the flowering season or the fruitfulness of individual trees.

The effect of girdling on the fertilization process and fruit set

Experiments with detached flowers, testing the influence of different factors on pollen tube growth and penetration into the ovule, gave the following results:

- (a) At temperatures lower than 12°C, no pollen tube reached the ovary. At 20-25°C pollen tube growth was most rapid; at 35°C or above, the rate of pollen tube growth was slowed down.
- (b) Addition of sugars increased the rate of pollen tube growth, and also of its penetration into the ovule.

Trials with attached flowers in the orchard showed that girdling increased the rate of pollen tube growth and of its penetration into the ovule. We believe that the increased content of carbohydrates following girdling is the factor responsible for the increased rate of pollen tube growth in flowers of girdled branches.

The positive effect of girdling on fruitfulness manifests itself first in the increased rate of fruit set, recognizable already five days after pollination and continuing until the last stage of

abscission of fruitlets and fruits. The rate of fruitlet abscission was similar for girdled and ungirdled branches. Girdling increased also the number of seedless fruits, with spring treatments being more effective than autumn treatments. Changes in dry matter percentage, and in levels of macro elements and carbohydrates following girdling

The effect of girdling was tested on the percentage of dry matter, level of carbohydrates (starch and sugars), and level of macro elements (nitrogen, phosphorus, potassium and calcium) of aerial parts (leaves, bark, wood) of old 'Fuerte' trees and of 'Fuerte' seedlings, and roots (central and lateral) of 'Fuerte' seedlings.

In old 'Fuerte' trees the findings were:

(a) Dry matter percentage and carbohydrate (particularly starch) level were higher in girdled branches (leaves, bark, wood) than in control trees, whereas in ungirdled branches of girdled trees the levels were lowest;

(b) Percentage of ash and its components (nitrogen, phosphorus, potassium, calcium) was lower in girdled branches than in ungirdled branches of trees.

In 'Fuerte' seedlings the results were similar to those in old trees, but the differences were more marked. In the aerial parts of girdled seedlings, the dry matter percentage and level of starch were higher and the levels of ash and macro elements were lower than in the aerial parts of ungirdled seedlings. In the roots girdling caused the opposite effects: low dry matter percentage and starch levels in girdled seedlings as compared with ungirdled ones.

Interrelationships between girdling and vegetative growth

The occurrence of vigorous vegetative growth and the presence of leaves at blossoming time were found to have a considerable influence on fruit set. Periodic repeated pinching of young growth during the blossoming period resulted in a consistent and significant increase in fruit set. Girdling promoted abscission of mature leaves on the one hand, but retarded new vegetative growth on the other hand. These effects were most pronounced when girdling was carried out in autumn, less so in winter, and nil in spring; both effects acted in the opposite way on productivity.

An interrelationship was observed between vegetative growth and mature leaf abscission; removal of young growth at the time of fruit set delayed abscission of mature leaves. Our experiments with seedlings demonstrated that girdling inhibited almost completely the growth of roots for a long period; only after healing of the girdling wound did moderate growth of roots begin again. As a consequence, the shoot: root ratio changed significantly. Due to infeasibility we could not examine the effect of girdling on roots of mature trees, but it seems to us that the damage may be less than that to seedling roots, since mature trees are usually girdled only partially.

The mode of action of girdling in increasing fertility

Girdling caused many changes in the avocado tree, some of which increased or decreased fertility, and some of which were not associated with fertility. It seems to us that the following effects of girdling harm fruit set and productivity:

- (a) Advance of flowering time to a season with too low temperatures, or too low bee activity;
- (b) Abscission of mature leaves at blossoming time;
- (c) Damage to the roots, which may directly affect productivity by restricting the supply of water, minerals and other substances to the aerial parts of the tree.

Girdling also produced changes increasing fruit set and productivity by:

- (a) A rise in carbohydrate level in the aerial parts which, in our opinion, is responsible for the increased pollen tube growth rate and improves fruit set;
- (b) Inhibition of the young vegetative growth.

Both changes diminish competition for nutrients by increasing the ratio of supply to demand. Under such circumstances the supply of assimilates to the flowers is improved, thus enhancing the chances of fruit set.