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A STUDY OF AVOCADO TREE CARBOHYDRATE CYCLES TO DETERMINE WAYS OF MODIFYING ALTERNATE BEARING

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Abstract

Carbohydrate levels in Hass and Fuerte avocado trees with an established biennial bearing cycle were evaluated, in order to determine the effect of high yield during the previous season on the ability of the tree to flower, set fruit, nurture the fruit to harvest maturity and produce consecutive good yields.

Trees with a 5- to 6-year record of yield oscillations were used in the trial. Root, bark and wood samples were taken at various intervals to establish patterns of reserve carbohydrate (starch) demand as well as the carbohydrate recovery rates after harvesting.

Results indicate that a very low reserve carbohydrate level at a crucial stage of fruit set and development negatively affects the ability of the tree to retain its fruit load.

To overcome alternate bearing it is recommended that fruit numbers be reduced by branch pruning thus diminishing starch depletion and avoiding strain on the tree reserves while scoring branches after harvest will accelerate the carbohydrate recovery rate in these branches.

1. Introduction

The triggering of irregular or biennial bearing in fruit trees can be attributed to many factors. In the avocado the perpetuation of this trend is directly related to the depletion of assimilates by the high fruit load of an on-year, followed by a recuperation year which then usually results in the next overload of fruit for an on year, and so on. Low yield has sometimes been attributed to inhibitory substances produced by the fruit, in particular the seed, which reduces flowering. Some researchers have claimed that gibberellins produced by seeds seem to be effective as inhibitors of flower initiation (Hoad, 1978).

In many tree fruits the off-year is apparent at blossom time with clearly diminished flower production, but with the avocados in this study, limited flowering was never a factor. In fact the trees usually flowered profusely and set fruit, but the fruits abscised at a later stage often when they had already reached a substantial size.

2. Materials and methods

Avocado trees (Hass and Fuerte) more than 20-years-old with a 5-6 year record of fruit yield were used but for the purpose of this study we eliminated trees that were regular poor bearers, those potentially infected with sunblotch viroid and others with apparent deviations from the

norm. The trees selected for this study all had an established biennial bearing pattern recorded over at least a five-year period.

Root, bark and wood samples were taken at various times during the year for starch analysis in order to determine reserve carbohydrate levels and recovery rates.

3. Results and discussion

Early fruit abscission was associated with very low carbohydrate reserve levels in the tree after harvest (Figure 1) and an inability of the tree to replenish its reserves in time for the flower initiation, flowering and/or fruit set stages.

In Figures 2 & 3 the carbohydrate reserve recovery patterns of on- and off-trees are illustrated. The on-trees (Figure 2) show the severe carbohydrate depletion associated with the high demand for assimilates by the heavy fruit load which had just been harvested. The rapid recovery of starch through July and November is evident despite the fact that many of the trees which were now in an off-year carried large numbers of fruit till January when they were eventually abscised. Trees that were known to be in an off-year cycle were sometimes graded as high yielding trees in December only to find that at the end of January most if not all of the fruit had abscised. The off-trees (Figure 3), i.e. trees that had a poor harvest for the season just ended, are now in an on-phase and the higher starch level in May just after harvest is followed by an increase for July and then by November the fruit demand for assimilates is reflected by the downward trend in starch levels.

The abscission of avocado fruit at different times can probably be ascribed to different levels of carbohydrate depletion or hormonal imbalances brought about by the depletion. Early abscission was usually associated with very low carbohydrate reserves at fruit set while some trees with slightly more carbohydrate reserves, retained the fruit much longer before abscission.

Fruit abscission was hot correlated to the carbohydrate reserve levels at the time of abscission, as by then the potential off-year trees had, in most instances, achieved a higher carbohydrate reserve level than the potential on-year trees.

Figures 4 & 5 show the similarity of the starch reserve levels in Fuerte and Hass avocados.

Discussion

The apparent lack of concern over the detrimental effect that biennial bearing has on avocado production is confusing (Davie et al, 1993). Low yields, small fruit, poor quality, fertiliser wastage and complicated management as a result of trees in different growth patterns can in many instances be ascribed to the biennial bearing phenomenon.

To overcome or modify alternate bearing it is necessary to increase the level of carbohydrate reserve in the tree at the flower induction to fruit set stage.

This can be achieved by

1. reducing the fruit load of the tree in the on year in order not to overtax the carbohydrate reserves of the tree,
2. harvest fruit as early as possible to allow more time for the tree to recover,

3. score 50-60% of the branches on a tree that has just been stripped of a high fruit yield in order to retain the carbohydrates in these branches without causing root starvation,
4. keep trees small with a higher ratio of root, trunk and structural branch reserves to canopy size and
5. immediately after harvest irrigate the tree sufficiently to achieve optimum photosynthesis and a build up of reserves before applying nitrogenous fertilisers.

References.

Davie, S.J. and van der Walt, M.C., 1994. Is biennial bearing of avocados inevitable? S.A. Avocado Growers Ybk. 14:80-82.

Hoad, G.V., 1978. The role of seed derived hormones in the control of flowering in apple. Acta Hort. 80:93-103.

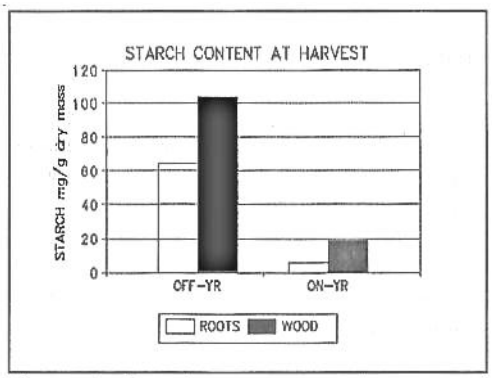

Figure 1 Starch content at harvest of avocado trees after on- and off-years respectively

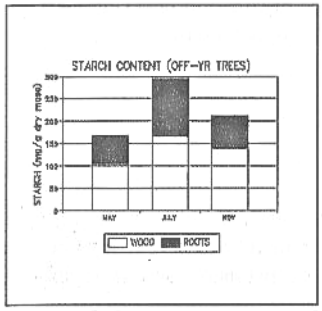

Figure 2 Starch content of avocado trees that in April (at harvest) had given a high yield

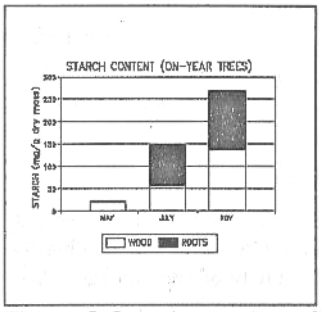

Figure 3 Starch content of avocado trees that in April (at Harvest) had given a poor yield

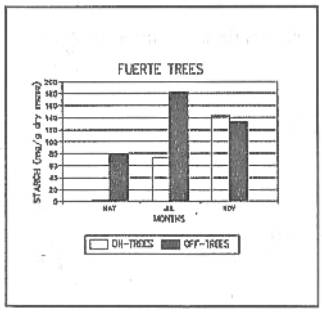

Figure 4 Recovery of carbohydrate reserves in Fuerte avocados after an on- and off-year

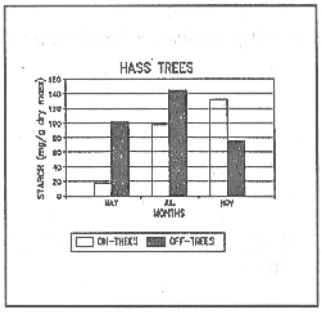

Figure 5 Recovery of carbohydrate reserves of Hass avocados after on- and off-years