

IS BIENNIAL BEARING OF AVOCADOS INEVITABLE?

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ABSTRACT

The apparent lack of concern regarding the low production potential of avocados brought about by alternate or biennial bearing and the inherent detrimental effects on yield, fruit size and quality is discussed. It is suggested that through manipulation of the tree, in order to achieve and maintain a high ratio of tree frame and root mass to canopy size, solutions to these problems can be found.

INTRODUCTION

Biennial or alternate bearing is arguably at present the single most important problem limiting production of quality avocados. Because of the complexity of the problem we seem to have chosen to ignore it rather than find a solution.

Solutions to the same problem have been found for other crops and it is now possible with reasonable accuracy to predict the yield of quality fruit for many deciduous crops.

Unfortunately, in the avocado industry, the reason this problem is mainly ignored, is the fact that individual trees alternate in bearing and not the whole orchard in the same season. You therefore have about 50% of the trees giving an average to high yield and 50% giving a poor yield or no yield at all.

This "average" yield is apparently acceptable to the industry.

THE EFFECTS OF BIENNIAL BEARING

The question can be asked whether the lack of concern with regard to biennial bearing and its serious repercussions does not stem from a lack of understanding regarding the consequences of alternate bearing.

To fully appreciate the problem we need to establish what we are settling for when we choose to live with alternate bearing:

1. You get at best about 50% 60% of the potential yield. One reason avocado yield figures are so low.
2. You settle for a high proportion of small and unsaleable fruit. A major problem for the industry.
3. The quality of the fruit and with this its shelf-life is below optimum. Export potential is limited.
4. When trees have suffered the severe stress of a heavy crop it can result in leaf shedding, branch and root die-back and in severe cases the tree can die. The

recovery process for trees that survive must of necessity affect production, fruit size and quality.

5. You are always dealing with trees in the same orchard that need to be treated differently to obtain optimal results. One group is recovering from severe carbohydrate depletion while the other group has an excess of reserves. Fertiliser applications and even irrigation regimes cannot be correct for both groups at the same time.
6. Low reserves mean the tree cannot adequately utilize the nutrients in the soil and fertiliser is wasted.
7. This acceptance of the fact that half the trees are probably not going to have a good yield results in regular poor bearers being overlooked unless you have a system of recording individual tree performance.

CARBOHYDRATE RESERVES

Our observations to date indicate that in older trees it is usually the size of the tree frame (trunk and main branches) and root system that plays the important role of providing sufficient reserves of carbohydrate to sustain a regular yield.

Young trees have a better root and frame to canopy ratio which probably accounts for their more regular production pattern. One tree, which is part of our study, is a Fuerte on a seedling rootstock with an interstock, until recently cultivated under dry land conditions. It has yielded an average annual fruit load over the past 6 years in excess of 500 kg (25 ton ha⁻¹). The lowest recorded yield was 370 kg in a drought year.

This tree has a canopy spread of 15 meter diameter and a height of about 6 meters. Besides having a deep extensive root system, what makes this tree unique is the size of its trunk.

The trunk diameter is nearly 2 meters and about 2,5 meters in height before it branches while other trees around it average about 0,5 meter diameter and usually branch below the one meter level.

A rough estimate of the reserve carbohydrate in this trunk section alone is that it is at least equivalent to the total carbohydrate (sugars, starch and oil) content of the annual fruit crop.

This large reservoir of carbohydrate along with that contained in the root structure is probably the reason for its regular high yield. We are not advocating that we copy this tree but use it to illustrate our contention that the roots and frame of the tree must provide sufficient reserves if you wish to eliminate alternate bearing.

MANIPULATION

Manipulating trees in order to achieve a regular production of quality fruit is standard practice in most fruit crops but not however with avocados.

Pruning trees is probably the only way to increase the ratio of frame and root mass to canopy size and in time provide the tree with a higher carbohydrate reserve to draw on during fruit development.

An understandable reluctance to prune trees exists yet the most severe form of pruning is exercised, that of tree thinning in overcrowded orchards.

It is apparent that many avocado trees have become so large that the daunting prospect of pruning such trees almost makes biennial bearing preferable. It is nevertheless possible to get these trees back to a more controllable size by step-wise reduction.

Before thinning orchards the tree size control option should be considered while in older orchards where extra large trees are reduced in size, new trees can be introduced into the space created

STUDY INDICATIONS

In the work carried out at Westfalia (van der Walt & Davie, 1993) where individual tree records were available we found the following:

1. A high yield tree (A tree) as opposed to a low yield tree (E tree) severely depletes the carbohydrate reserves in its frame branches and roots. Figures 1 and 2 show how low the starch values were in May for both Fuerte and Hass A trees.
2. This depletion invariably results in an "off" year with low fruit yield.
3. Low carbohydrate reserves did not usually affect the ability of the tree to flower or set fruit.
4. Even in November and December Fuerte trees in their "off" year often have large numbers of developing fruit of which most abscise later.
5. This abscission is not the result at that stage of low carbohydrate levels as the recovery rate after harvest of high yield trees is very rapid. In fact trees harvested during April had made a dramatic recovery of the reserves by the end of July and by November were almost at their peak (Figs. 1&2).
6. A message to the tree that it is in no fit state to carry another heavy crop seems to have been given at a very early stage probably before or during flower initiation.
7. A certain threshold level of carbohydrate is apparently required to stop this message being given.

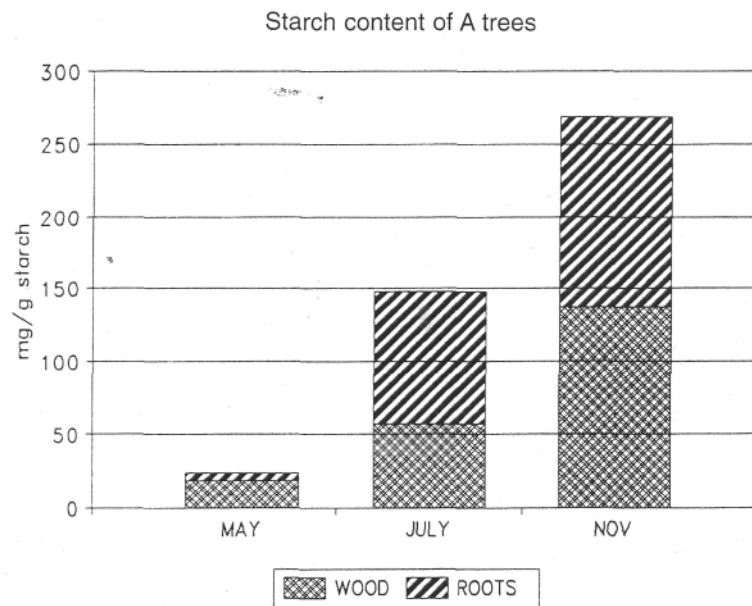


FIGURE 1: Starch content of the A trees

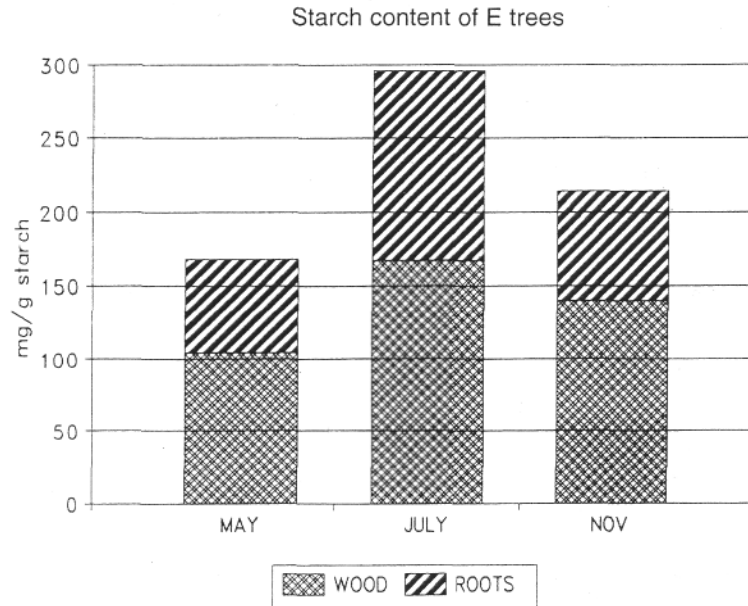


FIGURE 2: Starch content of the E trees

Our studies over the past two years on trees that have a regular on/off bearing pattern have indicated that whatever the initial cause of an "off" year as far as fruit yield is concerned the perpetuation of the cycle is probably controlled by the carbohydrate reserves.

If the starch reserves of the tree are severely depleted the tree will have a poor yield in the coming season as it needs an "off" period to replenish its reserves.

The following season should however, although there is no guarantee, result in a heavy crop load which can unfortunately have a detrimental effect on the fruit size and quality.

AIM

Rather than settling for biennial bearing let us assume that our aim is an orchard with trees regularly bearing an optimal number of quality fruit of the required size.

QUESTIONS

Questions that need to be answered are:

Is there a messenger substance that limits yield and what is it? We are not referring to a substance limiting flowering or fruit set but to a substance that causes the fruit that sets to abscise often at a very late stage. How and when can we negate the effect of the message substance and stop the fruit abscising?

Is there a carbohydrate threshold level which will stop the message being sent and result in regular yields and at what stage do we need to attain this threshold level?

How can we stimulate carbohydrate production and/or retain sufficient carbohydrate during a high yield year?

What must we do to accelerate recovery after harvest?

What are we doing which may adversely affect a trees recovery rate?

We need to continue in our effort to find answers to these questions, but in the mean time however we need to start manipulating some trees (old and young) to establish the response of the trees to the various treatments and determine which treatments have the greatest economic benefits.

TREATMENTS

1. Pre-bloom pruning of trees that are expected to set a heavy crop in order to reduce the number of fruits that set.
2. Reducing the number of fruit by thinning. We need to determine by what means, to what extent and at what stage. We also need to determine whether early harvesting of the larger mature fruits will help during the on year and whether late hanging of some fruit on the tree exacerbates the problem?
3. Girdling certain branches of "off" trees in an attempt to retain the fruit that has set and determine the irreversibility of the abscission message.
4. Stimulate branching of young trees in order to increase the frame mass to canopy ratio.
5. Prune trees to obtain a better frame and root to canopy ratio.
6. Re-examine irrigation regimes in order to promote strong root growth and to accelerate the carbohydrate recovery rate.
7. Examine the timing of fertiliser applications to avoid placing additional stress on trees when they are at their lowest carbohydrate levels.

CONCLUSION

Our work to date was aimed at establishing norms and values related to avocado production especially with biennial bearing trees. These data are essential in order to establish in the short term the response of the tree to manipulation while in the longer term the response will obviously be reflected by yield and quality assessments.

This work will not solve all the problems of the industry but in response to the initial question regarding the inevitability of alternate bearing we are convinced that a reduction of the canopy to root and frame ratio must have a beneficial effect on production, fruit quality and size and go some way to eliminating or at least substantially modifying biennial bearing.

REFERENCE

VAN DER WALT, MARTIE. & DAVIE, S.J. 1993. Carbohydrate and other studies on alternate bearing Fuerte and Hass avocado trees. *South African Avocado Growers' Association Yearbook* 16: 82-85.