

The Influence of Tree and Fruit Manipulation on Avocado Tree Physiology Preliminary Results

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ABSTRACT

Cincturing of Hass avocado trees in various ways and at various times, along with fruit thinning, was examined for its effect on root and xylem starch reserves and on fruit yield and fruit size. The additional aim of these studies was to examine the influence tree and fruit manipulation can have on the Hass avocado's tendency to alternate bearing. Further work on the development of the avocado growth model is also described. This paper lists the experiments being conducted and provides some data where available.

INTRODUCTION

Papers to follow will discuss manipulations being applied to avocado trees of various ages and at various stages of growth and development. All our manipulation and physiology research projects have the same objective, i.e. to achieve manageable avocado trees that will annually produce optimal yields of marketable fruit at maximum profitability.

Physiological studies are conducted in conjunction with the manipulation trials to find explanations for the reactions of the trees to these manipulations and to determine how these reactions can best be utilized for achieving the objectives set out above.

In the main the horticultural research priorities listed by the avocado industry are being addressed in the current research programmes of the ITSC. However, the emphasis is on the Hass small-fruit problem and tree-size control.

This paper is a report of the work in progress, and where data is already available, these are given and tentative deductions made where sufficient information exists.

We use the term 'cincturing' in this paper to imply a single knife cut around the stem or branch penetrating the phloem but without removal of any tissue. 'Girdling', on the other hand, is used as a general term which covers all the various physical methods of restricting sap flow in the phloem.

EXPERIMENT 1

Aim

To assess the effect of repeated girdling on yield of Hass avocados with particular reference to alternate bearing.

Material and methods

Three-year-old Hass trees that had their trunks spiral-girdled the previous season were used in this experiment. In May 1995 ten of these trees were left ungirdled as controls, ten had their trunks cinctured, and ten had half the main frame branches cinctured. The 1995 yield figures were available and in May, July and October of 1995, and in January 1996 root and xylem samples were collected for analysis. Further samples will be collected in April and July 1996.

All the trees in this trial were measured at the start of the trial to determine the effect of the manipulation on the development of the tree. The tree height and canopy radius were established and the main stem circumference was measured 20 cm above ground level.

Results to date

Fruit counted on the trees on 9 January 1996

- *Main stem cinctured*: Mean number of fruit per tree = 95,9 (SD 49,0) (average yield of these trees in 1995 = 24,9 kg)
- *50% of frame branches cinctured*: Mean number of fruit per tree = 85,5 (SD 41,2) (average yield of these trees in 1995 = 27,5 kg)
- *Controls — uncinctured*: Mean number of fruit per tree = 67,4 (SD 25,0) (average yield of these trees in 1995 = 23,1 kg)

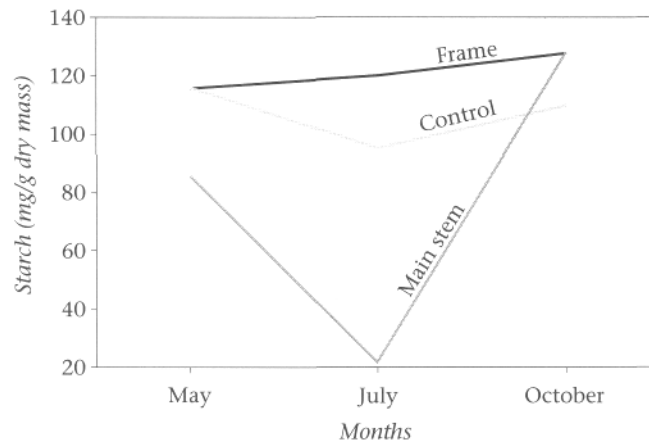


Figure 1
Root starch concentrations of cinctured and control avocado trees

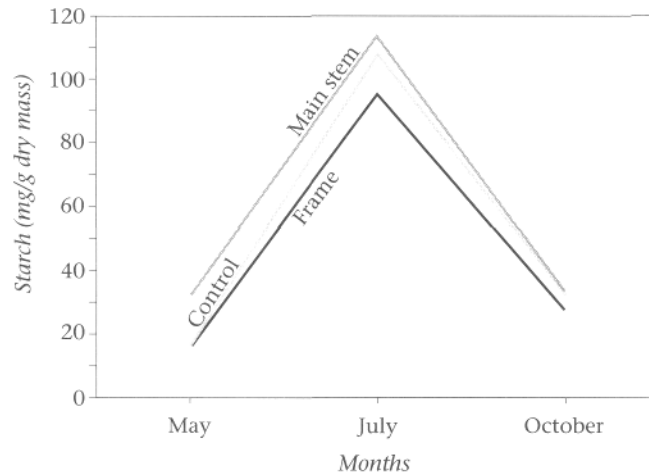


Figure 2

Xylem starch concentrations in cinctured and control avocado trees

Starch analysis

The root and xylem starch content of the trial trees are recorded for May 1995 (two days before the cincturing treatments were applied), for July and for October 1995 (figures 1 and 2). Of interest in figure 1 is the drastic reduction in root starch that follows the cincturing of the main stem of the tree when compared with the root starch levels of the trees where only half of the main frame branches were cinctured.

There were no significant differences between the xylem starch levels of the three treatments (figure 2).

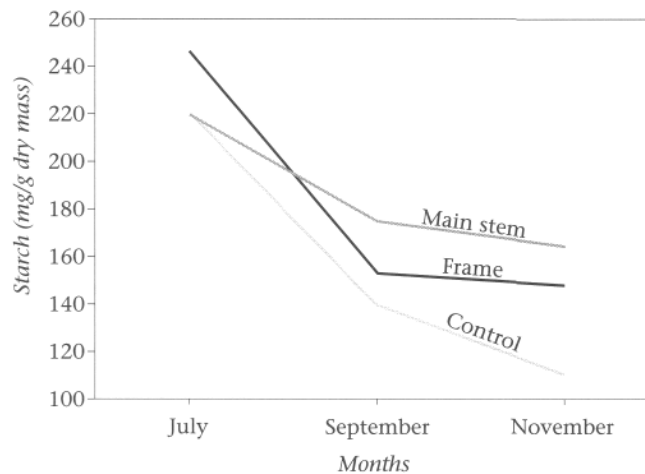


Figure 3

Root starch concentrations in cinctured and control avocado trees

Discussion

From the fruit counts in January 1996 it appears that cincturing increased the fruit load but we need to wait till harvest to ensure that the fruits are retained to maturity. At that time we will also determine the effect cincturing has on fruit size.

EXPERIMENT 2

Aim

To determine the best time for girdling six-year-old Hass avocado trees to improve fruit size and the resultant effect on alternate bearing.

Material and methods

In work previously conducted at the ITSC it was found that girdling or scoring fruit bearing branches in December resulted in a 35 % average increase in fruit mass after only 8 weeks when compared to ungirdled controls (Davie *et al.*, 1995). This experiment has been repeated and fruit mass will be determined at harvest.

Various sets of six-year-old Hass avocado trees that are showing distinct patterns of alternate bearing were cinctured in July (before flowering), October (in full flower) and November 1995 (after fruit set). Root and xylem samples were taken for analysis from these and control trees in July, September, October, November and December 1995. Further samples will be taken from these trees in February, April, July and October 1996.

Results to date

Starch analysis graphs for root and xylem samples do not give any indications at this early stage of the effects of cincturing (figures 3 & 4). Fruit growth curves for the control and treated trees do show a tendency toward larger fruit on the cinctured branches than on the uncinctured branches of the same tree but the results need to be confirmed at harvest.

DISCUSSION

The actual harvest data will be available after May 1996 and the effects of the treatments will then become apparent.

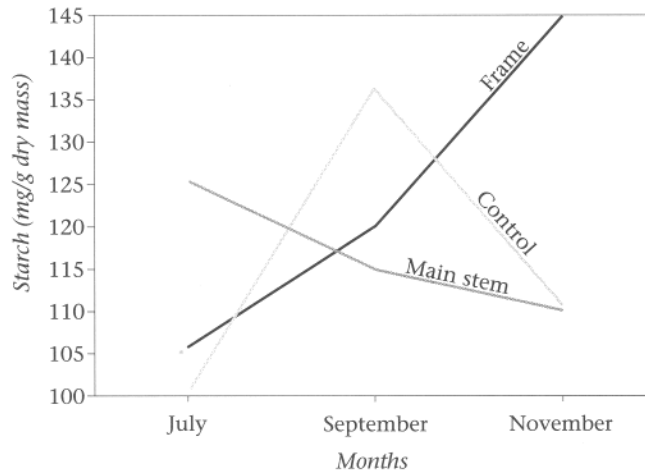


Figure 4
Xylem starch concentrations in cinctured and control avocado trees

EXPERIMENT 3

Aim

To determine the effect of fruit thinning on fruit size and the resultant effect on alternate bearing.

Material and methods

Six-year-old Hass trees with an established alternate bearing pattern were used in this trial. On 21 November 1995 three trees were stripped of all fruit, three had half the fruit removed, three had 30 % removed and three were left with all their fruit. Fruit were counted on the trees and the trees were sampled for starch analyses. Further starch analysis samples were collected in February 1996 and more samples will be taken in May, August, October and in February 1997.

Measurements were made of the tree height, canopy radius and main stem circumference of the trial trees in order to determine the effect of fruit thinning on tree development.

Results to date

Fruit yield figures and fruit size measurements will be made after May when the fruit is harvested.

EXPERIMENT 4

Aim

To continue with the development of a growth model for the avocado tree in order to

obtain more information on:

- the effect of fruit load on energy utilization;
- the effect of pruning on energy utilization;
- the nitrogen metabolism/allocation reaction in the avocado tree;
- assimilate allocation between roots, shoots and fruit over two seasons for three-year old and six-year-old trees; and
- The effect of cultivar and harvesting date on energy utilization and accumulation.

Materials and methods

Six-year-old Hass avocado trees are being excavated and analysed for wet mass, dry mass, starch content and minerals. Trees have been removed in June 1995, October 1995 and February 1996. More trees will be removed for analysis in June and September 1996.

Forty trees of each cultivar (Hass, Fuerte, Ryan and Pinkerton) have been planted in 100 t containers in the nursery at Burgers Hall Experimental Station. These trees will be used for various carbohydrate and mineral studies and were regularly measured (height, canopy radius and stem circumference).

Results to date

The data on the excavated trees are being accumulated and collated and the analytical study of the trees in the pots will start after October 1996.

CONCLUSIONS

Substantial data will become available over the next few months once harvesting commences. A number of these trials will continue in order to determine long-term effects of the manipulations applied.

REFERENCE

DAVIE, S.J., VAN DER WALT, M.C. & STASSEN, P.J.C. 1995. Girdling avocado trees for improved production. *South African Avocado Growers' Association Yearbook* 18: 51 - 53.