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GIRDLING FOR INCREASED "HASS" FRUIT SIZE AND ITS EFFECT ON CARBOHYDRATE PRODUCTION AND STORAGE

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Abstract

In Hass avocado trees, the girdling and scoring of about 50% of the fruit bearing branches per tree, at the end of November 1994, resulted in an initial accumulation of carbohydrate in the leaves and branches of the girdled limbs. The girdling of only 50% of the branches and also the width of the girdle are crucial to the process since healing of the girdle wound, and continued nutrient supply to the root system, is essential for maintaining tree health and vigor.

During fruit development, the reserve carbohydrate levels are rapidly diminished in both the girdled and ungirdled fruit-bearing branches. Although no apparent restriction in upward sap-flow could be detected, girdling nevertheless resulted in diminished nitrogen, phosphate and calcium levels, in the leaves of the girdled branches when compared with ungirdled branches. This is probably due mainly to the accumulation of carbohydrate in the leaves, which also caused a 50% reduction in chlorophyll content. Water uptake by the tree has been shown by Kurzmann (1966) to be little affected by girdling.

Nitrogen uptake is apparently restricted by girdling but this is attributed to the lower carbohydrate levels in the roots and the consequent impairment of metabolism. The scoring wound should be completely healed four-to-five weeks after treatment.

Photosynthesis rates were initially reduced when starch accumulated in the leaves on the girdled branches, as indicated by the yellowing of the leaves. However, as the carbohydrate levels in the girdled branches were reduced by the increasing demand of the developing fruits, photosynthesis rates recovered.

Preliminary results showed that girdling when the fruit demand for carbohydrate was at its peak, gave an average increase in individual fruit mass of 36%, after eight weeks, when compared with fruit on the ungirdled branches of the same trees.

1. Introduction

Girdling is an age-old tree manipulation practice often used to stimulate trees into more productive habits. It has been utilized over centuries for a variety of purposes yet despite research reports of benefits derived by girdling trees, it has not generally been adopted as a standard practice in the tropical and subtropical fruit industries.

Girdling seems to come into fashion from time to time, and after a short while, fades from the picture again. More often than not, girdling is tried as an instant cure for some or other problem, and whether it is successful or not the process is shelved till the next crisis.

The main function of girdling is to stop or reduce the flow of sap via the phloem to the lower parts of the tree and to the roots. In this way carbohydrates are accumulated above the

girdle. Girdling is usually carried out by cutting through the phloem and removing a strip of tissue. When no strip of tissue is removed, the process is referred to as scoring.

Girdling has been applied with varying degrees of success to many different crops for a variety of purposes but primarily to increase fruit yield. Successive annual girdling can be applied to maintain these improved yields for a few years (Lahav *et al.* 1971; Ticho, 1970; Trochoulias & O'Neill, 1976), but three years, however, seems to be the maximum number of repetitions with positive benefits.

2. Materials and methods

Alternate branches of six year-old Hass trees, at Nelspruit, that were regularly irrigated and had set a good fruit crop, were scored and girdled on 8th December 1994 and the remaining branches on the same trees, bearing similar quantities of fruit, were labeled as controls.

Starch content was determined in the treatment and control branches while photosynthesis rates were measured at various stages of the trial.

About 50% of the branches were girdled thus avoiding root starvation.

3. Results

The girdling and scoring, of a number of branches on the trial trees, yielded the following results.

3.1. Observations

3.1.1. Leaves on girdled branches, without fruit, showed signs of yellowing after two weeks as a result of starch accumulation while the leaves on branches with fruit took slightly longer for the yellowing symptoms to develop.

3.1.2. The scored branches showed signs of complete wound healing within five weeks but the girdled branches had failed to heal properly after twelve weeks. The time required for the healing process and the re-establishment of sap flow depends on the width and severity of the girdle as well as the condition and phenological stage of the tree.

3.2. Physiology

3.2.1. The leaves on scored and girdled branches without fruit showed a decrease in photosynthesis rate within a few days after treatment and had stopped photosynthesizing for much of the day by the 14th day after treatment. Branches with fruit took longer to show a reduction in photosynthesis.

3.2.2. Carbohydrates and especially starch, accumulated rapidly above the girdle (figure 1).

3.3. Effect on the fruit

The most encouraging results related to the fruit size increase on the girdled and scored branches when compared with the untreated control branches.

All the fruit from girdled, scored and control branches were harvested eight weeks after treatment.

The fruit on the scored and girdled branches showed on average a mass increase of more than 35% over the fruit on the non- treated control branches. The average mass of individual

fruit on the girdled and scored branches was 139,8 and 138,7 gram respectively while the fruit on the non-treated control branches averaged 103,1 gram each (figure 2).

If the 36 g advantage obtained in this eight-week period could be maintained to harvest then the result would substantially improve the fruit count. Figure 3 shows the fruit count shift which occurs with only a 25-30% mass increase of individual fruits.

4. Discussion

It is too early to make firm recommendations but the results of this preliminary experiment indicate that girdling or scoring at the correct time can increase the fruit size in Hass.

Our preliminary recommendation would be to score (not girdle) alternate branches of a Hass avocado tree that has set a good crop, at the end of November. This would mean that about half the branches would still be supplying nutrients to the roots to prevent root starvation and sufficient root development should still occur.

Our continued research will be looking at the optimum time for girdling treatments and the long-term effects of such treatments on tree performance and fruit quality.

References

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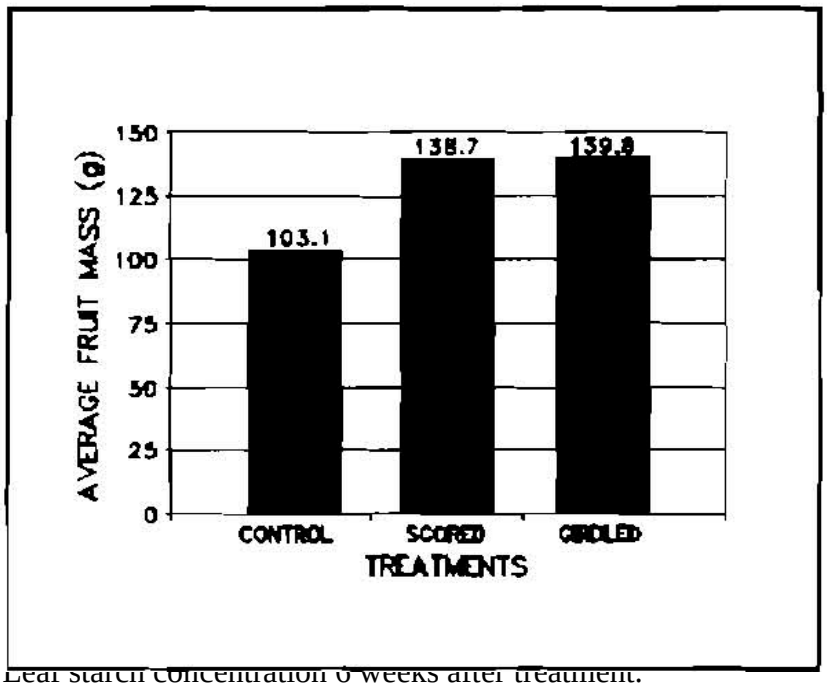

Figure 1. Leaf starch concentration 6 weeks after treatment.

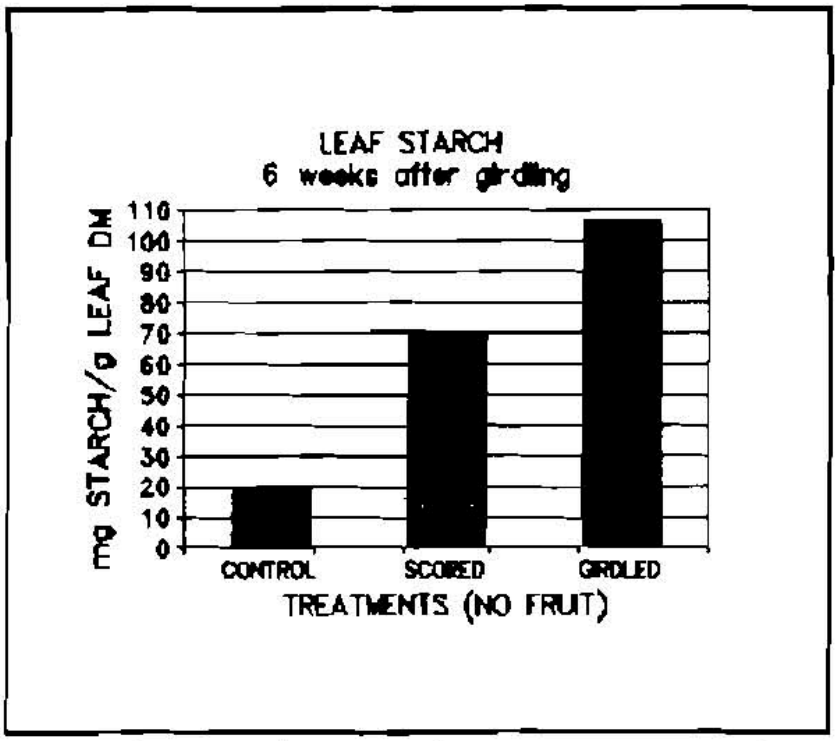

Figure 2. Avocado fruit mass 8 weeks after treatment.

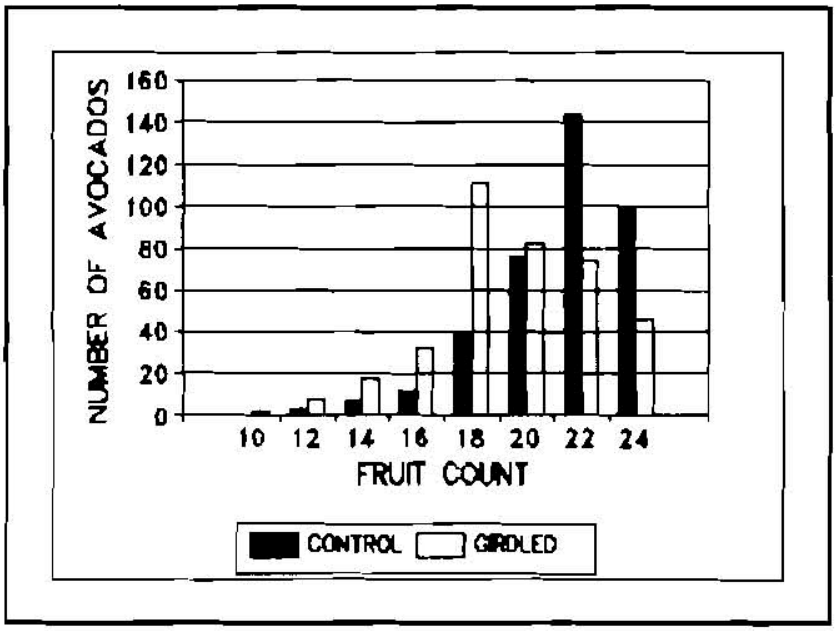

Figure 3. Fruit count shift with a 25-30% fruit mass increase.