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Updating Pinkerton export parameters and evaluation of new and upgraded avocado postharvest applications

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ABSTRACT

During the last two seasons, an in-depth study was conducted aimed at improving the storage potential of the Pinkerton cultivar. After the 1999 season a set of recommendations was formulated and these were implemented during the 2000 season. The most important of these dealt with harvest maturity, storage temperature, storage atmosphere and the calcium content of the fruit. Of these, maturity proved to be the most important. The most significant research finding made during the last season concerns the nitrogen content of the fruit. It would appear that the nitrogen content of fruit that stores well remains below 1% during the last four months before harvest, while that of fruit that stores poorly, varies between 1% and 1.4%. As a result of this observation, a project was launched to determine the nitrogen content of fruit to be exported during the coming season. A study aimed at regulating the nitrogen content of avocado fruit in both high and low risk areas was also initiated. With regard to calcium content, the recommendation of > 1000 ppm in fruit within the 50-100 g range still applies. However, the Ca:N ratio of the fruit seems to be more important than the Ca content on its own. It is recommended that the Ca(ppm):N(%) ratio be above 500 during March. From then on, the ratio should not drop by more than 100 points per month.

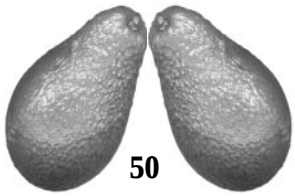
The recommendations regarding fruit maturity were also updated. It is recommended that during an off-season such as the coming one, the mean minimum moisture content of high risk fruit should be increased from 75% to 77% while the maximum moisture content be increased from 79% to 80%. In the case of low risk orchards it will be advisable to increase the lower limit from 72% to 75 %. With regard to storage temperature, it is recommended that the 7°C setting be retained. It is also recommended that all Pinkerton be exported under controlled atmosphere. A range of new and updated postharvest applications were also evaluated. In the first of these, a modified atmosphere bag developed in Israel was evaluated with 'Pinkerton', 'Fuerte' and 'Hass'. In the second, the efficacy of an ethylene inhibitor, 1-methylcyclopropene (1 MCP), was determined using all commercial export cultivars. Both products gave good results that justify semi-commercial evaluation. The use of 1-MCP in combination with controlled atmosphere storage at non black cold-inducing temperatures also warrants further research.

INTRODUCTION

Due to the considerable post-harvest problems encountered with the Pinkerton cultivar, SAAGA commissioned a number of in-depth studies into the problem during the 1999 season. A set of recommendations emanated from these studies (Bower, *et al*., 2000, Penter & Stassen, 2000 and Kruger *et al*. 2000).

Over-maturity proved to be the single most important factor causing grey-pulp in Pinkerton and conformation to strict maturity guidelines was one of the actions contributing towards better quality fruit during the 2000 season. In addition to maturity specifications and soil potential associated risk analysis, certain recommendations pertaining to fruit calcium content, electronic firmness sorting, the use of heat shock treatments, storage temperature, and storage atmosphere were made. Kruger *et al*. (2000) made the following recommendations for the 2000 season:

1. Producers in high risk areas with good soils and high rainfall were urged to start harvesting earlier. In practice this meant that in an ex-banana producing area such as Burgershall, harvesting should commence during April and producers should not allow the fruit to hang until June, as is presently the case. In cooler, lower risk areas, it was recommended that producers take account of the tree load, maturation rate and prevailing climatic conditions to prevent grey-pulp occurring towards the end of the season.
2. It was recommended that the maximum allowable moisture content (signaling the start of the harvest season) be increased from 75% to 79%. A minimum moisture content (signaling the end of the harvest window) was set at 75% for high risk areas and 72% for low risk areas.
3. It was further suggested that packinghouses in high risk areas conduct orchard-specific maturity evaluations using large sample sizes while testing the fruit individually.
4. At the time, it was recommended that a small fruit set be removed if it was followed by an abundant late fruit set.
5. It was further suggested that the effect of climate be taken into account when interpreting the manifestation of storage-associated physiological disorders in exported fruit.
6. As a guideline, a calcium content of above 1000 ppm was proposed for the fruit when they fall within the 50-100 g mass range.
7. Based on the results attained by Penter and Stassen (2000), it was recommended that the industry consider the installation



of calcium dip tanks in packinghouses.

8. It was recommended that the fruit be exported at a storage temperature of 7°C.
9. It was advised that all Pinkerton be exported under controlled atmosphere.
10. The results attained with electronic firmness sorting experiments and heat treatments were shortly referred to.

During the 2000 season, an effort was made to update the above recommendations. Pre-harvest investigations entailed the refinement of the maturity and nutritional facets, while post-harvest evaluations included the evaluation of upgraded and newly developed post-harvest technologies.

MATURITY

During the 2000 season, the maturity survey was continued and the number of sample points increased. In contrast with the 1999 'off season', the 2000 season was an 'on season' and the fruit loads were considerably higher. Bigger fruit loads are usually associated with slower maturation and better quality fruit. However, considerable variation in fruit maturation rate and storage potential occurred between different growers in high risk areas and between differently aged orchards on the same farm. Fruit from young orchards and orchards where fruit thinning was practiced matured faster and contracted grey-pulp earlier in the season. The intensity of grey-pulp was also more severe in these orchards.

Although the inter-relationship between grey-pulp and maturity is confounded by other factors such as fruit age (from set to harvest) and the nutritional status of the tree, the observations made during the last season support the continued use of strict maturity specifications to prevent grey-pulp. It is firstly suggested that the upper limit be increased from 79% to 80% in both high as well as low risk areas. It is further recommended that the maximum limit (mean minimum moisture content) be increased from 75% to 77% in high risk areas and from 73% to 75% in low risk areas.

In contrast with 2000 which was an 'on season', the 2001 season is an 'off-season' associated with accelerated maturation and a higher risk of producing fruit with poor storage potential. It will therefore be worth the effort to adhere to the stricter maturity recommendations.

FRUIT MINERAL CONTENT

During the 2000 season important information was generated pertaining to the nitrogen content of the fruit. Results from an extensive survey indicated the nitrogen content of fruit with good storage potential remained under 1% from March until harvest. In contrast, the nitrogen content of fruit with poor storage potential fluctuated between 1% and 1.45% during this period.

Although we found nitrogen content to be the most important indicator of fruit quality by far, it is suggested that the present early season fruit calcium content recommendation (higher than 1000 ppm in fruit within the 50-100 g range) be retained as an additional guide. When considering the calcium:nitrogen ratio of the fruit, the results suggested a decrease in this ratio as the fruit matured. During March, the Ca (expressed as ppm):N (expressed as a percentage) ratio of good storing fruit was found to be more than 500 while that of poor storing fruit was below this figure. The required ratio of these two minerals hereafter decreased by approximately 100 units per month. For instance, during April it was 400 while in May it was found to be above 300.

ROLE OF REPEATED FRUIT SETS – PRELIMINARY RESULTS

Only introductory work has been done on the effect that repeated fruit setting has on storage potential. A project aiming to determine the maturation rate and storage potential of different fruit sets has since been launched and the results will be available at the onset of the 2002 season.

From the preliminary results we suggest that producers should not attempt to remove specific sets from a tree and that fruit loads be kept as high as possible. We would, however, like to reiterate the importance of harvesting within the correct maturity range as specified above.

STORAGE CONDITIONS

It was recommended that Pinkerton be exported at 7°C during the 2000 season. It was further reported that, although CA does not prevent grey-pulp, the ripening retarding action of this technique definitely warrants its continued use.

During the 2000 season a number of novel and upgraded post-harvest technologies were evaluated. These trials were conducted with Pinkerton as well as the other 4 export cultivars.

The first set of trials aimed to evaluate the efficacy of an Israeli modified atmosphere (MA) storage bag (Xtend®: Stepack, Israel). The effect of MA was found to be comparable with CA, in that ripening was effectively inhibited during storage.

The second set of trials aimed to evaluate the efficacy of the ethylene inhibitor, 1 methyl cyclopropene (1-MCP, Rohm and Haas, USA). This chemical binds to the cellular receptor sites of ethylene, thereby blocking the action of the latter hormone. Similarly to CA and MA, this technique was found to retard ripening effectively. It may have other beneficial effects on fruit physiology, such as reducing black cold injury, but these results need to be confirmed during subsequent trials.

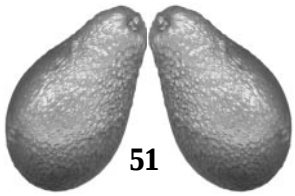
It should be noted that although all of the above methods effectively lengthen the storage period, there is a limit to this in that extended storage almost inevitably leads to an increase in fungal infections towards the end of the storage period.

RECOMMENDATIONS FOR 2001 SEASON

Based on the results attained during the 2001 season, the following recommendations are made for the 2002 season:

Maturity

High risk areas: 80-77%.
Low risk areas: 80-75%.



Calcium content

Preferably higher than 1000 ppm in fruit within the 50 to 100 g size bracket.

Nitrogen content:

Not higher than 1% in fruit pulp as from March 2001 to harvest.

Calcium/nitrogen ratio

Preferably higher than 500 (ppm/%) in March, 400 in April and 300 in May.

Storage temperature

7°C

Storage atmosphere

CA or MA, while the use of 1-MCP may be seriously considered upon registration

FURTHER RESEARCH

A number of research approaches will be taken during the coming season.

An attempt will firstly be made to lower the nitrogen content of fruit in high potential/high risk areas. This will be attempted by lowering the nitrogen content of the soil, making use of a number of nitrogen removal techniques.

As low fruit yield confounds the issue, an attempt will also be made to control the magnitude of alternate bearing by increasing and carefully controlling the nitrogen content of fruit during the 'on cycle' in low risk areas. If successful, this work may have other beneficial spin-offs.

During the last season, the CA, MA and 1-MCP studies were done as separate trials. During the coming season, fruit to be stored under CA/MA will be treated with 1-MCP before storage at a range of black cold reducing storage temperatures.

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