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Development of fruit maturity and mineral content norms for export avocado cultivars from different South African avocado growing regions

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ABSTRACT

The aim of this study is to establish appropriate harvest maturity and fruit mineral content norms for Fuerte, Hass, Edranol, Pinkerton and Ryan grown in the Limpopo, Mpumalanga and KwaZulu-Natal production regions. During the 2001/02 season, fruit were sampled on a regular basis from farms in the Barberton, Eshowe, Hazyview, Levubu, Melmoth, Nelspruit, Richmond and Tzaneen districts. Measurements taken included fruit growth, moisture content and mineral composition. The intention is to use this information to formulate a quality assurance plan for all cultivars similar to that developed for Pinkerton during the last number of seasons. Thus far, provisional reference points for fruit moisture and nitrogen content have been formulated for Fuerte and Hass in the Nelspruit, Kiepersol and Tzaneen growing areas. However, intensive storage trials are required before refined recommendations can be made for high and low risk orchards during both 'on' and 'off' years. The study is continuing.

INTRODUCTION

Since 1998, the ARC-ITSC has been involved in resolving the so-called "Pinkerton problem" which included both physiological (mainly grey pulp and black cold injury) as well as pathological (mainly anthracnose and stem-end rot) components (Kruger *et al.*, 2000, Kruger *et al.*, 2001, Snijder *et al.*, 2002).

The Pinkerton growing areas were subdivided into high risk and low risk areas and the storage potential of the fruit was determined during the lower risk "on seasons" as well as the higher risk "off seasons". Specific recommendations were made regarding harvest maturity, fruit nitrogen content, fruit calcium content, the role of tree age, the role of flowering period, the influence of fruit load, the effect of storage temperature, the effect of controlled atmosphere storage and the potential use of 1-MCP.

Commercial feedback received during the past two seasons indicate the recommendations to have had a positive influence, as considerably better Pinkerton arrivals were generally recorded (Nelson *et al.*, 2002).

During the last number of seasons, it became obvious that, although less dramatic, quality problems similar to those encountered with Pinkerton, occur in the other export cultivars (Nelson *et al.*, 2002). For this reason, the research project was expanded during the 2001/02 season so as to include the other cultivars. The research area was also

extended to include all the major production regions.

MATERIAL AND METHODS

Before the season started, a sampling timetable was prepared for the Levubu, Tzaneen, Kiepersol, Nelspruit, Northern KwaZulu-Natal and Southern KwaZulu-Natal production regions. Fuerte, Hass, Edranol, Pinkerton and Ryan fruit were sampled 6 times from November 2001 until the end of the 2002 season. In total, 170 orchards located on 26 farms were sampled.

The moisture content of samples, consisting of 10 –15 fruit each, was first determined after which the N, K, Ca, Mg, Zn and B content of the pulp was measured. A total of 22 000 fruit was evaluated in this way.

In addition to the above, 8 000 fruit from the Levubu, Tzaneen, Kiepersol and Nelspruit areas were harvested at 3 moisture content stages and stored under export simulation conditions. After storage the fruit were left to ripen at room temperature and evaluated for external and internal disorders.

The data was stored in a database and it is presently being processed. The results hereunder are therefore preliminary and will be updated as the database is further processed.

RESULTS AND DISCUSSION

Our standing maturity recommendation for Pinkerton is that the fruit must be harvested between 80% and 73% moisture levels in low risk areas during an "on season". During an "off season", the lower limit for low risk areas moves up to 75%. The same percentage applies to high risk fruit during an "on season" while the cut off point for high risk fruit exported during an "off season" moves up to 77 %. As far as fruit nitrogen content is concerned, our original recommendation for Pinkerton was that the N content of the fruit must be under 1% by March. This date was subsequently advanced to January (Snijder *et al.,* 2002).

The above recommendations were formulated based on work conducted mainly in the Kiepersol, Nelspruit and Barberton areas. Our original classification of high risk orchards in the Kiepersol area were those planted in old banana lands with a high organic nitrogen content. Low risk orchards were considered to be those planted in the sandy soils in the Nelspruit and Barberton areas. As far as the Tzaneen area is concerned, the present study showed high risk orchards to be those that received copious amounts of organic fertilizer, especially with a chicken litter base. This practice was not only found to increase the nitrogen content of fruit, but the fruit were found to have a steeper growth curve and were generally bigger.

Our preliminary observations in the Kiepersol, Nelspruit, Barberton and Tzaneen areas indicate the appropriate maturity span for Fuerte to be fairly similar to that developed for Pinkerton. We therefore make the provisional recommendation that, in these areas, the parameters developed for Pinkerton be applied to Fuerte. As an interim measure, it is recommended that in the case of Hass, both the upper and lower cut off points developed for Pinkerton, be lowered by 2%. Therefore 80% - 77 % becomes 78% - 75%, 80% - 75% becomes 78% - 73% and 80% - 73% becomes 78% - 71%.

In addition to the above cut off points, we further recommend that a maturation rate norm be introduced for Fuerte, Hass and Pinkerton. During the present study, we found faster maturing orchards to have significantly poorer storage potential than fruit from slower maturing orchards. Our preliminary recommendation is that the fruit should not lose more than 1% moisture every 10 days.

As far as fruit nitrogen content is concerned, we firstly recommend that the "at / below 1% by January" parameter developed for Pinkerton be retained for Fuerte and Hass produced in the Nelspruit, Barberton, Kiepersol and Tzaneen areas. It is further important that the rate of decrease be uniform with no intermittent rises in fruit nitro-

gen content occurring. The present study however, indicated that an additional parameter is required for the beginning of the season. Based on the results, it is recommended that the fruit nitrogen content of Fuerte, Hass and Pinkerton produced in the Tzaneen, Kiepersol, and Nelspruit areas not exceed 1.7% during November.

Some interesting observations were made in the Levubu and KwaZulu-Natal production areas. Grey pulp was found to be less of a problem in the Levubu area when compared to Tzaneen, Kiepersol and Nelspruit. Although Fuerte and Hass fruit were found to grow at the same rate at the beginning of the season, the fruit growth rate was found to slow down earlier in Levubu, resulting in smaller fruit. The fruit nitrogen dilution rate was therefore also slower. It would seem that, in so far as grey pulp is concerned, the maturity and nitrogen parameters may be slightly relaxed for Hass in this area. However, further research is required to establish whether this also true in so far as black cold injury is concerned.

KwaZulu-Natal fruit had the characteristically slow maturation rate found to be beneficial to fruit quality. On the other hand, when compared to maturation rate, the fruit nitrogen reduction rate was found to be slower than in the other areas. No fruit from KwaZulu-Natal has been stored under export simulation conditions as yet and comprehensive storage trials will be conducted during the coming season.

Although we have previously placed considerable emphasis on fruit calcium levels, our more recent research results suggests nitrogen to be the most important quality determining element that requires intensive management. Our present recommendation with regard to calcium is that producers should ensure that soil conditions, including pH, is conducive for the uptake of calcium. With regard to the other minerals (potassium, magnesium, zinc and boron), our preliminary recommendation is that producers should ensure that their orchards are within the present leaf and soil norms for these elements.

In addition to maturity and nitrogen content, important recommendations were made for Pinkerton growers regarding fruit set period and tree age. As the fruit set periods of the other cultivars are not as extended as that of Pinkerton, this aspect was not addressed in the present study. In terms of tree age, our recommendation is that Pinkerton exports should only commence after the trees have reached the age of 5 years. In the case of Hass, it would appear that fruit from younger orchards are exportable, provided they fall within the correct maturity and nitrogen perimeters.

Last year, some pertinent suggestions were made regarding the development of a strategy aimed at reducing the incidence of black cold injury (Kruger *et al.*, 2002). These included both pre-harvest and postharvest aspects. During the last season, certain of the observations, e.g. the negative effect of shading (by windbreaks) and the neutral effect of relative humidity (in cold rooms), were confirmed by industry members. An epidemiological survey was further conducted using export simulation data obtained from Westfalia Estates.

Through the years, a set of maturity related storage temperature regimes were developed by SAAGA. When the use of CA became regular practice, exporters increased the storage temperature by approximately half a degree in an attempt to reduce the incidence of black cold injury. Our results and those generated during commercial simulations, indicate that storage at these temperature regimes, should result in minimal black cold injury during "on years". However, during "off years", this is not the case. This is mainly due to pre-harvest factors. The most important interim recommendation we can presently make, is that the above fruit nitrogen content norms be closely adhered to during an off year.

In so far as pathology is concerned. Although the above maturity and nitrogen rec-

ommendations were developed to reduce physiological disorders, they also have an impact on fruit pathology. As a result of the drastic reduction in physiological disorders, pathological disorders have become much more conspicuous in the Pinkerton cultivar during the last season. Two aspects require urgent attention. The first relates to storage temperature. Although the use of CA/1-MCP may permit this, it is not recommended that the storage temperature be increased more than 1.5°C above the RA based SAAGA storage regime. The risk of fungal infection developing during prolonged storage at higher storage temperatures is simply too big.

A second aspect that requires urgent attention, involves the export of hail damaged fruit. In certain cases, hail damage is not visible on the skin of fruit at the time of harvest. However, the fruit have sustained damage to the pulp and fungal infections start to develop in these areas upon ripening. In the past, reports on this problem were sketchy due to the problem only manifesting by the time the fruit is consumed. However, the increase in forced ripening programs brought this problem to the fore, not only with Pinkerton, but also with the other cultivars . It is therefore recommended that no fruit from hail damaged orchards be exported, even if no external lesions are visible.

This study is to continue during the coming season. Less frequent mineral content analyses will be conducted but the storage trial component will be considerably expanded. Proper attention will also to be given to the Edranol and Ryan cultivars.

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