ABSTRACT

The susceptibility of the 'Pinkerton' avocado cultivar to mesocarp discolouration, after storage, has seriously threatened its export from South Africa. This disorder has proven to be complex, requiring a better understanding of the fruit's physiology. The purpose of this study was to identify the role of pre- and postharvest factors, or their interactions, in the development of the problem. This was done using fruit from several production areas of varying mesocarp discolouration histories (referred to as "high", "medium" or "low risk" areas) during the 2000 and 2001 seasons. Fruit were stored at 8, 5.5 and 2^{o}C for 30 days, as well as at ambient (20^{o}C) temperature. Evaluations of fruit quality were made before and after storage, as well as after softening. Once removed from storage the weight loss (during storage) was determined, and fruit firmness and carbon dioxide (CO_2) production rates monitored daily. It was found that temperatures below the recommended shipping temperature of 5.5^{o}C, i.e. 2^{o}C, produced the best internal fruit quality. This was supported by the membrane integrity studies that showed less membrane stability at the warmer storage temperature of 8^{o}C. Furthermore, the fruit remained hard during storage and subsequently had an extended shelf life.

Fruit origin was also found to play a major role in browning potential, with discolouration being consistently more severe in fruit from "high risk" areas and increasing in severity as the season progressed. The rate of CO_2 production was found to follow a similar trend, with rates increasing as the season progressed, and also being slightly higher in fruit from "high risk" areas. The higher CO_2 production rates were thought to be related to a decrease in membrane integrity as the season progressed. While storage temperature was not found to have a significant effect on the rate of CO_2 production after storage, it did affect the time taken to reach the maximum rate, with fruit stored at 2^{o}C taking longer.

Biochemical analyses to determine the concentration of total phenolics and the activity of the enzyme polyphenol oxidase (PPO) also showed that the potential for browning was initiated by preharvest conditions. While no significant differences were found between growers with regards to total phenol concentrations, the PPO activity was found to be higher in fruit from poor quality areas, and subsequently browning potential was expected to be higher in these fruit. It was, however, found that the potential for browning could be reduced by storing fruit

at 2°C, as this decreased the total phenolics concentration. This evidence further emphasized the idea that storage at 2°C could be highly advantageous.

Fruit mineral analysis showed that certain key elements played a significant role in the severity of mesocarp discolouration, with excessive fruit nitrogen and decreasing copper and manganese concentrations appearing to play major roles. The high fruit nitrogen concentrations were suspected to reflect fruit grown on very vigorous trees, resulting in shoots competing with fruit for available reserves. It is suggested that 'Pinkerton' of a quality acceptable to the market, can be produced by manipulating source:sink relationships, particularly through decreasing the availability of nitrogen, followed by low temperature (2-4°C) shipping. Future work should concentrate on manipulation of source:sink relationships, to take account of both climatic conditions and leaf to fruit ratios.

The evaluation of chlorophyll fluorescence as a tool for predicting mesocarp discolouration potential in 'Pinkerton' proved to be unsuccessful in this study and future studies may require modifications to the current technique. It is suspected that differences in chlorophyll content, for example, between fruit from different origins, will have to be taken into account when interpreting results.

The success of using 2°C storage to improve the internal quality on 'Pinkerton' fruit prompted further studies, during 2004, to ensure that the development of external chilling injury would not decrease the marketability of the cultivar. Low temperature conditioning treatments, prior to storage, proved to be highly successful in reducing the development of external chilling injury, thus further improving fruit quality as a whole. Preconditioning treatments consisted of fruit that were kept at either 10°C, 15°C or 20°C for 1 or 2 days before being placed into storage for 30 days at 2°C or 5.5°C. All preconditioning treatments were compared to fruit that were placed directly into storage. The effect of fruit packaging on moisture loss (as determined by weight loss) and chilling injury was also investigated using unwaxed fruit, commercially waxed and unwaxed fruit individually sealed in micro-perforated polypropylene bags with an anti-mist coating on the inside (polybags). Holding 'Pinkerton' fruit, regardless of packaging treatment, at 10°C for 2 days prior to storage at 2°C or 5.5°C significantly decreased the severity of external chilling injury. The use of polybags during preconditioning and storage showed potential in further reducing the development of external chilling injury, although the higher incidence of fungal infections in these fruit needs to be addressed. The

determination of proline concentrations in fruit exocarp tissue after storage was helpful in determining the level of stress experienced by fruit that were subjected to different packaging and preconditioning treatments. In this study waxed fruit (Canuaba Tropical) subjected to 1 d preconditioning at 10^{o}C, 15^{o}C or 20^{o}C or placed directly into storage at 2^{o}C showed very high proline concentrations and also displayed more severe external chilling injury, despite unwaxed fruit losing more weight during these treatments. The role of moisture loss thus needs further investigation. The thickness and method of wax application was thought to play an important role in the higher external chilling injury ratings in this study as waxed fruit often developed chilling injury symptoms around the lenticels and it was suspected that either the lenticels were damaged by the brushes used to apply the wax or that the lenticels became clogged thus resulting in reduced gaseous exchange. Nevertheless, the success of low temperature conditioning in reducing external chilling injury, while maintaining sound internal quality, may enable storage temperatures to be dropped even further, thus enabling South Africa to export avocados to countries that require a cold disinfestation period prior to entry to eliminate quarantine pests (e.g. fruit fly).