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STORAGE TEMPERATURE STUDIES

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OPSOMMING

Om 'n opbergingstemperatuur te bepaal vir die Fuerte kultivar wat van toepassing gemaak kan word gedurende die seisoen, is twee faktore wat moontlik verband met mekaar kan hou, ni boordtemperatuur vóór pluk en vrugvolwassenheid (% olie inhoud), vergelyk met koueskade wat gedurende dieselfde periode gedurende die seisoen voorgekom het.

SUMMARY

This is an attempt to determine more effective storage temperatures throughout the Fuerte avocado, season where two possibly related factors were considered, viz prevailing preharvest orchard temperatures and fruit maturity (% oil content) compared to cold damage experienced over respective periods of the same season.

INTRODUCTION

Until recently, the recommended storage and transport temperature has been 5,5 °C from packhouse to the UK and European markets. A new approach is, however, to gradually lower the suggested temperature as the orchard temperatures fall during the winter months, without however, creating external cold damage. Swarts (1982) discovered that the temperature sensitivity of the Fuerte avocado was largely influenced by the preharvest orchard temperatures prevailing, and that it appeared that the number of hours the orchard ambient fell below 17 °C shortly prior to harvest, played a significant role. To usefully apply the above in a packhouse receiving fruit from areas of varying temperature histories on any given day would be almost impossible. This study was, therefore, undertaken to determine whether any useful parameters could be established for the Fuerte cultivar.

EXPERIMENTAL PROCEDURE

Two-weekly samples of five cartons of Fuerte avocados were taken for each of three different storage temperatures (3,5 °C, 5,5 °C, 7,5 °C) and stored thus for 30 days, to monitor internal and external deviations. The experiment was started on 5 May, and immediately after 30 day storage, the fruit was externally examined for deviations (cold damage). Thereafter, fruit was stored at ambient until edible, and reexamined externally, as well as internal condition (grey pulp and pulpspot) was recorded, and statistically analyzed.

The experimental fruit originated from a single no irrigated orchard over the entire season and moisture content determinations were undertaken on every consignment. Records were kept and supplied by Westfalia of prevailing maximum and minimum ambient temperatures over the whole period. Firmometer studies were undertaken of the fruit immediately after removal from cold storage and monitored at approximately 2 day intervals thereafter until soft.

storage temperatures.

Cold damage is indicated in percentage of fruit which displayed the symptoms as well as the intensity of damage (fruit area damaged).

Fig 1 indicates the average increment in oil content for Fuerte avocados in the Letaba area for the 1983 season in the form of a regression calculated on the average percentage oil content per week. A good correlation coefficient of r = 0,979 was established. In 1980 and 1981 (Smith & Huisman 1982) and in 1982 (Smith unpublished), similar studies were undertaken with very little difference in results from the 1981 to 1983 season.

At 30 days at 5,5 °C storage temperatures, cold damage symptoms could only be found in fruit harvested up to early April. No further cold damage appeared again at this storage temperature for the remainder of the season. Storage for 30 days at 3,5 °C, however, resulted in very severe damage to fruit harvested up to April and sporadically caused low intensity damage thereafter. The marks on the fruit during the latter period did not significantly disturb the appearance of the fruit, but under current export regulations, would have been reject able.

Firmometer readings were taken to monitor the post storage ripening of all the trials and appear in Fig 2 as averages per storage temperature. The number of days taken for fruit to reach an average of 70 on the firmometer reading is given in Table 1.

From Table 1 and Fig 2, the different stages of maturity indicated that Fuerte fruit in stage 2 has a longer shelf life than in stages 1 and 3 and that the difference between stages 1 and 3 is not significant. In stage 4 (one observation point), all fruit had recorded 100% on the firmometer within 5 days post storage irrespective of storage temperature and the ripening rate could not be determined and it would appear a 70% firmometer reading was reached in a significantly shorter period than was the case in the other three stages of maturity. A possible explanation may be found in the degree of maturity or over maturity of this fruit (high percentage oil content), as well as the gradual increase of ambient orchard temperature (i.e. reduction of hours below 17 °C).

It would appear possible, with current information available, to create a practical model to indicate the most suitable storage temperature for Fuerte if both preharvest orchard ambient temperatures (hours below 17 °C), as well as fruit maturity (percentage oil content of fruit flesh) are taken into account.

Both aspects must satisfy certain minimum conditions to establish the correct storage temperature and, therefore, seasonal climatic variations will be accounted for.

During the 1983 season, slight cold damage still appeared during April (stage 1 fruit) after 30 days storage at 5,5 °C, as well as serious damage at 3,5 °C. No cold damage whatsoever was found during the same period at 7,5 °C after 30 days storage. Therefore, during this period, a 30 day storage at 6,5 °C should result in no cold damage and the best possible shelf life for the above conditions. The average number of hours that orchard ambient was below 17 °C was approximately 5 hours for this period, and the fruit maturity reached a maximum of 16% oil content. Therefore, it can be concluded that for night temperatures below 17 °C for 5 hours or less and a fruit maturity of 16% oil or less, the safe storage temperature would be 6,5 °C.

As no cold damage was observed at 5,5 °C (30 day storage) after the first period, and sporadic damage was observed at 3,5 °C, and seeing the orchard ambient temperatures during the night hours varied greatly over the period, but had increased to 12 hours below 17 °C (18/4 22/5), with fruit maturity between 16% and 20%, one could now drop the storage temperature to 5,5 °C for these conditions (bearing in mind the great fluctuation of night temperatures and, therefore, the number of hours below 17 °C) without the risk of cold damage to the fruit. Therefore, the minimum requirements for change from 6,5 °C to 5,5 °C would be at least 10 hours or more below 17 °C per day and fruit maturity of at least 16% oil content.

temperature, therefore, would be 4,5 °C. The minimum requirements for this change would, therefore, be a minimum of 15 hours below 17 °C per day with fruit maturity of a minimum of 20% oil content.

Studying firmometer readings of the post storage ripening of this stage (stage 3) of fruit maturity, it appeared that in the latter half, fruit was ripening faster than the first half, and a further reduction in storage temperature would possibly improve the shelf life (greater 26% oil content and a minimum of 15 hours below 17 °C per day).

After 4 August, the night temperatures started to increase and the average number of hours below 17 °C decreased. What was, however, important, was that all the fruit in this fourth stage had such a high rate of ripening (within 5 days after removal from storage, all fruit was 100% soft by firmometer reading) that it would appear that fruit maturity was playing a significant role here (26% oil content and higher). As the fruit during this period would be arriving overseas during the European summer and late summer, one could expect a considerably short shelf life, and this would possibly suggest that Fuerte fruit with a maturity of 26% oil content and higher, should preferably not be exported by sea if a satisfactory outcome is to be expected.

Statistical analysis of the incidence of grey pulp and pulpspot showed no significant differences between the different storage temperatures.

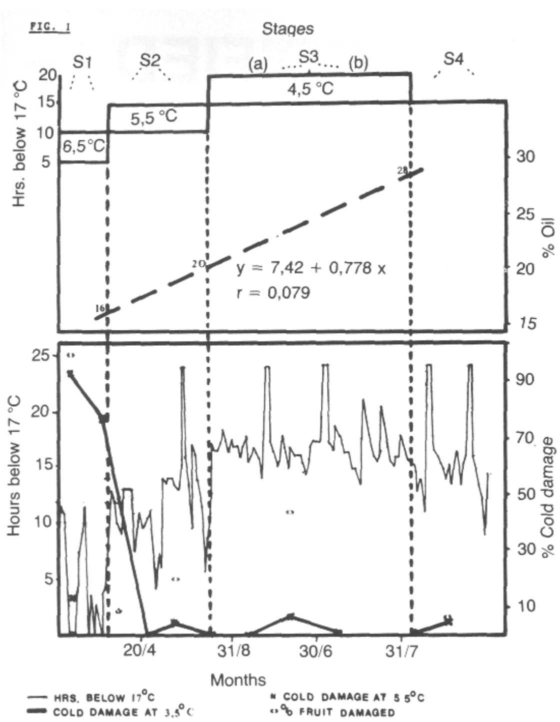

FIG. 1 — Cold damage which occurred at 5,5 °C and at 3,5 °C (for 30 days), the number of hours the ambient temperature remained below 17 °C for the 1983 season as well as the average oil content incresent and suggested storage temperatures, are represented.

TABLE 1. Days to firmometer reading of 70%

Stages	Temperature		
	3,5 °C	5,5 °C	7,5 °C
1 ———	5,6	4,2	4,3
2 - - - -	8,0	5,8	5,2
3(a) —‖—	5,6	5,0	3,9
3(b) — —	5,0	4,0	2,5
4 ········	Ripe in 5,0 days		

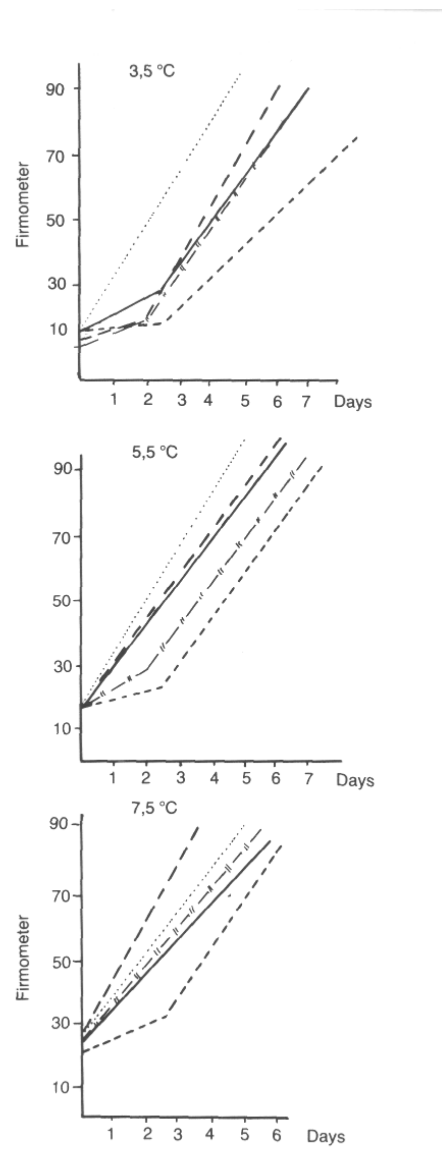

FIG. 2 — Firmometer readings monitoring the post-storage ripening of Fuerte fruit during the different stages as determined in Fig. 1.

however, completely eliminate cold damage. Later in the season cold damage of low intensity was observed at a storage temperature of 3,5 °C and it is further concluded that cold damage should be eliminated at a storage temperature of 4,5 °C for this part of the season.

By observing preharvest orchard temperatures coupled to average maturity of the fruit, storage temperatures can be adjusted through the season to avoid cold damage to the fruit as well as achieving the best possible condition of arrival (firmness) on the overseas markets.

The practical application of the above, however, does pose a problem as an industry, as the various Fuerte production areas could experience overlapping temperature/maturity relationships at any given time, which may make it impossible for the shippers to comply with the various area temperature requirements.

Confirmation of these results is planned for the 1984 season, as well as determining similar parameters for the other commercial cultivars.

The application of any further finesse to the current storage and transport temperatures for avocados will serve no purpose nor create any improvement whatsoever, if the cold chain from packhouse to overseas markets cannot be effectively maintained. The areas causing the greatest concern are during containerization, the sea journey and post arrival periods in the European ports. (Smith 1982).

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