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# COOLING RATES OF AVOCADOS IN CARTONS WHEN PALLATIZED

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***OPSOMMING***

*Die snelheid van verkoeling van gepalletiseerde avokado's was ondersoek. Uit die waarnemings is vasgestel dat met die passlewe verkoelingstelsel die wugtemperatuur in die pallet nie die gewensde 5,6°C binne 24 uur bereik het nie. Die verkoelingsterugvloeirigting, of van bo na onder of omgekeerd, hetgeen betekenisvolle uitwerking op die verkoelingsnelheid teweeg gebring nie, nog minder het 'n eksperimentele karton enige merkwaardige verskil gemaak nie.*

***SUMMARY***

*The rate of cooling avocados inside a palletized load was investigated. The centre of a given pallet did not cool down to the desired storage temperature of 5,6°C within 24 hours in a passive cooling system. It was also found that a modified carton and/or the direction of airflow from the top to the bottom of the pallet, or visa versa, had no significant influence on the rate of cooling.*

## INTRODUCTION

It had been generally acknowledged that the timely cooling of avocados after harvest is one of the most important factors ¡n achieving the longest possible storage life for the fruit.

It was decided to investigate the efficiency of the commonly utilized passive cooling systems in cooling a palletized consignment of avocados down to storage temperature of 5,6°C, specifically with respect to the centre of the pallet load.

## Method and Materials

A specially designed cool room was so constructed to enable the airflow to be directed from top to bottom of the pallets or visa versa. The cool room was large enough to contain 8 pallets of avocado cartons, each stacked 18 layers high.

Commercially packed and strapped pallets of fruit were used and temperature recording was done by means of a Honeywell "electronic 15" 24 point temperature recorder using copper/thermocouple constantan probes. Fifteen probes were placed in a vertical plane through the centre of the pallets at 3 per layer, in layers 1,6, 10, 14 and 18. (Fig. 1) The probes pierced the fruit and recorded temperatures at a depth of ± 6 mm in the centre fruit of each carton. Only one pallet was monitored, the others representing the normal cool room load and pallet positions. Temperature recording was continued in each experiment until virtually all the fruit had reached storage temperature.

The existing ambient temperatures of the day were accepted and no preheating or cooling was employed to obtain uniform starting temperatures, other than the normal pre-cooling to 13°C prior to packhouse run.

Two different airflow directions were employed; top to bottom and visa versa. The standard Letaba export cartons containing fruit with or without a cellophane wrapping were used as well as an experimental European lidless type carton and various pallet positions.

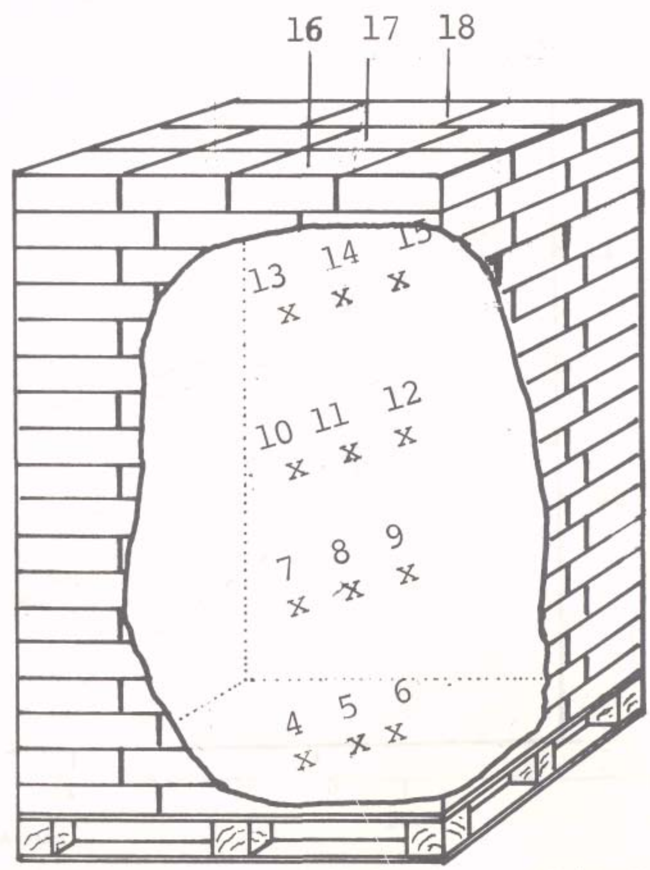


FIG. 1: The position of the thermocouple probes inside the palletized avocado cartons

## Results

The results are given in figures 2 to 7 with the following objectives:

1) This trial was to replicate the normal top to bottom passive airflow system used in most avocado cool rooms. The pallet floor plan was standard. (Fig. 2)
2) Standard coolroom top to bottom airflow with standard pallet floor plan. Airflow

direction reversed (7 hours after cooling had started) in an attempt to remove the "hotspot". (Fig. 3)

3) Top to bottom airflow with the rail truck pallet floor pattern (Fig 4) to observe the effect of "bypass" areas for cool air (Fig 5).

4) Bottom to top airflow direction using standard export carton, containing nude fruit, to determine whether the absence of wrapping material improved the cooling rate. (Fig. 6)

5) Top to bottom airflow direction with a European type lidless carton "pillar stacked" on the pallets to observe whether the absence of a carton lid and larger ventilation areas allowed by the carton design and pillar stacking improved the cooling rate of the fruit. (Fig. 7)

**Discussion**

The palletized conventional avocado carton with conventional packing material proved in all cases to allow insufficient heat exchange in the centre of the stacked pallet under passive cooling, taking at least 28 hours to reach 5,6°C.

The centre of the same pallets took up to 40 hours to reach 5,6°C when loosely placed in a cool room (as in LA 3 SAR refrigerated trucks).

Reversing the airflow direction to bottom to top after 16 hours did not improve the cooling rate of nude fruit in the carton. By repeating the reversal of airflow after 18 hours there was a slight improvement in the cooling rate; the fruit in the centre of the carton in the pallet reached a temperature of 5,6°C within 24 hours.

Using the lidless European type carton, containing fruit wrapped in cellophane, and top to bottom passive airflow the "hotspot" was found to shift downwards in the pallet and took 20 hours to reach 5,6°C.

**Conclusion**

From the trials it is obvious that a passive air cooling system is not effective enough to cool palletized cartons of avocados within the desired 12 hours after palletisation.

The highly ventilated European carton did not have sufficient effect on the cooling rate to make passive air cooling acceptable. Forced air cooling as well as other carton and stacking methods should be investigated.

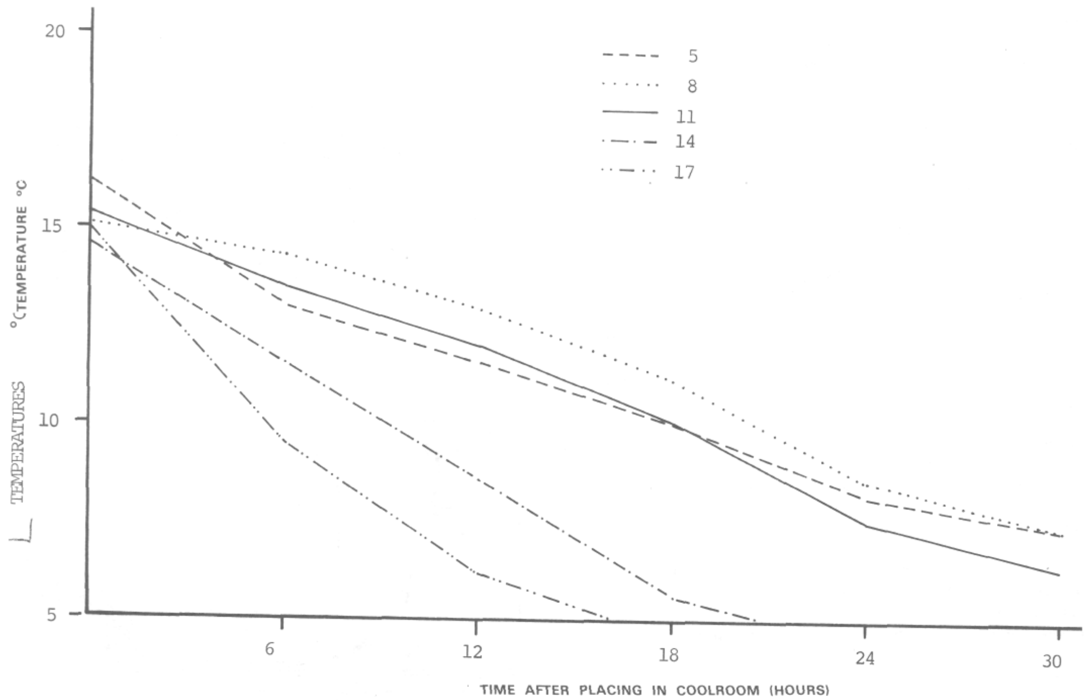


FIG. 2: Rate of cooling of cellophane wrapped fruit with passive airflow as found in most avocado coolrooms. Airflow direction from top to bottom of stacked pallet

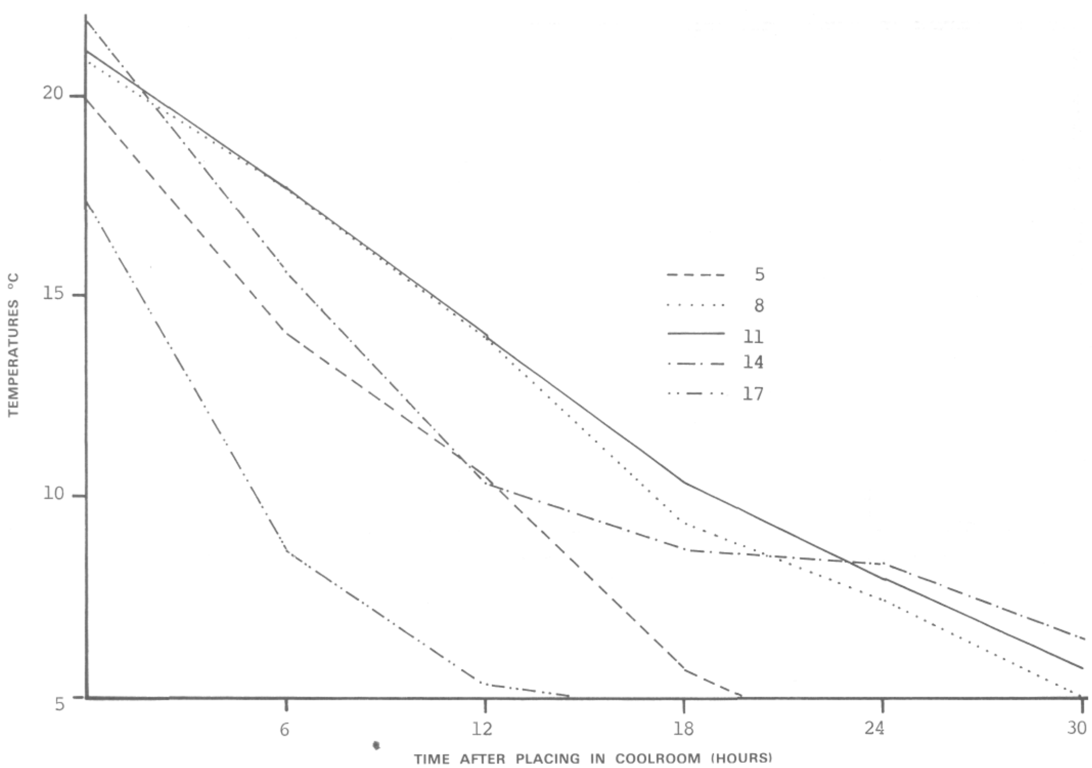


FIG. 3: Cooling rate of fruit with passive airflow from top to bottom of pallet, but airflow reversed after 7 hours in an attempt to remove the "hotspot"

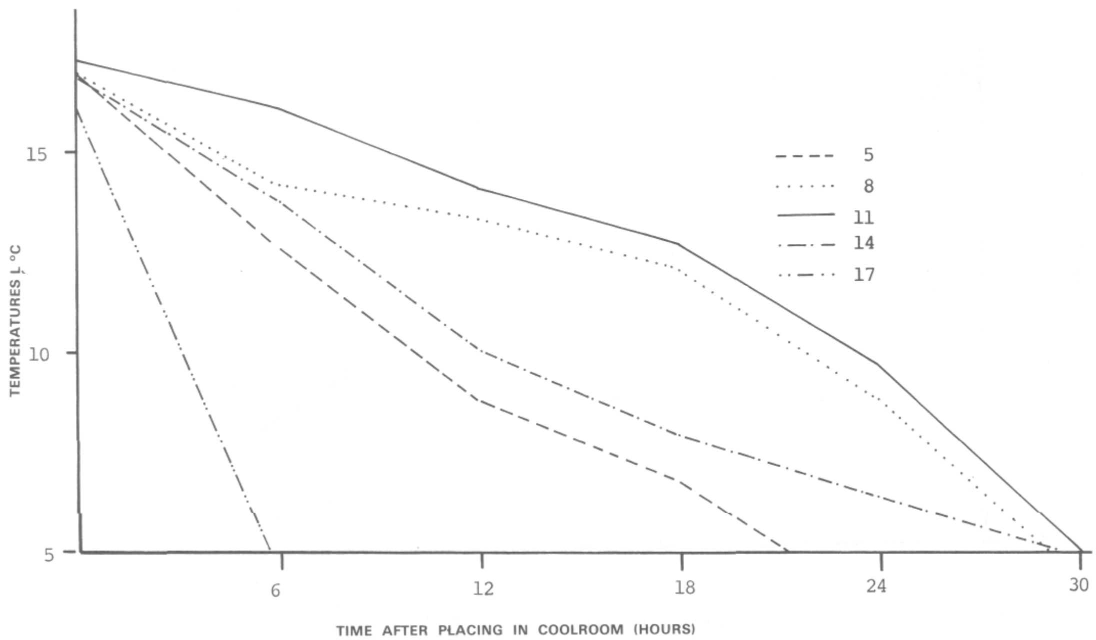


**FIG. 4: Cooling rate of fruit with top to bottom airflow direction with a railtruck pallet pattern**

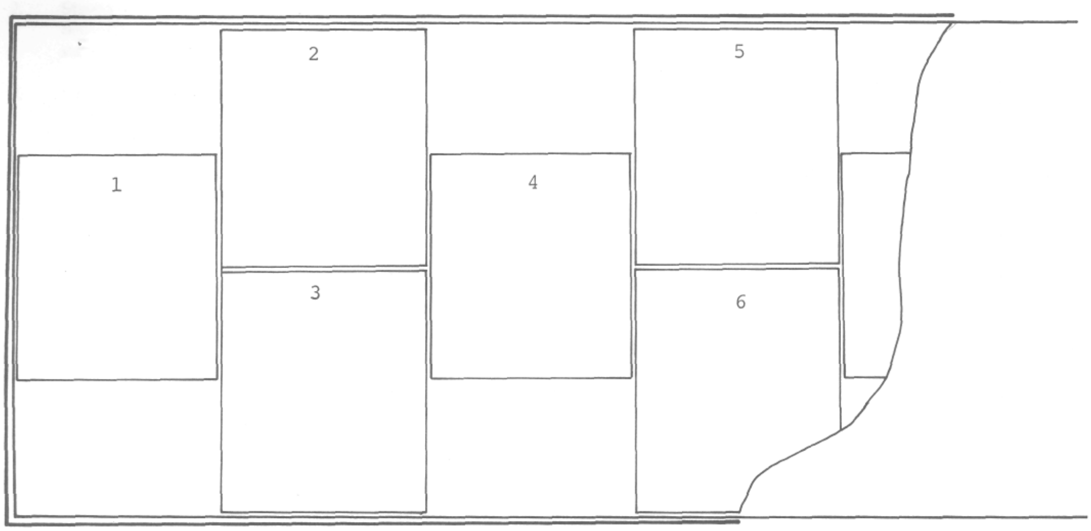


**FIG. 5: Plan of pallet layout in SAR L3 Refrigerated Truck indicating bypass areas for cool air shown as gaps between truck wall and pallets no. 1, 2, 3, 4, 5 and 6**

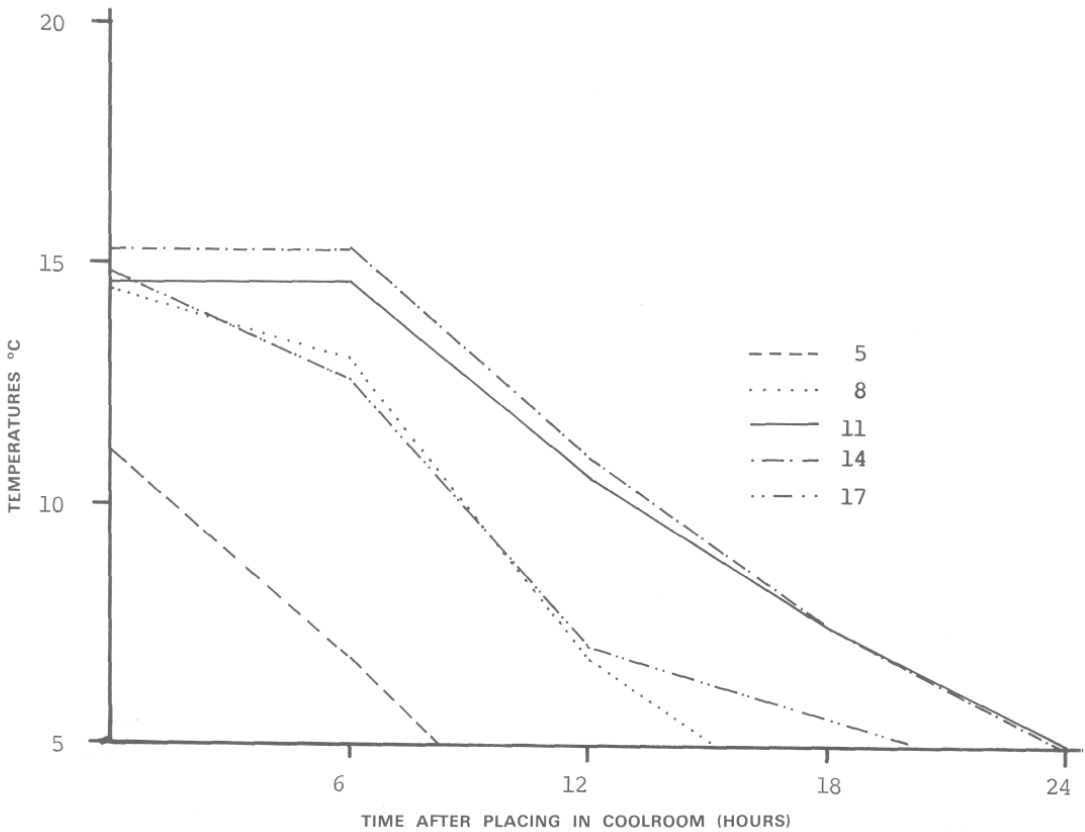


FIG. 6: Cooling rate of unwrapped palletized cartons of avocados with a passive airflow direction from bottom to top of pallet

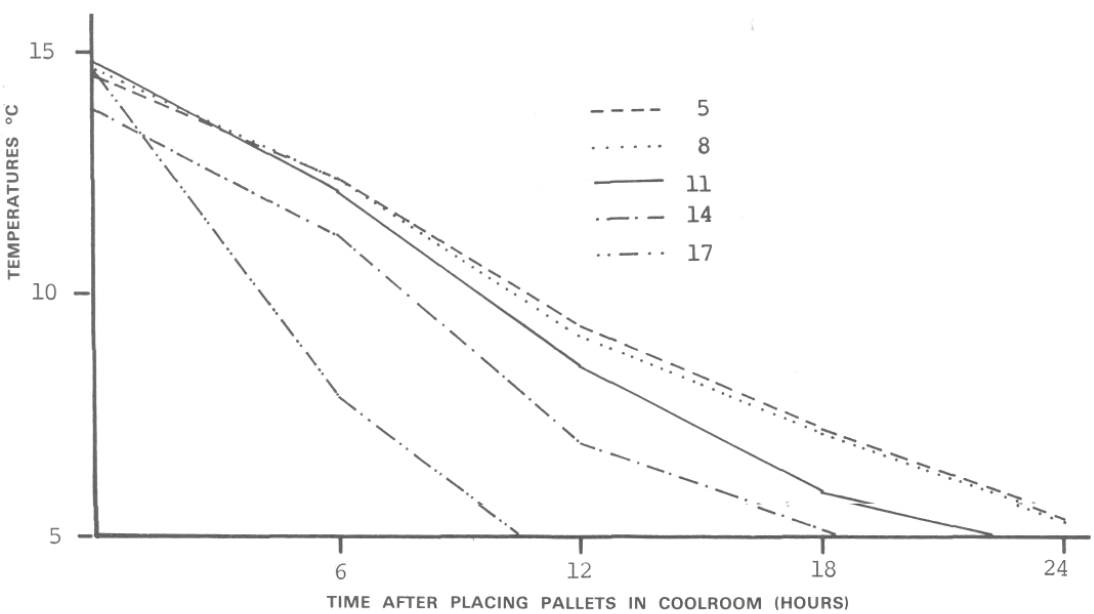


FIG. 7: Cooling rate of wrapped avocados in a European type lidless carton, with passive airflow direction top to bottom