

Temperature Variations in Refrigerated Motorised Transporters

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ABSTRACT

Thermocouples were placed at various positions in the trailer of two refrigerated motorised transporters (RMT's) carrying mangoes to Cape Town Harbour from packhouses in the Tzaneen region. Delivery air temperature was reduced during the period of transport to combat temperature increases associated with transporting (Oosthuysen, 1997a). The temperature reductions were generally effective in reducing the temperature of the air at the top of the pallets, but were ineffective in countering temperature increases at the centre or base of the pallets. The floor temperature was often greater than pallet air temperature and oscillated with time. This indicates that a source of heat was the trailer floor. The sides and ceiling of the trailers may also have been a source of heat.

The data show that temperature was not maintained in the RMT's used. The implementation of methods to enhance air circulation within the trailer and better insulation of the trailers may improve the situation.

UITTREKSEL

Termokoppels is op verskeie plekke in die sleepwaens van twee koeltrokke wat vrugte vanaf pakhuis in die Tzaneen-omgewing na Kaapstadhawe toe vervoer, geplaas. Lugleweringstemperatuur is verminder gedurende die vervoertydperk om temperatuurverhogings geassosieer met vervoer teen te staan (Oosthuysen 1997a). Die temperatuurvermindering was oor die algemeen nie effektief nie. Dit het die temperatuur aan die bokant van die palette verminder, maar kon nie temperatuurverhogings in die middel en in die onderste deel van die palette stop nie. Die vloertemperatuur was baie keer hoër as die van die lug in die palette en het met verloop van tyd gevarieer. Dit het aangedui dat 'n hittebron die sleepwa-vloer, en heel moontlik ook die kante en dak, was.

Die inligting dui aan dat temperatuur nie instand gehou word nie in die RMT's wat gebruik is. Die aanwending van metodes om lugsirkulasie te verhoog in die sleepwaens, en om insulering van die sleepwaens te verbeter, kan die situasie verbeter.

INTRODUCTION

The arrival of soft mangoes at fruit warehouses in Europe has been a problem in the past. Such arrivals occur despite temperatures being as specified during the sea voyage to Europe. Oosthuysen (1992, 1994, 1997b) demonstrated that mangoes experiencing increased temperatures

for periods prior to their placement in cool-storage show increased ripening during cool-storage.

Poor air circulation and increases in temperature in the trailers of refrigerated motorised transporters was shown by temperature monitoring studies performed during the 1997/98 season (Oosthuysen, 1997). There was no indication that the source of the heat was the fruit.

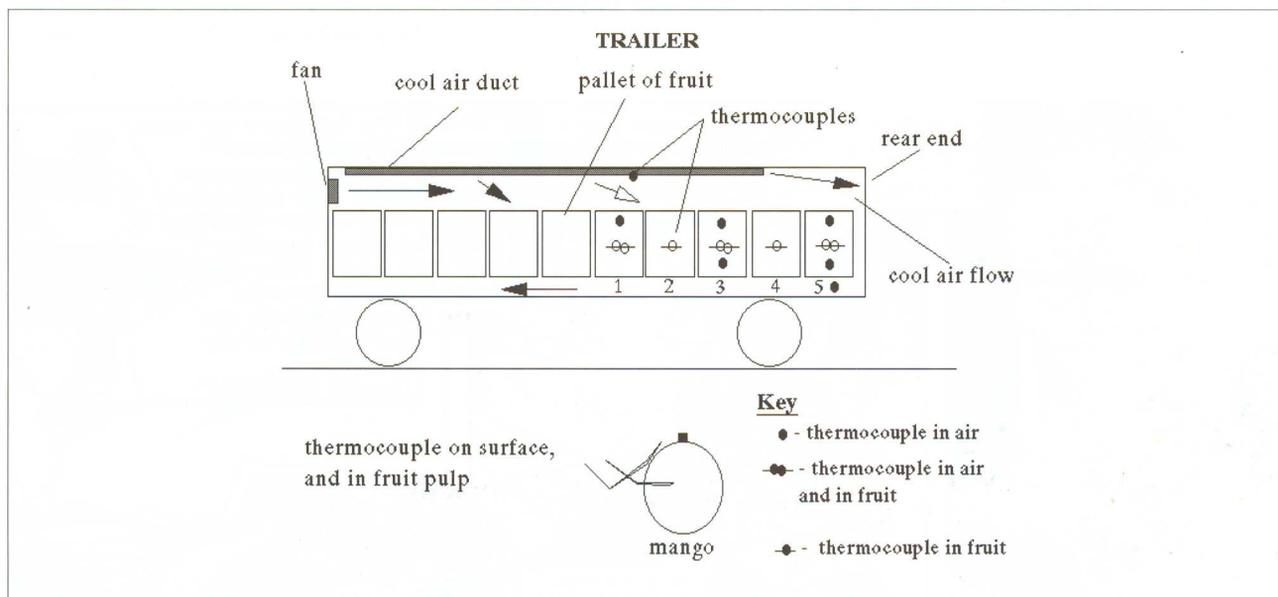


Fig. 1 Thermocouple placement in the trailers of the road motorised transporters (RMT's).

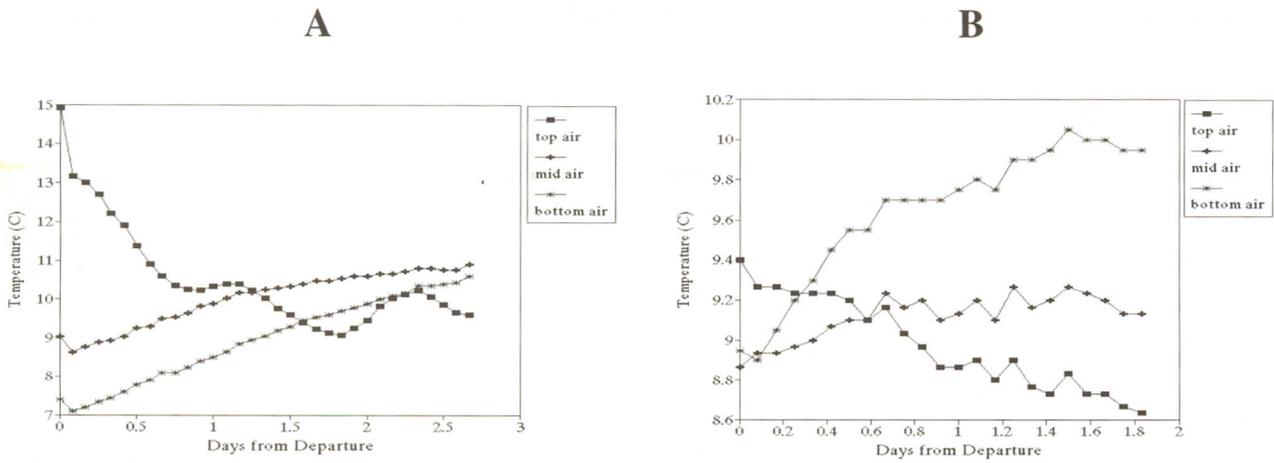


Fig. 2 Average temperature of the air-thermocouples located at the various heights in the pallets.

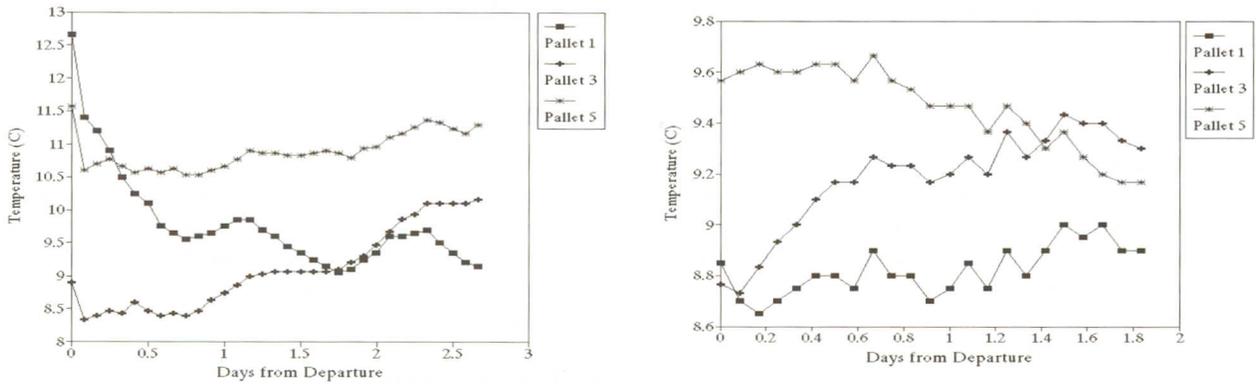


Fig. 3 Average temperature of the air-thermocouples located in Pallets 1, 3 or 5.

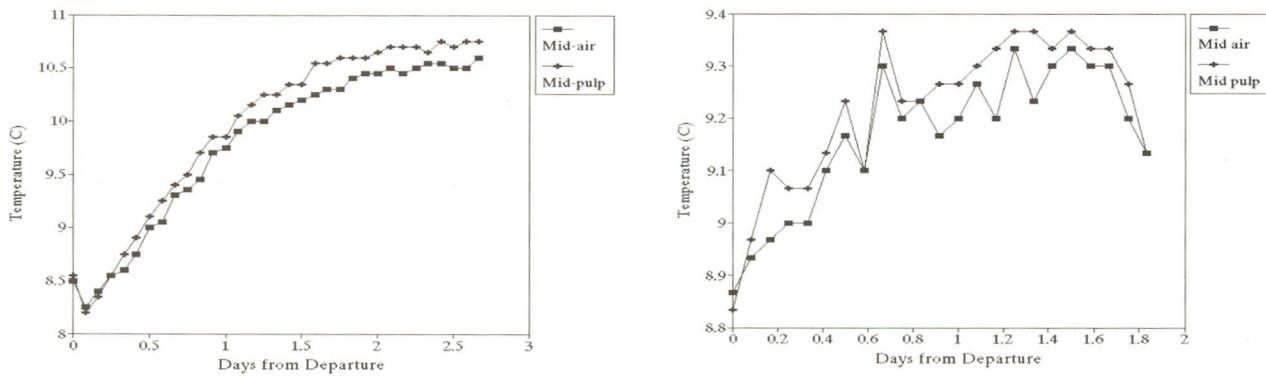


Fig. 4 Average temperature of the thermocouples placed on or in the fruits from which pulp temperature was measured.

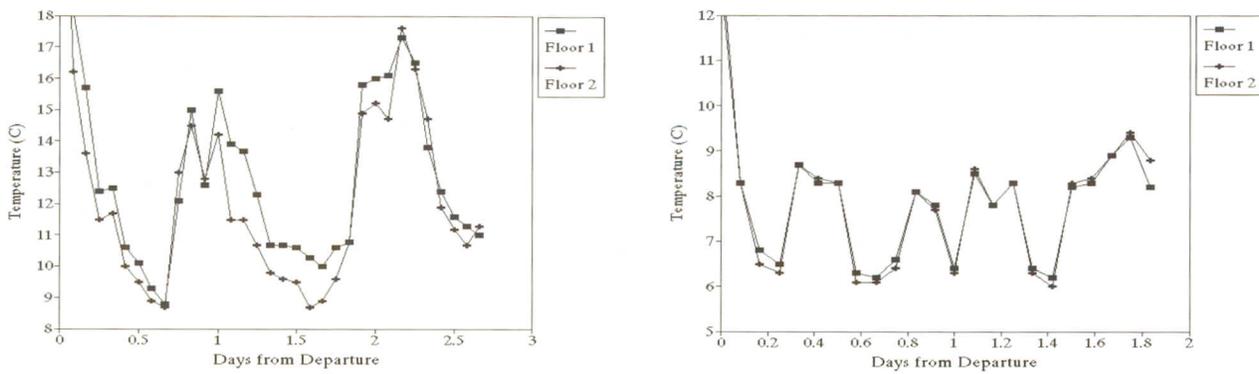


Fig. 5 Temperature of the thermocouples placed in the air space beneath Pallet 5.

The effect of delivery air temperature reductions during the trip to counter air and pulp temperature increases in the pallets was assessed in the present study.

MATERIALS AND METHODS

A Grant Squirrel temperature recorder was placed in the trailer of each of two RMT's at the time of loading. The RMT's were loaded with mangoes procured from different locations in the Tzaneen region. The specified temperature of the delivery air was 8°C. The placement of the 15 thermocouples and of the temperature recorder was identical in each trailer. Fig. 1 shows the locations of the thermocouples. The thermocouples were placed in and/or on fruits in inner central cartons (vertical core) located at various heights within the pallets. The "low" thermocouples were placed in the carton row just above the lowest carton row. The mid-thermocouples were placed in the central row. The "high" thermocouples were placed in the row immediately beneath the top carton row. Where fruit surface air temperature and pulp temperature were recorded, both temperatures were taken from the same fruits. Thermocouples were stuck on the surface of certain fruits and were also inserted to a depth of 2.5 to 3 cm in the same fruits (see Fig. 1). Thermocouples were placed in five adjacent pallets on one side of the trailer. These pallets were located at the rear-end of the trailer. Two thermocouples were placed above the floor beneath the pallet used which was closest to the door (floor thermocouples - floor 1 and floor 2).

Temperature was logged every two hours from the time of departure until that of arrival at Cape Town docks.

RESULTS

Figs. 2A and 2B show average temperature of the air-thermocouples located at the various heights in the pallets. Average temperature at the upper end of the pallets generally decreased with time as a result of the reductions in delivery air temperature implemented. The effect of the temperature reductions appeared to be limited to Pallet 1 (Fig. 3A) or Pallets 1 and 3 (Fig. 3B), which were closer to the cooling unit. Temperature at the centre and bottom of the pallets generally increased with time. Temperature generally increased in Pallet 5, the pallet closest to the door of the trailers.

Figs. 4A and 4B show average pulp temperature and average air temperature resulting from the measurements from the thermocouples placed on and in the fruits at the centre of the pallets. Air and pulp temperature increased with time. Air temperature and pulp temperature at any stage differed little. In one of the trailers these temperatures showed coincident increases and decreases (Fig. 4B). The foregoing imply that the increases in temperature observed were not due to heat emanating from the fruits themselves.

Figs. 5A and 5B show the temperature of the thermocouples in the air space beneath Pallet 5. Floor temperature

oscillated with time, and, in the case of the first trailer (Fig. 5A), was often markedly greater than the temperatures measured in the pallets. This would appear to indicate that a source of heat was the trailer floor. The temperature variation found in the first trailer (Fig. 5A) may have resulted from differences in external heat exposure (day vs night) of the trailer. The variation in the second trailer (Fig. 5B) may have resulted directly from periodic activity and inactivity of the trailer's cooling unit. This is primarily stated in view of the greater degree of temperature variation relative to the first trailer.

CONCLUSIONS

Temperature in the pallets increased for the most part. Temperature management efforts were generally ineffective in countering the temperature increases. The data indicate that the source of heat was not the fruits themselves.

In the first trailer, the temperature of the air just above the trailer floor was elevated and varied with time. This leads to the conclusion that a source of heat was the floor of the trailers. The sides of the trailers may also have been a source of heat.

It might be concluded that air temperature maintenance of the trailers is poor, and that this is due to inadequate air circulation and trailer insulation. Methods of enhancing trailer insulation and air circulation should be considered by the transport companies.

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