Development of intermittent balanced atmosphere conditions for South African export avocados using currently available logistics

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ABSTRACT

This project aims to establish whether a practical intermittent balanced atmosphere procedure, using collapsible tents and air tight trucks in place of door to door containers, can be developed. From the results it would appear that it will be possible to create a balanced atmosphere *en-route* in trucks. It would further seem possible to create a balanced atmosphere in tents pitched in the packhouse cold store, the harbour's holding store and the overseas receiver's cold store. A CO_2 controller designed for the project worked well but needs to be smaller with longer lasting batteries.

INTRODUCTION

The first export of South African avocado fruit under controlled atmosphere (CA) took place during 1995. The technology was gradually phased in and is now universally adopted. Generally, an atmosphere of 6% CO_2 and 4% O_2 is used. However, during recent years, certain service providers have started using a balanced atmosphere (BA) where the CO_2 is allowed to passively build up to 8%. This level is then maintained for the duration of the containerised portion of the export journey (the O_2 is not regulated and is approximately 13% when the CO_2 level is set at 8%). Information generated during industry trials and laboratory experiments (Kruger *et al*., 2019) has shown that the above BA combination delivers similar results to CA. This prompted us to attempt to establish whether BA can be used in other links of the chain such as the packing house, refrigerated trucks, the harbour transit cool store and the cool store of the importer.

The present report deals with trials performed in refrigerated trucks, as well as in packing house cool stores. The aim of the refrigerated truck trials was to firstly establish how air-tight they are (this is not only important in terms of the present study, but also in so far as planned SmartFresh applications in the trucks are concerned). This will be followed by trials aimed at creating balanced atmospheres in the trucks during the 2019 season.

In the packing house based leg of the study, the aim was to develop and test appropriate technologies that will allow for the creation of balanced atmosphere conditions inside collapsible tents placed within the cool stores of packers, transit facilities, importers and ripeners.

MATERIALS AND METHODS

Refrigerated truck tests

This part of the study was performed in two phases.

During the first phase, the CO_2 build up in one truck each from three service providers was recorded after loading at three packing houses in Tzaneen until arrival at the storage facilities near Cape Town harbour.

During the second phase, curtains (Fig. 1) were installed in three trucks from the fleet of the service provider found to have the most air tight trucks. The above operation was then repeated.

Cold room tent tests

A transparent plastic tent with an electrical conduit pipe frame (Fig. 2) was used for the trials. A CO_2 controller with pipes that can be fitted to the wall of the tent was thereafter designed. The tent was filled with fruit and the CO_2 allowed to build up in the tent. The accuracy and efficiency of the system was thereafter tested.

RESULTS AND DISCUSSION

The CO_2 and O_2 levels recorded in the trucks are shown in Figure 3. The CO_2 levels in the trucks of the first two service providers increased to between

Figure 1. Curtain fitted behind the doors of a refrigerated truck from the service provider with the most air-tight trailers. The curtain was fitted to the inside of the trailer using double sided tape. Silicon was inserted in the corners.

Figure 2. Tent and CO_2 controller assembly used in the packing house-based trials. The tent was designed for one pallet and consisted of a plastic sleeve fitted over an electrical conduit pipe frame. The controller-assembly was made up of a CPU unit housed in a plastic container. Plastic pipes were used to connect the valves to the plastic sheeting and the battery was placed on the outside of the tent.

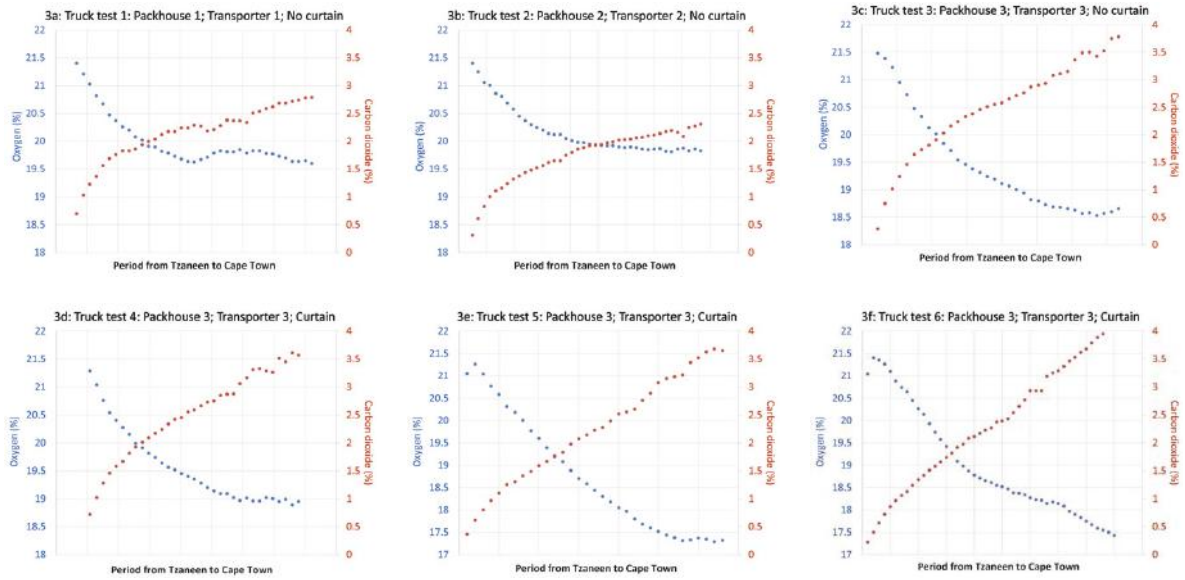

Figure 3. Oxygen and carbon dioxide levels recorded in 6 refrigerated truck/trailer combinations travelling from Tzaneen to Cape Town harbour. Figure 3a-3c consist of readings taken inside the trailers of three service providers (the trailer represented by Figure 3c proved to be the most air tight). Figure 3e-3f consist of readings taken inside three trailers of the service provider with the most air tight trailers after fitting a plastic curtain behind the door. The curtain did not further improve the air tightness of the trailers.

2.5% and 3% (Figs. 3a & 3b) while those of the third increased to between 3.5% and 4% during the journey to Cape Town harbour (Fig. 3c). In the latter case, the fitting of a curtain behind the doors did not further increase the CO_2 levels inside the trucks (Figs. 3d-3f).

The CO_2 levels measured in the tent during a 4-day period are shown in Figure 4. For this specific test, the valves were set to open when a CO_2 reading of 9% was reached and to close again after the level had dropped to 8%. As may be deduced from the graph, the apparatus and setup worked satisfactorily. It is interesting to note that the intervals between the closing and opening of the valves decreased as the fruit's respiration rate increased towards the end of the storage period.

During the present season, the primary aim was to develop appropriate technology that will not unnecessarily interfere with current logistical procedures. During the coming season, both the tents and trucks will be filled with CO_2 until a level of 8% is reached after which an attempt will be made to retain the levels for the duration of the respective storage periods.

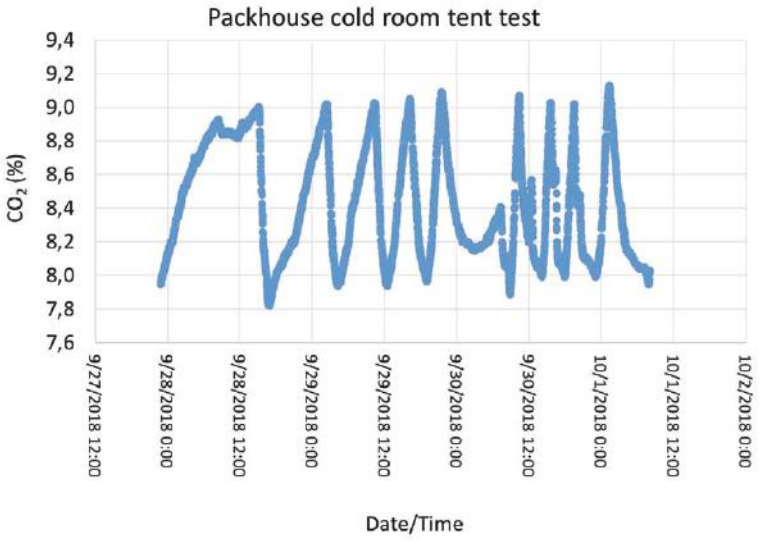

Figure 4. Carbon dioxide levels inside a custom-made single pallet tent fitted with a specially designed CO_2 controller assembly. The controller managed to maintain the CO_2 levels between 8% and 9% inside the tent.

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