

Be cool, man

Easier said than done when you are a pear or a bunch of grapes en route from the farm to a supermarket in a foreign country. One break in the chain that holds your looks and flavour together and you could be heading for the compost heap instead of the kitchen table.



Temperature is the greatest determinant of fresh produce deterioration rates and potential market life.

IT IS A DISTURBING FACT that a large percentage of the fruit harvested on farms goes to waste. Research findings for developing countries indicate that 40% of fruit and vegetables produced are lost due to poor post-harvest storage, processing, packaging, distribution and retail practices.

One of the biggest reasons for this, is a break in the cold chain – the series of refrigeration processes that slows down the rate at which fruit ripens so that it reaches the consumer in the best possible condition. The economic knock-on impact of an ineffective cold chain is potentially disastrous: unstable prices for local farmers and an uncompetitive export industry.

In South Africa, the Perishable Products Export Control Board (PPECB) governs the export of

perishable products. Every year, the PPECB publishes protocols and procedures for the handling, storage and transportation of perishable products, with specific emphasis on optimum temperatures. For fruit, the prime indicator is pulp temperature, ie, how warm or cool the fruit's flesh is. The pulp temperature of apples and grapes, for instance, should be maintained at -0,5°C for the duration of their journey – from the farm and pack house to the consumer's shopping basket.

Despite the PPECB's best efforts, losses still occur. To understand the extent of and reasons for the problem, the Post-Harvest Innovation Programme joined forces with the CSIR and Stellenbosch University in a study that examined export cold chain practices in the Western Cape between June 2012 and October 2013.

Dr Esbeth van Dyk, principal supply chain analyst in the Transport and Freight Logistics section of the CSIR's Built Environment division, was the project leader. Working with her were Master's degree students and staff from the Stellenbosch University's departments of Logistics and of Horticultural Science. Four of the 10 largest exporters of deciduous fruit and table grapes in South Africa agreed to participate in the study.

THE AIMS OF THE STUDY

"Looking at summer fruit varieties that are exported in containers, we firstly wanted to determine the causes and the extent of breaks in the cold chain in order to minimise or possibly eliminate them," says Dr Van Dyk. "The study's second objective, and final outcome, is a Good Cold Chain Practice Guide to help the fruit industry improve operational procedures, reduce losses and improve the quality of export fruit." The guide will enhance the South African fruit industry's international competitiveness and reduce losses and claims, resulting in significant savings for both the industry and logistics operators.



- 1 Dr Esbeth van Dyk.
- 2 Good harvesting practices are the first link in an efficient cold chain.



The quality of uncooled table grapes deteriorates more in one hour at 32°C than during one day at 4°C, or even a full week at 0°C.



HOW IT WAS DONE

The research team observed cold chain practices on fruit farms, in pack houses, in cold stores and at the Cape Town Container Terminal in the Port of Cape Town during the 2012/2013 summer fruit season.

In addition, the researchers conducted 12 temperature trials: one apple, two summer pear, three plum and six table grape trials from different production areas in the Western Cape and Northern Cape.

They placed temperature monitors in certain fruit cartons just after the pallets left the cold store to be loaded into the container. The monitors measured the fruit pulp temperatures and/or the ambient temperature and humidity throughout the container's journey to its overseas destination. The temperature data was e-mailed back for analysis. Although only 42 out of the 74 monitors were retrieved, valuable information was gathered.



PROJECT TITLE
Good Cold Chain Practice

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DURATION
16 months

PHI-2 CONTRIBUTION
R505 000

LEAD INSTITUTION
CSIR Built Environment

BENEFICIARY
The table grape and deciduous fruit industries

FOCUS AREA
Logistics

HUMAN CAPITAL DEVELOPMENT
Four Honours and two Master's degree students

PRESENTATIONS AND PAPERS DELIVERED
Five

PUBLICATIONS
One

 In sub-Saharan Africa, it is estimated that as much as 20% of all fruit and vegetables produced are lost before they reach the consumer. If one prefers to err on the side of caution and works on a 5% loss, in South African terms it means that about 12 290 tons of table grapes were lost in the 2011/2012 season. Given the season's average export price, the losses amount to more than R153 million.

For the purposes of the study, a break in the cold chain was defined as any rise in ambient temperature above 2°C for longer than 90 minutes.

THE FINDINGS
The researchers found several reasons for breaks in the cold chain:

On the farm

- Fruit is picked in high temperatures at midday.
- Picked fruit waits for a long time in high temperatures to be transported to a pack house.

At the pack house

- Insufficient shade at the receiving areas.
- High temperatures inside the pack house.
- Fruit is too warm when it is packed.

At the cold store

- Due to a lack of airlock loading bays, fruit is left outside under a roof while waiting to be loaded.

At the container terminal

- Trucks wait in long queues to enter the port. Containers from cold stores within two hours' travel time do not have gensets (power source) to maintain the cold chain temperature.

The temperature trial data showed that the difference between ambient and fruit pulp temperatures can be more than 1°C between the pallets close to the refrigeration unit and those at the door of the container. It also confirmed that a container cannot re-cool the fruit and only maintains the pre-cooled temperature. The extent of the cold chain problem was confirmed by data received from the exporters that indicated that only 13 of the 123 containers that were monitored experienced no breaks. Almost 60% of the

cold chain breaks happened at the interface between the cold store and the container truck, and 30% of the breaks occurred between noon and 16:00 – the hottest part of the day. More than 20% of the breaks continued for more than a day.

Dr Van Dyk says that the real solution to the cold chain challenge lies with people. "The cold chain will only improve once all the participants appreciate the impact of temperature on the shelf life of fruit and the important role they play in maintaining the cold chain." She is confident that the Good Cold Chain Practice Guide will play a role in this process.

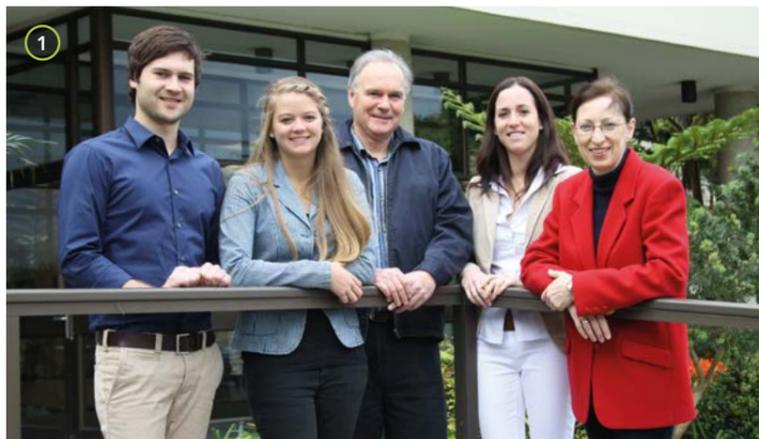


THE LINKS IN THE COLD CHAIN

The fruit export cold chain starts the moment the fruit is harvested. The freshly picked fruit is pre-cooled in a refrigerated room to remove the field heat – a crucial step to preserve the quality of the fruit.

The pre-cooled fruit is transferred to the pack house where it is sorted and packed. The next stop is the cold store where the packaged fruit is cooled rapidly to its optimum storage temperature (eg, -0,5°C for table grapes) and then kept refrigerated at this temperature until the road trip to the port from where it will be exported. If the load will spend more than two hours on the road, the PPECB prescribes that it has to be transported in a refrigerated (reefer) container, fitted with a generator set or in a refrigerated truck.

Once the load reaches the port, the containers are stacked in a reefer container yard and plugged into electrical power points. Containers are usually stacked according to the sailing schedule and loading plan of the vessel they will be exported on. Once on board the vessel, the containers are plugged into the vessel's electrical power supply.



- 1 The research team members are (from left) Heinri Freiboth, Laura Haasbroek, Prof. Malcolm Dodd and Dr Leila Goedhals-Gerber (all from Stellenbosch University) and Dr Esbeth van Dyk from the CSIR.
- 2 On the farm: Fruit is sometimes picked in high temperatures and wait for a long time to be transported to a pack house.
- 3 The Good Cold Chain Practice Guide is a valuable educational tool that reiterates the importance of keeping fruit cool, thereby adding to its quality and shelf life.
- 4 At the pack house: Fruit is often too warm when packed, either due to insufficient pre-cooling or high temperatures inside the pack house.
- 5-6 At the cold store: An airlock loading bay keeps the cold chain intact. Where cold stores do not have airlocks, the fruit is often left outside under a roof while waiting to be loaded.
- 7 At the container terminal: Trucks often wait in long queues to enter the port. Containers from cold stores within two hours' travel time do not have gensets to maintain the cold chain temperature.