

# Handling procedures for avocados 1999 season

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## 1. BACKGROUND

A detailed technical report on the 1998 commercial temperature and quality surveys has been prepared. This technical report is available from the PPECB on request.

Standard handling procedures, as developed over the past decade are summarised in paragraphs 2 to 6. Changes recommended for the 1999 season as well as planned semicommercial investigations are summarised in paragraphs 7 and 8 respectively.

The aim of this document is to formulate practical procedures, technical evaluation procedures and further experimentation.

## 2. PICKING AND PRECOOLING

### 2.1 Picking maturity

Optimum fruit moisture content is clearly defined in the fruit quality regulations applied by the PPECB. PPECB personnel are keen to assist growers and exporters in the correct interpretation and application of moisture content as maturity index.

Moisture content must never exceed the prescribed percentage per cultivar at time of picking. Exporters must also be very careful not to extend the shipping period too late into the season.

Moisture content is also directly related to optimum storage temperature regime. This factor is considered when applying shipping temperatures and growers should therefore keep PPECB informed of moisture content readings.

### 2.2 Removing of field heat

Time and temperature between picking and marketing are, apart from picking maturity, the two most important post-harvest quality determining factors. The sooner the product is precooled and shipped after picking, the better.

### ***Recommendations***

- Picked fruit must be taken to the packhouse at least every four hours and must never be allowed to stand in the orchard and, even worse, be exposed to warm temperatures and direct sunlight.
- The field heat must be removed on arrival at the packhouse by keeping the fruit at 16°C prior to packing.

- Fruit temperatures must not increase between picking and packing.

### **2.3 Packing**

Avocados must be treated and packed as soon as possible after picking, but in any event on the same day of picking. Fruit should never be accumulated on the floor at ambient temperatures.

#### ***Requirements***

- The correct packing date code must be stamped on the cartons.
- The correct date codes must be stamped in such a way that it can be easily read even after the pallet has been strapped. The best position is on the left upper corner on the front end of the carton.

## **3. PRECOOLING, ROAD TRANSPORT AND PRESHIPMENT HANDLING**

### **3.1 Installation of thermocouples**

A sterile thermocouple wire must be installed into an avocado in the centre carton in the 10<sup>th</sup> layer from the bottom of the pallet. This thermocouple must be securely fixed and the open end must be taken to the outside of the front end ("business" end) of the pallet. All pallets must be fitted with a thermocouple wire at time of building the pallet.

### **3.2 Precooling**

The cold store at the packhouse is the only link in the whole cold chain that can effectively precool the fruit. The cold store operator must load and manage the store correctly to obtain effective precooling without inducing chilling injury, but still to cool to as close as possible to the specified temperature.

#### ***Requirements***

- Cold stores must be PPECB registered.
- Avocados must be precooled prior to loading into the refrigerated truck (RMT) to such a temperature that it will not be warmer than specified in par. 3.6 on arrival in the port.

### **3.3 Refrigerated road transport**

The most important aspect regarding refrigerated motor transport is that the unit is not designed or built to cool the product. Heat leakage, due to warm ambient and road surface temperatures, into the unit may even result in the fruit temperatures increasing during transit.

#### ***Requirements***

- The RMT must have a valid PPECB certificate
- The temperature control must be on delivery air.

- The RMT must be precooled for at least three (3) hours to the required transport temperature prior to loading. This is to ensure that the unit is functioning correctly for avocados and also to minimise temperature increases during loading.
- The exporter/packer must ensure that the temperature setting is correct and that air is actually delivered within  $\pm 0.5^{\circ}\text{C}$  of the selected setpoint.
- The cooling unit must be switched off during loading.
- The exporter/packer must record the actual pulp temperatures as taken with the thermocouples of every pallet at the time of loading and the driver must countersign the document.

### **3.4 OFF LOADING IN PORT**

Well planned logistics are essential to ensure quick transfer and minimum temperature increases. Special care must be taken to ensure that the avocados arrive within the temperature specification and within sufficient time to load the container. Additional time is required to prepare and gas CA containers. Fruit for CA transport must arrive in the port in time to allow for container loading, gassing and testing.

Exporters must plan inland loading to ensure direct transfer into container on arrival in the port.

#### ***Requirements***

- Loading depot, PPECB Area Manager and the Cape Town Technical Officer (CTO) in the port must be notified of delays in arrival of RMT's.
- RMT's must arrive at the loading depot before the cut-off time.
- No container loading shall take place after cut-off.
- Split loads and local market fruit in the same RMT cause delays and temperature increases. This must be avoided at all times.
- If split loads cannot be avoided, local market fruit must be precooled to the same temperature as export fruit. Local market fruit must also be loaded first into the RMT, i.e. cooler side.
- Off loading must take place in such a way that a minimum temperature increase takes place.

### **3.5 TEMPERATURE CHECKS**

The PPECB will verify precooling road transport conditions and product temperatures during off loading in the port. Cold store and depot managers must inform the respective PPECB Area Manager timeously to arrange for a PPECB Assessor to attend loading.

#### **3.5.1 Check the RMT and the following temperatures prior to opening of the doors:**

- Temperature set point
- Temperature registered on recorder chart

- DAT Delivery air temperature
- RAT Return air temperature
- Validity of the PPECB certificate
- General condition of RMT

### **3.5.2 Take the following pulp temperatures via thermocouples with an electronic thermometer during off loading:**

- In pallet at the back (door end)
- In centre pallet
- In pallet at the front
- Inside a randomly selected pallet

All the above temperatures and respective pallet numbers will be recorded and sent via e-mail to the relevant PPECB Area manager. He will then inform producers of problems experienced in the port.

### **3.5.3 Reject the avocados for export if:**

- The RMT is not registered with the PPECB or does not comply with PPECB standards.
- The fruit is warmer than the specified tolerances above the initial shipping temperature.
- The pulp temperature is either warmer than specified in par. 3.6 or colder than 1.0°C below the specified initial shipping temperature.
- The fruit is older than 12 days at advised ETD of the vessel if the ETD was not changed after commencement of packing for the specific vessel. This period will be extended by the number of days the vessel is delayed, should a delay occur.

## **3.6 DURING TRANSFER**

Quick direct transfer from the RMT or cold store into the container to minimise temperature increase is essential. The product must be protected against the elements and must not be subjected to extreme temperature and humidity conditions. Recooling must be resumed as soon as possible to ensure compliance to the TTT as specified in par. 5.

- Clip-on-units (COU's) may be used in Durban and Port Elizabeth but must be calibrated and designated for the use of avocados only. A thermocouple must be installed in the delivery air stream by the shipping line and must be read by the representative of the shipping line (normally Portnet) on commencement of cooling and at least every 12 hours thereafter during routine inspections to ensure accurate temperature control.
- PPECB and Portnet personnel will, on a regular basis, monitor the temperature set points, delivery (DAT) and return (RAT) air temperatures of the COU's in the port

terminal. Procedures will also be instituted to ensure that COU's are fitted to containers and cooling supplied on arrival of the container in the terminals in Durban and Port Elizabeth. COU's will only be disconnected when the vessel is ready to load the container.

- COU's may not be used in the port of Cape Town.
- Air temperatures of port hole containers in Cape Town are monitored every four hours.

### **3.7.7 Optimum container loading temperatures**

Large scale industry research results confirm that pulp temperatures at loading of a port hole container in Cape Town or a conventional ship in any port must not exceed the following per fruit age group to ensure optimum quality on arrival at the market. Fruit age is calculated as the number of days between the date code stamped on the carton and the holding store intake cut off date or load date in respect of conventional shipping. (A part of a day is rounded off downwards, for example 3 days 14 hours becomes 3 days).

Avocados 3 days and less old (deadline\*\*)

- Maximum 4°C above holding store intake temperature

Avocados 4 to 6 days old

- Maximum 3°C above holding store intake temperature

Avocados 7 days and older

- Maximum 1 °C above holding store intake temperature

The avocado industry however, mainly due to insufficient cooling capacity, insists on loading older fruit up to 3°C (and not 1°C) warmer than the holding store intake temperature. PPECB agreed to this request (see par 3.7.2) based on the industry decision that the temperature tolerances refer to thermocouple temperature readings. It must however be pointed out that warmer loading calls for intensive temperature management to counteract the possible ripening effects of old avocados loaded warmer than 1°C above specification.

\*\*Deadline fruit is avocados (based on date code) packed on the last packing day for specific vessel i.e. fruit packed not more than 72 hours before the ETA of the vessel.

### **3.7.2 Loading temperatures Cape Town**

The port of Cape Town is best equipped for porthole container loading and conventional shipping of avocados. It is therefore possible to deviate slightly from the most optimum product requirement and still maintain product temperature and quality.

The following criteria apply:

- **Loading of port hole containers**

Maximum temperature tolerances

Fruit up to 3 days old = 4.0°C above holding store intake temperature

Fruit 4 to 6 days old = 3.0°C above holding store intake temperature

Fruit 7 to 12 days old = 1.0°C above holding store intake temperature

Please note: Industry has requested that avocados older than 7 days also be loaded within a 3°C tolerance.

Although agreed, PPECB does not support this request

- **Loading of integral refrigerated containers port loading**

All pulp temperatures to be within an absolute maximum of 1.0°C above the requested first phase carrying temperature.

- **Loading of integral refrigerated containers inland loading**

All pulp temperatures to be within an absolute maximum of 1.5°C above the requested first phase carrying temperature.

Note: No step down procedure will be allowed as this is seen by some exporters as a method not to apply proper precooling.

This excludes the proposed temperature management system for Pinkerton avocados. In the case of Pinkerton this is a planned procedure as opposed to ad hoc manipulations sometimes requested by export agents to get by with inefficient cooling and planning.

- **Loading of CA integral refrigerated containers port and inland**

All pulp temperatures to be within an absolute maximum of 1.5°C above the requested first phase carrying temperature

Note: The reason for the warmer loading temperature tolerance for CA containers is that controlled atmosphere (CA) can reduce the respiration heat of the fruit substantially. Less heat load is therefore put onto the cooling unit making it possible to apply available cooling capacity to the fruit.

- **Loading of conventional ships**

All pulp temperatures to be within an absolute maximum of 2°C above the specified carrying temperature.

### **3.7.3 Loading temperatures in Port Elizabeth and Durban**

Due to transport distances and other logistical considerations the following temperatures shall apply.

- **Loading into port hole containers**

All pulp temperatures to be within a maximum of 3°C above set point.

Note: Due to the fact that clip-on-units (COU's) are the only way of maintaining product temperature in the ports of Port Elizabeth and Durban, every attempt should be made to load avocados as close as possible to the specified carrying temperature. Also see note par. 3.6.

- **Loading into integral refrigerated containers**

Maximum 1.0°C above set point as for Cape Town

- **Loading into CA integral refrigerated containers**

Maximum 1.5°C above set point as for Cape Town

- **Loading of conventional ships**

Maximum of 2°C above set point as for Cape Town

#### **4. SHIPPING TEMPERATURE REGIMES**

Shipping temperatures are continuously adapted during the season based on changes in the fruit physiology as a result of the change from summer to winter. A number of factors such as oil (moisture) content, susceptibility to chilling injury, ripening rates, disease susceptibility etc. are considered.

A temperature management procedure is also administered to ensure most optimum product temperatures during the voyage. The following temperature regimes only serve as a guideline and may change from week to week and even during the voyage.

##### **4.1 Early picked avocados all cultivars**

1<sup>st</sup> phase: Cool to 7.5°C and ship at 7.5°C

2<sup>nd</sup> phase: Reduce DAT to 7°C approximately 5 days after departure of the vessel (Fruit between 8 and 17 days old)

3<sup>rd</sup> phase: Reduce DAT to 6.5°C should the RAT increase.

##### **4.2 Mid season avocados**

1<sup>st</sup> phase: Cool to 6.5°C and ship at 6.5°C.

2<sup>nd</sup> phase: Reduce DAT to 6.0°C approximately 5 days after departure of the vessel.

3<sup>rd</sup> phase: Reduce DAT to 5.5°C should the RAT increase.

##### **4.3 Late season avocados**

1<sup>st</sup> phase: Cool to 5.5°C and ship at 5.5°C.

2<sup>nd</sup> phase: Reduce DAT to 5.0°C approximately 5 days after departure of the vessel.

3<sup>rd</sup> phase: Reduce DAT to 4.5°C should the RAT increase.

Note: These temperatures are not fixed and are changed according to seasonal climatic conditions, cultivars, fruit quality, physiological behaviour of the fruit and even market requirements.

#### **5. HOLDING OF CONTAINER AND TTT**

Product temperature must be maintained after the container is loaded. This is very critical because any heat build up cannot be removed by the transport or shipping equipment.

## ***Requirements***

- The total Time Temperature Tolerance (TTT) that a container with avocados may be without cooling, is three (3) hours.
- A maximum of 2 hours will be allowed between loading the container and coupling to the Holding store in Cape Town or to a Clip-on-unit (COU) in the other ports.
- A maximum of 1 hour will be allowed between removing the container from the Holding store or uncoupling of the COU and reconnecting to the cooling system of the vessel. The Holding store (Cape Town) and COU's (Durban and Port Elizabeth) must be set at the specified DAT. Portnet must record the DAT at least every 4 hours and PPECB must verify the function and correct temperature control at least once every 24 hours. (See par 3.6).
- Gensets must be provided to supply electric power to the cooling unit whenever the traveling time from the cold store to the port terminal exceeds 2 hours.

## **6. SHIPPING, VOYAGE AND DISCHARGE**

### **6.1 During loading and during the voyage**

A very strict temperature management programme must be followed by the Chief Engineer to minimise quality loss. It must however be remembered that:

- The DAT can only be controlled within the specified minimum and maximum temperatures.
- Pulp temperatures during the voyage are available only for certain integral containers and then only if temperature sensors are installed during loading.
- The refrigeration staff of porthole container ships must also take care of up to 880 other port containers plus up to 100 integral containers on the vessel and cannot supervise all product temperatures 24 hours a day for 16 days.

### ***Procedure***

- The PPECB gives verbal and written carrying instructions to the Master and Chief Engineer.
- The brine in the cooling system must be reduced prior to the loading of containers in order to deliver air at the correct temperature immediately after coupling of the last container in any row.
- The temperature thermostat must be set to ensure correct delivery air temperature prior to loading of the container.
- The container must be connected and cooling started immediately after completion of loading the specific row.



- The Chief engineer and his personnel control the DAT and RAT according to the PPECB instructions and reports to the PPECB at regular intervals. The first report must be received within 24 hours after departure. Thereafter temperature reports must be received not later than 12:00 (RSA local time) on every Monday, Wednesday and Friday during the voyage.
- PPECB liaises with the industry representative and formulates corrective measures if required.
- The PPECB informs the Master of the required DAT temperature change.

## **6.2 DURING AND AFTER DISCHARGE**

There is no temperature control during this very critical period after discharge. The responsibility of the vessel also ends when the container is lifted from the vessel. It is therefore the responsibility of the importer or his agent to arrange for immediate collection of the container and recooling as soon as possible to the same final temperature instruction to the vessel.

### **Procedure**

- The fruit must be put under cooling as soon as possible, but within a maximum of 2 hours after discharge.
- Should the importer be unhappy with the condition of the fruit, a competent quality surveyor must be called in immediately.
- The surveyor must provide a detailed technical report on fruit quality, pulp temperatures and general conditions of the load.

## **7. SPECIFIC CHANGES APPLICABLE TO THE 1999 SEASON**

New systems such as inland loading of integral containers as well as new research findings also necessitate changes. Some of these proposed changes need to be tested under commercial conditions. Following is a brief summary of the optimum procedures proposed for the 1998 season.

### **7.1 Picking maturity**

The maturity standards as specified in the quality regulations must be applied. It must be remembered that these are minimum standards and that less mature avocados may develop more chilling injury during cold storage and transport.

### **7.2 Fruit temperature monitoring**

Effective cooling of all the fruit in a consignment to the optimum pulp temperature is one of the most important factors ensuring all fruit arriving hard in the market place.

### **Actions**

1. The avocado industry introduced a system for the placing of a thermocouple in an avocado in the centre of the top third of each pallet. Thermocouple pulp

temperatures will be recorded by the packhouse on dispatch, upon arrival in the port and during container loading.

2. PPECB will record at least four pulp temperatures (thermocouple readings) on arrival in the port. Should the fruit be warmer than the specified optimum, PPECB will take more temperatures to determine if the pallets can be loaded into containers or need to be re-cooled. Final decisions whether to ship or not will be based on thermocouple temperature readings. Pallets will be broken down and pulp temperatures taken if thermocouples were not installed.

### **7.3 Shipping temperature regimes**

Two shipping temperature regimes for porthole container shipments will be possible. A third regime will be available for avocados shipped from Durban later in the season. CA containers can be set individually. Conventional shipping decks can only be operated at one temperature per compartment

#### ***Actions***

1. Optimum recommendation is to start off at 7.0°C at the beginning of the season (i.e. at least first two weeks) and to reduce the delivery air temperature (DAT or set point) to 6.5°C during the voyage.
2. An alternative recommendation where chilling injury may be a problem is to start at 7.5°C and to reduce to 7.0°C during the voyage. It must be remembered that this regime tends to result in softer fruit on arrive overseas.
3. An additional regime of 6.5°C to 6.0°C will be available in porthole containers at the beginning of the season when Natal is not shipping. This regime can be used should softening be expected.
4. Step down of regimes will be introduced as the season progresses and will be based on fruit temperatures recorded during the voyage and on quality feed back from Europe.
5. No step down temperature procedures will be allowed to cater to ineffective precooling and bad planning. A step down temperature regime may be introduced for Pinkerton because this is a planned procedure to achieve an identified goal.
6. All experiments must be finalised at time of booking. No experiments will be allowed at time of shipping because some exporters use experiments as a way to ship warm produce.

All results of approved experiments must be made available to the PPECB. This includes voyage conditions.

### **7.4 Loading temperature**

Detailed loading specifications are given in par. 3.7.2. These are the most optimum parameters and were applied with great success for a number of seasons. A number of practical implications must however be considered. More important factors are:

- Pre-destination (pre-sorting) of fruit requires pallets to be built up over days resulting in different mixes (packer, age, temperature, count etc.) on the same pallet and

making it impossible to segregate between "deadline" and "non-deadline" fruit. Temperature tolerances of the oldest fruit on the pallet will apply.

- Recooling space in the port is becoming very limited (especially due to pre-sorting) and exporters must ensure effective precooling prior to dispatch to the port.

### **Actions**

The following maximum container loading tolerances will be applied during 1999. (i.e., maximum tolerance above the specified initial shipping temperature).

1. Port hole container
  - a. Dead line fruit = Maximum 4°C
  - b. Non-dead line fruit = Maximum 3°C industry request = Maximum 1°C based on industry research
2. Integral refrigerated container = Non CA inland loading  
Maximum tolerance 1.5°C
3. Integral refrigerated container = Non CA port loading  
Maximum tolerance 1.0°C
4. Integral refrigerated container = CA port and inland loading  
Maximum tolerance 1.5°C
5. Conventional shipping decks

### **7.5 CA shipping**

The first four to six shipments of the season tend to arrive softer than preferred. Reasons for this phenomenon are unknown but late summer rains, warm pre-harvest conditions, selective picking of fruit from early blossoms etc. were mentioned as contributory factors.

Investigations during 1997 and 1998 confirmed that fruit softening can be reduced considerably by CA conditions. The CA effect normally becomes less pronounced later in the season.

### **Action**

The PPECB and SAAGA temperature committee recommends that exporters should ship, as much as possible, avocados in CA containers during at least the first four weeks but preferably the first six weeks of the Fuerte season. This does not imply that only CA must be used or that regular atmosphere (RA) does not guarantee good quality, but experience confirmed that softening can be drastically reduced by CA. Hass avocados, except the very early picked fruit, did not respond to the same degree to CA as Fuerte avocados and RA shipments should be based more on economics. The effect of CA on Pinkerton avocados still needs to be confirmed. RA shipments can be phased in at a faster rate from approximately mid-April, i.e., after approximately 6 weeks from the beginning of the season.

## **7.6 Late arrivals**

Avocados must be containerised 12 hours before the estimated time of arrival (ETA) of the ship. This is to allow for planning of the loading operations and container positions. The 12 hour cut-off ruling will be strictly applied, to allow the smooth loading of the very big export crop and also to solve some problems that developed over the past number of seasons.

### ***Actions***

1. Only containers loaded and in the Holding store before cut-off will be shipped. Late arrivals cannot be accommodated after cut-off.
2. Dead freight will be payable on all avocados booked but not shipped.
3. CA containers will be loaded as soon as the "stack opens". This means that CA loading will start as soon as the fruit is available to reduce bottlenecks, especially toward the end of the week.

## **8. FURTHER INVESTIGATIONS**

Changes in volumes, port procedures and shipping concepts need to be managed. A number of semi-commercial experiments and monitoring will be done by the PPECB to formulate new tolerances and procedures. The following are some of the major investigations and must be regarded as experimental. PPECB will not allow exporters to apply these concepts as commercial practices prior to final approval by PPECB.

### **8.7 Inland loading of integral containers**

Maximum loading temperatures are specified in par. 3.7.2. Modern temperature controlling and cooling systems are being installed in some new integral refrigerated containers. These containers have improved cooling potential but must be connected to an external electric power source (genset) to ensure cooling is maintained during transport and handling in depots and the port.

### ***Actions***

1. PPECB, SAAGA, container suppliers and selected exporters will continue experimenting with inland loading to determine the en route cooling characteristics of integral refrigerated containers.
2. Tests will also be done to determine cargo warming rates to establish maximum Time Temperature-Tolerances (TTT's). These TTT's are required to specify maximum periods without cooling.

### **8.2 Recooling rate in Holding store**

The Cape Town Holding store (CTHS) has spare cooling capacity in the chill mode. Air circulation rates through the cartons and pallets may however reduce heat removal, especially in the vertical (top to bottom) mode as the cartons are basically designed for vertical air movement. The effect on RH during the recooling phase in the Holding store is also not known.

The objective will be to increase the percentage direct transfer from RMT's into containers closer to 80% (was 35% in 1997), to reduce handling and breaks in the cold chain.

### ***Action***

PPECB will evaluate the cooling and re-cooling rates in the Holding store and correlate these rates with arrival quality of avocados.

### **8.3 Industry experiments**

It very often happens that, due to factors such insufficient logistical planning and insufficient cooling, the fruit is not on temperature at time of loading. The exporter then requests an experiment. Experiments will only be allowed if:

- Such an experiment is requested at time of booking of shipping space.
- The purpose and procedures are confirmed in writing.
- A written undertaking is given that all parties will make all the technical information available.
- A report on the experiment is finalised and distributed to all the parties involved.

## **9. CONCLUSIONS**

Correct picking maturity, handling and cooling prior to dispatch are absolutely essential, because quality will continue to deteriorate despite the most optimum conditions being applied during storage and transport.

The cold chain must be applied within the specified tolerances. These tolerances cannot accommodate insufficiently precooled fruit or overmature fruit.

Fruit age (i.e., days between picking and arrival in the market place) was shown to be the most important factor, together with product temperature, determining the market quality of the avocados. Fast cooling and minimising delays in transport and shipment guarantees improved quality.