

## ***Handling Procedures for Avocados, 1998 Season***

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### **BACKGROUND**

A detailed technical report on the 1997 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 1 to 5. Changes recommended for the 1998 season as well as semi-commercial investigations are summarised in paragraphs 6 and 7 respectively.

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

### **1. PICKING AND PRECOOLING**

#### **1.1 Picking maturity**

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

Moisture content must never exceed 80% 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 SAAGA informed of moisture content readings.

#### **1.2 Removal 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 pre-cooled and shipped after picking the better.

##### *Recommendation*

- 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.

### **1.3 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 date codes must be stamped onto the cartons.
- The correct date codes must be stamped in such a way that it can be read easily. The best position is in the left upper corner on the front of the carton.

## **2. PRECOOLING AND ROAD TRANSPORT**

### **2.1 Precooling**

The packhouse cold store is the only link in the whole cold chain that can effectively pre-cool 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 the specified temperature as closely as possible.

#### *Requirements*

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

### **2.2 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 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 pre-cooled for at least three (3) hours to the required transport temperature prior to 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 exporter/packer must record the actual pulp temperatures of each and every pallet at the time of loading and the driver must countersign the document.

### **2.3 Off loading in port**

Well planned logistics are essential to ensure quick transfer and minimum temperature increases.

#### *Requirements*

- Loading depot and PPECB Area Manager in the port must be notified of delays on arrival of RMT's.
- RMT's must arrive at the loading depot before the cut-off time.
- Split loads and local market fruit in the same RMT cause delays and temperature increases. This must be avoided.
- Off loading must take place in such a way that a minimum temperature increase takes place.

#### *The PPECB will:*

Check the RMT and the following temperatures prior to opening doors:

- Temperature set point
- Temperature registered on recorder chart
- DAT Delivery air temperature
- RAT Return air temperature
- Validity of the PPECB certificate.

Take the following pulp temperatures of thermocouples where installed or 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.

Reject the avocados for export if:

- The RMT is not registered with the PPECB (does not comply to minimum standards to maintain the cold chain) and the fruit is warmer than the specified initial shipping temperature (Durban and Port Elizabeth) or the Cape Town holding store intake temperature.
- The pulp temperature either be warmer than specified in par. 2.4 or colder than 1.0°C below the specified initial temperature.

- The fruit will be older than 12 days at 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 this happen.

## **2.4 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. Re-cooling must be resumed as soon as possible to ensure compliance to the TTT as specified in par. 4.

**Note:** Clip-on-units (COU's) may be used in Durban and Port Elizabeth but must be calibrated and designated for the use of avocados. A thermocouple must be installed in the delivery air stream and must be read on commencement of cooling and every 12 hours thereafter to ensure accurate temperature control.

### *Requirements*

Large scale industry research results confirms 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. (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<sup>\*\*</sup>): 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

Commercially monitored temperatures and fruit quality results over the past 4 seasons confirmed that avocados 7 days and older can be containerised at 2°C above the optimum specified temperature. 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.

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

### ***Loading temperatures in Cape Town***

The port of Cape Town is best equipped for container loading and conventional shipping of avocados (and other perishable produce). It is therefore possible to deviate slightly from the optimum product requirement and still maintain product temperature and quality. The following criteria apply:

- Loading of **port hole containers**

## Temperature requirements

- Fruit up to 3 days old = Maximum 4.0°C above loading temperatures
- Fruit 4 to 6 days old = Maximum 3.0°C above loading temperatures
- Fruit 7 to 12 days old = Maximum 2.0°C above loading temperatures.

- Loading of **integral refrigerated containers**

All avocados maximum 0.5°C above set point

- Loading of **CA integral refrigerated containers**

All avocados maximum 1.5°C above set point

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 avocados maximum of 2°C above the specified carrying temperature.

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

Due to limited cold storage space in and around the ports for avocado container loading, the following temperatures shall apply:

- Loading into **port hole containers**

All avocados maximum 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.

- Loading into **integral refrigerated containers**

Maximum 0.5°C above set point as for Cape Town

- Loading into **CA integral refrigerated container**

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

## **3. SHIPPING TEMPERATURE REGIMES**

Shipping temperatures are continuously adapted during the season according to 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 optimum product temperatures during the voyage. The following temperature regimes only serve as a guide line and may change from week to week and even during the voyage.

### **Early picked avocados (all cultivars)**

- 1st phase: Cool to 7.5°C and ship at 7.5°C
- 2nd phase: Reduce to 7°C approximately 5 days after departure of the vessel (Fruit between 17 and 8 days old)
- 3rd phase: Reduce to 6.5°C should warming occur.

### **Mid season avocados**

- 1st phase: Cool to 6.5°C and ship at 6.5°C
- 2nd phase: Reduce to 6.0°C approximately 5 days after departure of the vessel.
- 3rd phase: Reduce to 4.5°C should warming occur.

### **Late season avocados**

- 1st phase: Cool to 5.5°C and ship at 5.5°C
- 2nd phase: Reduce to 5.0°C approximately 5 days after departure of the vessel.
- 3rd phase: Reduce to 4.5°C should warming occur.

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

## **4. 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 a Clip-on-Unit (COU) in other ports.
- A maximum of 1 hour will be allowed between removing the container from the holding store or uncoupling of the COU to 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. Formet 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.

NB: See note re. COU par. 2.4.

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

### **5.1 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 are not known during the voyage.
- The refrigeration staff must also take care of up to 880 other refrigerated containers on the vessel and cannot supervise the avocado 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 the correct temperature prior to loading.
- The container must be connected and cooling started immediately after completion of loading a specific row.
- The vessel (container and/or conventional) controls the DAT/RAT according to PPECB instructions and reports to the PPECB at regular intervals. The first report must be received preferably within the first 24 hours but not later than 48 hours after departure from Cape Town. Thereafter temperature reports must be received not later than 12h00 every Monday, Wednesday and Friday during the voyage.
- PPECB liaise with the industry representative and formulate corrective measures, if required.
- The PPECB informs the Master of the required DAT temperature change.

### **5.2 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 immediate collection of the container. This is especially important for discharge in the port of Tilbury.

## **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 file a report and complete the PPECB quality questionnaire.

## **6. SPECIFIC CHANGES APPLICABLE TO THE 1998 SEASON**

A number of different and new factors must be considered for the 1998 export season. One of the major aspects to manage is the expected record crop of more than 12 million cartons. This is approximately double the size of the previous season.

New systems such as controlled atmosphere (CA) containers as well as new research findings also necessitates 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.

### **6.1 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.

#### *Action*

SAAGA will institute a process in co-operation with PPECB and others, to monitor oil content on a regular basis during the season for a longer period (Weeks 9, 10, and 11; two fruit per pallet per packhouse for oil tests Moisture tests must be done within 3 hours from picking.)

### **6.2 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*

- SAAGA have introduced a system for the placement 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 and again on arrival in the port.
- PPECB will record at least four pulp temperatures (preferably the thermocouple readings) on arrival in the port. Should the fruit be warmer than the specified optimum, PPECB will take at least one temperature per every second pallet to determine if the pallets can be loaded into containers need to be re-cooled.



### **6.3 Shipping temperature regimes.**

PPECB will, as in the past, ensure two shipping temperature regimes. A third regime will be available for avocados shipped from Durban later in the season.

#### *Actions*

- Optimum recommendation is to start off at 7°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.
- Alternative recommendation where chilling injury may be a problem is to start at 7.5°C and to reduce to 7°C during the voyage. It must be remembered that this regime tends to result in softer fruit on arrival overseas.
- Additional regime of 6.5°C to 6°C will be available at the beginning of the season when Natal is not shipping. This regime can be used, should softening be a problem.
- Step down of regimes will be introduced as the season progresses and will be based on quality feedback from Europe.

### **6.4 Loading temperature**

Detailed loading specifications are given in par. 2.4.

These are 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:

- A large potential crop putting extreme pressures on all infrastructures including port handling and cold chain maintenance.
- Pre-destination (pre-sorting) of fruit require pallets to be built up over days resulting in different mixes (packer, age, temperature count etc) on the same pallet making it impossible to segregate between "deadline" and "non-deadline".
- Re-cooling space in the port is becoming very limited (especially due to pre-sorting) and exporters continued to send warm fruit to the port.

This has resulted in 65% of the fruit requiring re-cooling prior to shipment during 1997.

- Handling costs of loading depots increasing because of pre-sorting per destination, re-cooling etc.

#### *Actions*

The following maximum loading tolerances above the first phase loading temperature specification will be applied during 1998:

- Port hole container

Dead line fruit = Maximum 4°C

Non-dead line fruit = Maximum 3°C

- Integral refrigerated container (Non CA)

All fruit = Maximum 0.5°C

- Integral refrigerated container (CA)

All fruit = Maximum 1.5°C

- Conventional shipping decks

All fruit = Maximum 2°C

## **6.5 CA Shipping**

At least the first four shipments of the past number of seasons arrived softer than preferred. Reasons for the phenomenon are unknown but late summer rains, warm pre-harvest conditions, selective picking of fruit from early blossoms, etc. were mentioned.

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

### *Action*

Exporters should ship as many avocados as possible in CA containers during the first four 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 that softening can drastically be reduced by CA.

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.

## **6.6 Late arrivals**

Avocados, and other perishable products, 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 for the smooth loading of the very large export crop and also to solve some problems that developed over the past number of seasons.

### *Actions*

- Only containers loaded and ready before cut-off will be shipped. Containers loaded after cut-off will stay behind.
- Dead freight will be payable on all avocados booked but not shipped.
- CA containers will be loaded as soon as the "stack opens" and not only during the two days prior to the ETA of the vessel. This means that C A loading will normally start on a Monday for shipment the following weekend.

## **7. 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.

### **7.1 Inland loading of integral containers**

Maximum loading temperatures are specified in par. 2.4. Modern temperature controlling and cooling systems are being installed in some new integral refrigerated containers. It is claimed that these containers have improved cooling potential when connected to an external electric power source.

#### *Actions*

- PPECB, SAAGA, container suppliers and selected exporters will experiment with warmer inland loading temperatures to determine the *en route* cooling characteristics of integral refrigerated containers.

Tests will also be done to determine the cargo warming rate to establish maximum Time-Temperature-Tolerances (TTT's). These TTT's are required to specify maximum periods without cooling.

### **7.2 Loading temperatures CA containers**

CA reduces heat of respiration and therefore also the total heat load in the container. This may allow for possible warmer loading temperatures should it be necessary for early shipping. Loading at pulp temperatures up to 1.5°C above container thermostat set point did not affect final fruit quality provided CA conditions are established immediately after completion of loading.

#### *Action*

PPECB will, in co-operation with SAAGA and the container and CA operators, evaluate the response of avocados loaded up to 3°C above container thermostat set point.

### **7.3 Re-cooling rate in holding store**

The Cape Town holding store (CTHS) has plenty of 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 re-cooling phase in the holding store is also not known.

The expected increase from 6.2 million to more than 12 million cartons of avocados to be exported during 1998, will put tremendous pressure on all infrastructure in the port of Cape Town. All systems and cold chain management in the port, through the loading depots and the holding store will have to be evaluated.

The objective would be to increase the percentage direct transfer from RMT's into containers to 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.

## **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 pre-cooled 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 avocados. Fast cooling and minimising delays in transport and shipment guarantees improved quality.