

## AIC Ethylene Ripening Protocol

### Controlled Ripening – The Equipment and Technique

Ethylene is used to trigger the ripening of mature avocados. The use of ethylene ripening rooms enables avocados to ripen under ideal controlled conditions.

#### THE EQUIPMENT

The essential requirements of an ethylene ripening system are:

- A reasonably air tight room with insulation
- A temperature control system for cooling and/or heating
- An air circulation and ventilation system
- Humidity control
- An ethylene gas injection system and
- An electric control system

There are two methods of injecting ethylene into the room. Either method can be used. Room construction, heating and refrigeration requirements and air circulation within the room are similar for both methods. The two methods differ in the system of ethylene injection and the controlled amount of fresh air ventilation used in the trickle system.

#### SHOT METHOD

- 1- A concentration of 100 ppm ethylene is injected every 16 – 20 hours for 60 to 24 hours (time decreases as maturity increases during the season).
- 2- Before each injection, the room must be thoroughly ventilated by leaving all doors open for 5 to 10 minutes with the fan running. This prevents carbon dioxide levels building to concentrations that may adversely affect normal ripening.

#### TRICKLE METHOD

- 1- A concentration of 10 – 15 ppm ethylene is continually trickled into the room for 60 to 24 hours (time decreases as maturity increases during the season).
- 2- Inlet and outlet tubes are placed in the walls of the ripening room to maintain a flow of outside air through the room of about 1 percent of the room volume per minute. This must be done to prevent carbon dioxide levels building to concentrations that may adversely affect normal ripening.

The trickle system has several advantages over the older 'shot' method and is now widely adopted. Advantages of the trickle ethylene system are:

- Better control of temperature, ethylene and carbon dioxide concentration and humidity leading to more consistent fruit quality.
- Improved safety.
- The door may be opened at any time to load and unload fruit. (However it is advisable to open the door only when necessary)

## **THE TRICKLE ETHYLENE SYSTEM**

The essential feature of the trickle ethylene system is the continuous supply into the room of a trickle of ethylene gas to maintain the required concentration. An air flow and ventilation system circulates the room air and continuously introduces a small volume of fresh air while exhausting a similar volume of room air. This must be done to prevent the build-up of ethylene gas and carbon dioxide gas produced by the fruit.

The air circulation fans must run continuously during trickle ethylene ripening.

A vent pipe is positioned on the up stream side of the fan so that a fresh air intake of 1% of the room volume per minute is drawn from outside the room. The intake flow can be adjusted by altering the distance between the vent pipe and the fan or by using an adjustable gate valve. The flow rate through the vent pipe must be checked with an anemometer.

Another vent pipe near the floor on the downstream side of the fan allows stale carbon dioxide-charged air to escape.

## **ETHYLENE CONCENTRATION FOR TRICKLE SYSTEM**

Ethylene gas is bled into the room's incoming fresh air stream at a rate to maintain the concentration in the room at the desired level. Though the concentration of ethylene is not critical, concentrations of 10 – 15 ppm are adequate for ripening of avocados.

## **METERING ETHYLENE**

The gas is released into the room at a controlled rate of flow through a pressure regulator and metering system.

## **ELECTRICAL CONTROL CIRCUIT**

To ensure complete safety in the operation of trickle ripening rooms they must be fitted with a solenoid – operated valve to cut-off the ethylene supply in case of a power failure.

Ethylene is flammable at concentrations between 3.1 and 32% in air. Check all safety procedures especially with regard to compressed cylinders of ethylene or any other gas. Please be aware of any OSH issues.

## **TEMPERATURE CONTROL**

The recommended temperature range for ripening avocados is 16 to 20°C. Following the ethylene treatment the room must be vented and the fruit held at 16 to 20°C until it starts to soften, i.e. until it is sprung, which occurs approximately in 12 hours. Air circulation must be maintained at all stages during storage.

At temperatures above 20°C, disease development increases. Above 25 to 30°C, fruit soften unevenly, the skin discolours and off-flavours develop. At low ripening temperatures chilling injury often occurs.

Sufficient refrigeration capacity and air circulation is necessary to cool or warm fruit to the range of 16 to 20°C within 8 – 12 hours. This is easily achieved with forced air systems where the room is designed to force air through packages. During forced air ripening the air volume through the stack of fruit should be reduced to about one-third of that required for forced air cooling.

A relative humidity of 80 to 90% is recommended during and following ethylene treatment. Relative humidities below this range may lead to moisture loss and shriveling.

## **THE TECHNIQUE**

Steps in Controlled Ripening:

- 1- Place green mature avocados in the ripening room and cool or warm fruit to 16 to 20°C within 8 – 12 hours.
- 2- Trickle ethylene into the room at 10 to 15 ppm for two days (48 hours)
- 3- After 48 hours, remove fruit from the influence of ethylene by venting the room with circulating air or placing the fruit into an auxiliary room. Continue to store them at 16 to 20°C until they are 'sprung' (i.e. easily detectable softening when squeezed, which normally occurs between 8 and 12 hours). Avocados will start to soften and will be sprung 1 to 2 days after removal from ethylene.

- 4- Once avocados have reached the 'sprung' stage they can be stored at 2 to 4°C for 7 to 14 days to slow down further ripening. If left at 16 to 20°C or above, they will take 1 to 3 days to advance to the eating ripe stage from the sprung stage.

## IMPORTANT POINTS

- Two days of ethylene is usually sufficient to trigger the ripening process in avocados. However it may require up to 60 hours early in the season.
- Once ripening has started it can not be stopped only slowed
- Fruit needs to be treated in batches according to age of product (similar pick dates)
- After two days of gassing, firmness will vary from hard to just softening to sprung (easily detectable softening). Fruit will be eating ripe in another 1 to 3 days following the sprung stage if kept at 16 to 20°C or above.
- Avocados will not be eating ripe 48 hours after placing in the ripening room.
- Avocados are sometimes eating ripe 3 days from the start of gassing but the ripening time could be as long as 8 days if fruit maturity is not advanced.
- After fruit has been stored for 2 weeks or more, time from gassing to eating ripe is usually less than for unstored fruit.
- The later ethylene is applied after harvest to green mature fruit, the more uniform the ripening of fruit within a tray.
- Similar techniques of controlled ripening are used for another tropical and sub-tropical fruits. Ripening rooms used for bananas are also suitable for avocados.
- There is an art to the ethylene ripening and all lines are different. You will need to fine tune the process according to your own experience to achieve best results.