Citrus Packhouse

Module 4: Receiving and Initial Processes

Learner Guide

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1st edition 2022

The content of this module is based on audio-visual material produced by the Citrus Academy.

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Produced by

In collaboration with

With the support of

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Introduction

Fruit arrives at the packhouse from the orchard in picking bins or trailers, covered in dust, warm from the sun, and with all sizes and sorts mixed together. The only thing you can know for sure is that the citrus fruit in each bin or trailer is the same type and cultivar, and has been picked in the same orchard.

It is the responsibility of the packhouse to clean the fruit, de-green them if necessary, treat them with fungicides to kill established disease, improve their appearance and shelf-life by applying wax, separate them into size and quality categories, and then to pack like fruit together in boxes, ready to be loaded and taken to the harbour for export.

The first step in this process is to receive the fruit at the packhouse and, if necessary, to store it until it can be processed. If fruit is not processed straight away, and especially if it is going to be de-greened, it is drenched to protect against decay. If required, fruit is now de-greened to improve its colour. Right before it enters the packhouse process, the fruit is weighed and the details of the delivery are recorded. Fruit is also pre-sorted to remove green bombs and finally washed, at which point it enters the packhouse.

Receiving

As we have mentioned, fruit is delivered to the packhouse in picking bins or in picking trailers. Bins can be stacked on the back of flatbed trucks, or transported on specialised trailers attached to tractors. On arrival at the packhouse, bins are stacked in storage areas, where a first-in/first-out system is used to make sure that the fruit that was received first is processed first. Sometimes the packhouse is not that busy, and the fruit is processed right away. Trailers are simply unhitched from tractors and left to wait their turn, out of direct sunlight.

If fruit has to be stored for an extended period, such as over a weekend, it is best to store bins in closed storage areas. This fruit should be drenched to protect them from decay even if they are not going to be de-greened.

Weighing

Before fruit enters the packhouse process, the weight of the fruit in each bin or trailer is determined and recorded, along with the delivery date, the PUC of the production unit, the orchard and block number, the type and cultivar of the fruit, and any other relevant information. To enable traceability, it is a good idea to assign a batch number to each delivery which follows the fruit through the packhouse.

The manner in which the fruit is weighed, and the equipment that is used to do this, varies between packhouses, and depends on whether the fruit is in bins or trailers. At some packhouses, individual bins are placed on large scales and the details of the bin and its weight are recorded on the system right before the bin goes into the tipper. In other cases, the details of the bin are recorded on the system but it is only weighed right before it is tipped by scales that are integrated in the tipper system.

Picking trailers have to be weighed on a weighbridge, but few packhouses have weighbridges on the premises. Those packhouses often use an average, weighing ten or twenty trailers at a nearby weighbridge when they start picking a new cultivar, and using the average weight for all the trailers of that cultivar. Best practice is however to weigh every individual trailer and record the exact weight.

Packhouse Delivery Inspection

If the fruit is destined for a phytosanitary market, it has to be inspected at this point for false codling moth and fruit fly infestation. This inspection is part of the management system developed by CRI, aimed at eliminating the risk of FCM and fruit fly infestation of export fruit. For more details on these inspections, please watch the Citrus Academy audio-visual module on Monitoring and Inspection for Phytosanitary Markets.

Drench

The purpose of the drench is to remove the field heat from the fruit, and to protect the fruit from decay during de-greening and storage. All fruit that has to be de-greened is drenched before going into the de-greening rooms. Fruit that is going to spend an extended period stacked in storage waiting to be processed must also be drenched to protect it against decay. Some packhouses go as far as drenching all fruit that is not going to be packed within a few hours after arriving at the packhouse. This practice has a significant impact on reducing fruit decay and assuring quality.

There are different kinds of drench systems, but the most common involves stacking fruit bins two high in a drench with side covers, and flooding the fruit with water containing treatment chemicals. If the fruit is in trailers, it is first tipped and the fruit that has to be de-greened is sorted out and collected into bins to be drenched. Note that it is best practice not to stack bins more than two high, otherwise one will not get sufficient coverage of the treatment chemicals on all the fruit, particularly those in the bottom bins. The drench solution is recycled constantly, and replaced after a certain number of bins. The size of the drench tanks determines how many tons of fruit can be treated before replacing the solution.

Generally, fungicides, a water sanitiser and 2.4-D are used in the drench. 2.4-D helps to prevent the calyx from abscising. CRI issues and updates recommendations for the drench mix on a regular basis, and it is advisable to follow these recommendations closely. These include recommendations for the chemicals used in the drench, the mixing protocol and the drench operation. Be aware of the residue thresholds for your export markets and make sure that they are not exceeded.

Coverage and contact time are the crucial factors in the drench to ensure maximum benefit. Make sure that these recommendations are strictly adhered to for every batch of fruit. After drenching the fruit, it must be allowed to dry completely before going into the de-greening rooms. Ethylene gas cannot penetrate through moisture, and if fruit is still wet, it will take much longer to de-green.

De-greening

Citrus fruit reaches maturity in the winter months, between February and September, depending on the type of citrus and the cultivar, and the production region. The fruit rind changing colour is one of the last stages of the physiological maturing process, and it is possible for fruit to have matured internally, meaning they have reached the minimum sugar and acid levels the market requires, but not yet to have developed external colour. Growers are keen to start picking and packing their fruit as soon as they can to get into the market as early as possible.

De-greening is a treatment that accelerates the rind colour development by exposing fruit to ethylene in special rooms in the packhouse. Ethylene is a natural hormone that is associated

with cellular processes involved in ripening, such as the breakdown of acids and rind colour development. Ethylene specifically breaks down the green chlorophyll pigments in the flavedo, and induces orange carotene pigments to be synthesised more quickly.

Many types of citrus, including lemons, grapefruit, oranges, and tangerines, can be de-greened, but it is important to remember that fruit should only be de-greened after colour-break, meaning that natural colour development has to have started for de-greening to work. The temperature, ethylene concentration and exposure time are the critical factors for de-greening. Typically, fruit is exposed to between one and three parts per million ethylene gas for one to three days, at a temperature of between 18°C and 25°C. These factors vary for each type of citrus and cultivar, and depends on the colour of the fruit going into the de-greening rooms. Relative humidity and carbon dioxide levels inside de-greening rooms must also be managed rigorously.

The temperature, ethylene concentration, carbon dioxide levels, and relative humidity in de-greening rooms are monitored by sensors inside the rooms. The levels can be adjusted manually or electronically, with the most advanced systems monitoring and automatically adjusting the levels according to programmed set points.

Pre-Sorting

Before fruit enters the packhouse process, it is essential to remove green bombs and fruit that is clearly not suitable for export. Green bombs, which are fruit that is badly infected with fungal pathogens, will contaminate the systems and other fruit, and increase the spore load in the packhouse. Processing and treating fruit clearly not suitable for export beyond this point is a waste of time and money.

Pre-sorters remove all fruit that is decayed, split or clearly not suitable for export. They can also remove fruit that is too large or too small for export, but a pony sizer can also be used for this purpose. Decayed and split fruit is removed and destroyed – please see the module on Packhouse Sanitation for more details – and other fruit can be redirected to the local market lines or processing bins.

Fruit Washing

Fruit enters the packhouse through a wet or dry tip. Fruit is washed with water containing a sanitiser, in order to kill fungal spores, and to remove organic material and dirt that may have collected on it in the orchard and during picking and transport.

Sanitisers

Chlorine is a popular sanitiser in washing systems. The efficacy of chlorine however depends on the pH of the water, and on how clean the solution is. Chlorine is three times more effective in water with pH7 than pH8, and it is most effective if used in water with a pH between 6.5 and 7.5. If the pH of the water is outside this range, it should be corrected before being used in the washing system. If the sanitising solution in the washer becomes dirty, the chlorine will bind with the dirt particles in the water and become less effective at sanitising the fruit.

It is also important to keep in mind that chlorine breaks down Imazalil, one of the most important postharvest fungicides, and it will compromise the efficacy of the fungicide treatment if still present. Therefore, effective drying of the fruit before the fungicide bath is important.

Chlorine, or calcium hypochlorite products that have been formulated for swimming pools should never be used in a packhouse. Chlorine is volatile, and the formulations meant for use in a packhouse quickly dissipate after doing its job and sanitising the water. Swimming pool products are formulated so that the chlorine is released over a longer period to extend its sanitising action. Such a formulation gives enough active concentration in clear swimming pool environments, but the active concentration at any given time is much too low for our application. Furthermore, swimming pool formulations contain UV stabilisers and flow agents, creating a risk of unwanted residues on fruit.

Peracetic acid, or PAA, products are also used as sanitisers in washing systems, and are becoming more popular. It is important to consult CRI recommendations, and to follow the manufacturer's instructions closely for the correct concentration and application methods. Ozone is another sanitiser that is becoming more popular, and is applied to washed fruit by specialised systems.

When new sanitising products come onto the market, they have to be registered under the National Regulator for Compulsory Specifications Act (Act 5 of 2015). As part of the registration, the efficacy, possible side effects, residues, and the effects of long-term use must be verified. These findings are available from the manufacturer, and CRI can be consulted to be sure the product is suitable for use in a citrus packhouse. Remember, CRI act in the interests of the citrus industry alone.

Tip Systems

Fruit enters the packline through a dry or wet tip system. In a dry tip system, fruit is gently let out of bins onto a conveyor. In a wet tip, the fruit is tipped into a bath or tank of water. The water is agitated using, for instance, water jets at one end, so that the fruit moves through the bath. The fruit moves out of the bath on an elevator system and onto a conveyor.

The fruit then moves through a washing system with rollers and brushes. The sanitising solution is in a reservoir below the washing system from where it is sprayed through nozzles onto the fruit. The fruit is scrubbed clean of scale insects and dirt by the brushes.

The concentration of the sanitiser in the washing system should be checked regularly, and the sanitising solution should be filtered, and replaced regularly to ensure that it remains clean and effective. Spores, dirt and debris can build up in the system through the day, and this can form biofilm in the pipes and around the inside walls of the water reservoirs. Biofilm is an accumulation of fungi and bacteria, and can lead to the whole system becoming contaminated. At the end of each day, water reservoirs should be drained and washed with clean water.

Conclusion

If we have followed protocols and best practice, at this point of the packhouse process we will have fruit that is de-greened, healthy, clean and likely to be exported. In the next module, we look at how fruit is treated with fungicides and waxed in preparation for being packed.