Packer Newsletter

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HAL Horticulture Australia

Early season degreening and associated practices (condensed version).

Abridged version. Full text and references can be found in Packer Newsletter no. 100.

There are a number of important considerations in handling early season fruit destined for degreening. They can vary but detailed instructions for Australian conditions can be found in the Citrus Handling Guide (Tugwell 1999).

A summary of the important harvesting considerations is;

- Early season Navel oranges must show some natural colour development prior to degreening
- Fruit picked when trees are suffering water stress tend to wilt and lose their calyx during degreening.
- Hot fruit should be allowed to cool to below 27°C before degreening commences
- Fruit intended for degreening should be harvested with special care to minimize injury and wastage due to higher risk of mould development.
- Wet, turgid fruit should not be picked because this fruit is likely to incur rind cell disruption (Oleocellosis). Oleocellosis spots remain an obvious dark green after the degreening process.
- Full colour will not develop during degreening if oil sprays have been applied shortly before harvest.

Bin Drenching

Fungicide application prior to degreening is important because degreening provides ideal conditions for mould development. Tugwell (1999) suggested that dipping in fungicide is also useful because evaporation from wet fruit raises the humidity within the degreening room. However, wet fruit is a potential problem when humidity is already very high and there is insufficient airflow to evaporate free water from the fruit's surface. If your degreening rooms are already at optimum humidity &/or you have automated humidity control, you may be better to leave dipped fruit for 2-3 hours to dry before placing in the room. What you do depends on your situation, and requires effective monitoring of the conditions in your degreening rooms.

The calyx can be kept green by dipping in a solution containing 2,4-D before degreening. The effect can vary with cultivar, with best results obtained on lemons (Tugwell 1999). The optimum rates of 2,4-D ester vary but lower rates are often cited for use on easy peel cultivars.

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Inside This Issue

Read the Packer Newsletter and stop the rot.

SARDI South Australian Research and Development Institute

Government of South Australia
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ETHYLENE CONDITIONING TO REDUCE CHILLING INJURY AND NON-CHILLING PEEL PITTING IN MATURE FRUIT

There were many presentations at the International Citrus Congress in Spain but one that caught my eye was a poster on using ethylene to extend storage life. Before the Congress, I had been thinking about conditioning fruit to reduce chilling injury; and here was an interesting approach that didn't involve heating the fruit excessively.

Dr. LaFuente and co-workers at IATA-CSIC conducted their work on fully coloured Navelate oranges. The fruit were held for 4days under 2ppm ethylene (ethylene conditioned) and 90-95%RH before placing into either 12°C or 2°C for up to 60 days storage. The control fruit were treated the same except the first 4 days were in air only (no ethylene conditioning).

The results showed reductions in chilling injury in ethylene conditioned fruit held at 2°C and non-chill pitting at 12°C. Their conclusion was that ethylene conditioning improved postharvest life of Navelate oranges without any deleterious effects on internal or external fruit quality. However, It was difficult for me to interpret the practical implications because only damage indexes presented. The differences in non-chill pitting were large but the levels of chilling injury in were low for both control and ethylene conditioned treatments (assuming a low index value means less damage). My interest is in chilling beer: Err.. Sorry; I meant 'chilling injury'. It would be very interesting to hold fruit at lower storage temperatures, as required for disinfestation protocols. Slightly higher temperatures during ethylene conditioning may also provide heat and ethylene conditioning. This combination may reduce chilling injury further but other quality indicators, such as weight loss, would then need to be assessed. Interesting, but more work is needed!

PETER TAVERNER

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SORTING

The sorting of fruit into same colour groups prior to degreening is highly desirable since each colour group can be degreened for the optimum period. Wardowski *et. al.* (2006) found that colour sorting actually increases the efficiency of degreening and reduces decay.

DEGREENING PROCESS

Sometimes external appearances early in the season can be deceiving ; fruit can be green but internally mature. Under ideal conditions, as fruit matures it produces sufficient ethylene to colour naturally (Wardowski, Miller and Grierson 2006). When this does not occur, ethylene gas can be applied to hasten colouring. Ethylene does not ripen citrus fruits. However, ethylene does destroy chlorophyll, and promote the development of yellow and orange carotenoids in the flavedo (Stewart and Wheaton 1972).

The temperature (typically, 22° to 24° C) and high humidity (ideally, 95% RH) required for ethylene degreening also provides ideal conditions for the development of postharvest disease. Ethylene accelerates senescence of the fruit calyx, which favours 'stem-end rots'. Ethylene also plays a role in the induction of anthracnose decay. The level of ethylene used in degreening is important.

DEGREENING PRACTICES

The 'trickle' method is a common method to apply ethylene. Traditionally, the concentration of ethylene is usually around 5ppm, and should seldom exceed 10ppm. However, it has long been recognised that 1ppm is adequate (Grierson 2004) and, perhaps, becoming more practical to achieve.

Efficient airflow and ventilation facilitates uniform distribution of the ethylene and removes accumulated carbon dioxide. If you can measure CO_2 concentrations; the concentration should remain below 0.3%. If you can't measure CO_2, the common air ventilation recommendation of one room volume per hour is usually successful, but is related to good room design and automated humidity control (Wardowski *et. al.* 2006). The most undesirable effect of degreening under low humidity is fruit softening, and exacerbation of injuries and rind weaknesses.

Each growing region must determine its own optimum degreening conditions, especially temperature range. In Australia, a uniform temperature of between 20°C and 25°C for oranges and up to 30°C lemons is considered ideal for colour development (Tugwell 1999). Humidity should be above 80% while heating fruit and above 90% when up to uniform temperature. Maintaining above 95% RH is difficult without automatic controls, but the 'up-front' cost may be well worth it (see article back page).

HIGH ETHYLENE LEVELS CAN PROMOTE ANTHRACNOSE

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PETER TAVERNER

COMPATIBILITY OF PERACETIC ACID IN FUNGICIDE AND SALT MIXTURES.

Mixtures of fungicide and salt are becoming more common to overcome fungicide resistance, controlling sour rot or otherwise enhancing fungicidal action. We also recommend constantly sanitising recirculating water to avoid microbe accumulation (especially sour rot spores); this includes sanitising fungicide tanks. But, as more elements are added to the tank mixture the compatibility and efficacy becomes increasingly unpredictable. Salts and sanitisers acting as strong pH buffering agents can influence the efficacy of sanitiser and fungicide; sometimes for the better, sometimes for the worse and other times not at all. We are interested in trying to unravel these interactions but the potential combinations are bewildering.

In this study, we evaluated six fungicides but chose only one sanitiser; Tsunami on farm (Active Constituents: 110 g/L hydrogen peroxide, 160 g/L peracetic acid). Peracetic acid (PAA) has demonstrated good compatibility with these fungicides (without salts). The salts evaluated were sodium bicarbonate (Na bicarbonate) and potassium sorbate (K sorbate). Na bicarbonate is cheap and commonly used but tends to buffer into the alkaline range. K sorbate is more expensive but concentration can be monitored and disposal of K salts is often less regulated than for Na salts. However, we mainly evaluated K sorbate because it should buffer closer to neutral than Na bicarbonate.

We looked at PAA stability over time as an indicator of compatibility, and measured the pH change of combinations. The results are shown in Table 1. The stability of peroxyacetic acid (PAA) in mixtures with fungicide or fungicide with Na bicarbonate and K sorbate, was variable. An 80ppm PAA solution in RO water remained stable for at least 4 hours. Generally, the sanitiser and fungicide combinations were stable, except Philabuster where the concentration of PAA dropped to 60ppm in 5 minutes. We readjusted early losses back to 80ppm to see if this was just an initial 'demand'. We conclude it was where it remained stable for 1 hour after top up.

The PAA mixtures with Na bicarbonate and K sorbate demonstrated a loss of 20ppm after 1 hour. The combination of PAA, a fungicide and the salts varied but losses were usually modest or stable after topping up. This is encouraging but only indicative; we need to measure efficacy directly.

There are significant pH changes occurring with the various combinations. A pH change can have pronounced effects on fungicide efficacy and residue uptake. Peracetic acid is more effective at neutral or slight acidic conditions. The difference in efficacy is considered to be small between pH 5 to 8. However, much of the work has been for the control of bacteria, and very little on fungal spores .

Stay tuned! This is only the first piece in the puzzle. Much more work is required to determine the interactions of these mixtures. PETER TAVERNER

Fungicide	Salt	pH	PAA (ppm)	
			5 minutes	1 hour
No Fungicide	No Salt	4.0	80	80
	Na Bicarbonate	7.7	80	60
	K Sorbate	6.5	80	60
Magnate 750WG	No salt	3.3	80	80
	Na Bicarbonate	7.5	80	40
	K Sorbate	6.2	80	60
Fungaflor 500EC	No salt	4.8	80	80
	Na Bicarbonate	7.8	80	60
	K Sorbate	6.6	80	60
Scholar	No salt	4.0	80	80
	Na Bicarbonate	7.9	80	80
	K Sorbate	6.4	80	70
Tecto SC	No salt	4.3	80	80
	Na Bicarbonate	7.6	60	80
	K Sorbate	6.4	80	60
Philabuster	No salt	4.4	60	80
	Na Bicarbonate	8.0	80	60
	K Sorbate	6.4	80	60
Penbotec	No salt	4.4	80	80
	Na Bicarbonate	7.7	80	60
	K Sorbate	6.5	80	80

TABLE 1. PERACETIC ACID (PAA) CONCENTRATION AND PH OF TSUNAMI COMBINED WITH VARIOUS FUNGICIDES ALONE OR WITH SODIUM BICARBONATE OR POTASSIUM SORBATE, OVER A 1 HOUR PERIOD.

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Major voluntary contributors:

Postharvest Snippets!

International Citrus Congress held in Valencia, Spain

It was great to see a large Australian contingent in Spain for the Congress. Many grower/packers were keenly soaking up any information on offer. I certainly enjoyed sharing the experience with like-minded Australians.

I was also keen to spend time some with other postharvest researchers [I was lucky to meet the meditative and munificent Lluís Palou, the gigantic and garrulous Arno Erasmus and my only Belgian subscriber]. I was also curious about the newsletter readership; quite a few overseas people have requested it. I often wonder; do they still read it, or just press the delete button?

Wow! I was pleasantly surprised by the range of people that recognised my work. Many people read the newsletter regularly and in detail!

Pre season packer workshops

Murray Valley Citrus are sponsoring a workshop in Mildura early April. I will be presenting tips on maintaining appropriate fungicide residues on fruit. I will also talk about our fungicide resistance testing and some of the results.

Around the same time, Citrus Australia will be conducting sessions for packers in the Riverina and the Riverland. I was asked to give similar presentation at these meetings.

Degreening Mandarins: the condensed version

Full text in Packer Newsletter no. 100

Mandarins are more perishable than other citrus. Delays due to degreening pose increased challenges to maintaining fruit quality.

Temperature

The optimum temperature for degreening varies according to local climate and the initial colour of the fruit. Florida, similar in climate to Queensland, maintains a fairly high degreening temperature of 29°C. Mediterranean-type climates, similar to our Southern states, commonly use temperatures of 20-25°C. Although, some reports suggest that Spain degreen Satsuma and other early mandarin varieties at 18-22°C. A South African study compared degreening of Satsumas at 18°C and 24°C. They found that the higher temperature resulted in darker orange colour, but more fruit changed colour at the lower temperature. Regardless, there should be some colour break on tree before degreening.

Taste

Ethylene degreening may have an adverse effect of internal quality, resulting in off flavours. Another Spanish study found that degreening early season Satsuma mandarins (3-5 days; 4 ppm ethylene at 20°C) maintained quality. They also integrated a curing period into the degreening process (3-5 days; 4 ppm ethylene at 30°C). Early season fruit can be slow to reduce acid to palatable levels. Short periods of conditioning at 30°C can reduce acid levels and, thereby, improve taste (e.g., TSS:Acid ratio from 6.7 to 9.4 after curing). However, curing is only useful early in the season to reduce high acid to optimum maturity thresholds. High temperatures may increase shrinkage and reduce storage life.

Calyx Retention

Another Spanish study treated four Clementine varieties with either 5 or 10ppm 2,4-D ester before degreening. They found reduced calyx abscission on Clemenules and Clemenpons, but not Marisol and Oronules. The 2,4-D did delay colouring, but all fruit reached acceptable colour by 7 days at 85%RH. They also found that maintaining 95% RH by automatic controllers (rather than 85% RH) resulted in 2% more saleable fruit (less shrinkage).

Ethylene phytotoxicity

Some citrus cultivars are more sensitive to ethylene damage. To reduce the risk to sensitive varieties, such as 'Fallglo' tangerines, fruit can be allowed to 'degas' after ethylene treatment and prior to waxing. Alternatively, fruit can be exposed to ethylene for shorter periods (6-12 hours) before transferring into high humidity rooms (without ethylene) until acceptable colour development.

PETER TAVERNER