PACKER NEWSLETTER

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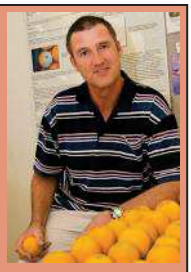

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SANTIATION—BACK TO THE BASICS

Sanitation is usually associated with measures to improve public health. Water is recognised as a primary source of contamination. As such, water sanitation plays a critical role in processing plants by reducing contamination of fresh fruit and vegetables. The sanitation practices used by citrus packers improve food safety (i.e., public health). They also have a role in controlling mould wastage and contribute to fungicide resistance management. In other words; It's really important.

APPLICATION OF SANITISERS IN CITRUS PACKINGSHEDS

Fresh produce may have populations of 10^4 to 10^6 microbes/gm when they arrive at packingsheds. Water used during postharvest handling can clean contaminated dirt from produce but it may also be a source of contamination. Wash water is often recirculated leading to a build-up of microbes, which inoculate 'washed' fruit. Fruit is sprayed with recirculating fungicide solutions to control postharvest diseases. These chemicals are specific and do not control other pathogens that, if present, may pose a health risk.

Sanitisers can maintain water quality by reducing microbe levels in water. Successful maintenance of processing water requires an understanding of the sanitisers used and the factors likely to affect their performance in packingshed operations.

DIFFERENCE BETWEEN FUNGICIDES AND SANITISERS.

The difference between chemical fungicides, such as Fungiflor®, and sanitisers, such as Nylate®, is explained in detail in previous newsletters (vol. 68, July 202 is an 'oldy' but a good reference). The main distinction is that chemical fungicides leave a residue on the fruit that protects it from re-infection during storage and marketing. This residual action is very important in the reduction of postharvest disease. Sanitisers give no residual protection to fruit. They are highly reactive and rely on destroying microbes on contact. They are not specific like fungicides and will destroy many fungal types and bacteria. It is this wide action against a range of microbes that makes them important in the maintenance of water quality. Sanitisers can be seen as a tool for reducing postharvest disease inoculation and improving food safety.

CLASSES OF SANITISERS

The sanitisers used in the citrus industry were mostly developed for the pool industry (e.g., pool chlorine). The challenge for sanitisers has been the high organic matter load in fruit processing and

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Read the Packer Newsletter and stop the rot.

SARDI
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POSTHARVEST PITTING

Pitting in fruit can appear due to a range of stresses. Postharvest pitting is a specific form. Typically, but not exclusively, associated with grapefruit and 'Fallglo' mandarin.

CAUSE: Oil glands collapse due to high humidity storage of dehydrated fruit. Similar symptoms can occur after mechanical damage.

SYMPTOMS: Cells collapse to form many small circular pits. Typically, pits appear in the stem-end first and progress downwards. The pits may coalesce to form irregular bronze to brown blemishes.

OCCURENCE: Postharvest pitting is increased by low humidity after harvest followed by high humidity (during degreening or cool storage). Incidence is not related to cool temperatures *per se* (i.e., it is not chilling injury). A key feature is that symptoms rapidly appear after waxing; sometimes within 24 hours but usually within 2 weeks.

Pits may also be associated with oleocellosis (see images above). Larger fruit sizes are more susceptible.

CONTROL: Orchard treatment with GA delays and reduces sensitivity. Minimise period after harvest in field (at low humidity). Rapid chilling after packing. Waxing with a lower solids wax and switch to carnauba-based waxes, which are more 'breathable'.

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compatibility with other processes or chemicals used in packing. Sanitisers commonly used are listed below:

Hypochlorites are inexpensive and in plentiful supply as household bleach and pool chlorine. However, they must be monitored carefully. They are very sensitive to pH, rapidly inactivated by organic matter and corrosive to metals. They are sold as a concentrated liquid (sodium hypochlorite) or in a granular/powdered form (calcium hypochlorite). A slow release tabular form of calcium hypochlorite is used in the citrus industry.

Bromo-chloro-dimethyl-hydantoins Nylate® is a unique product (Wobelea Pty Ltd) developed from the spa industry. There is a synergistic effect between chlorine and bromine producing much greater fungicidal activity. Nylate is much less pH dependant and organic tolerant than hypochlorites. Lower doses and running the solution slightly alkaline significantly reduce corrosion without sacrificing activity.

The product can be added manually (Nylate gel) or fully automated dosing systems can be provided by Wobelea Pty Ltd.

Chlorine dioxide is a powerful oxidising agent. Low levels are required, it is more stable in the presence of organic matter and is effective at a wide pH range. There are several methods and products used to generate chlorine dioxide. On site generators can be used to maintain safe, low levels of chlorine dioxide in packingline washes. Stabilised forms of chlorine dioxide are also available from various suppliers.

Quaternary ammonium compounds are NOT registered for fruit contact in Australia. They are very useful for sanitising surfaces because treated surfaces retain an active film which prevents the growth of microbes over a long period. They can be used for cleaning flat surfaces and brushes, where microbes can accumulate. Any residues should be rinsed from packing surfaces with potable water before running fruit. Some overseas markets, such as EU, have very low residue limits for commonly used quats (DDAC).

FACTORS AFFECTING THE ACTIVITY OF CHLORINE

This is just a quick refresher. More details can be found in other Packer Newsletters (e.g., vol. 68, July 202). The major factors listed below relate mostly to hypochlorites:

pH-hypochlorites are very pH sensitive. The optimum pH is 6.5 to 7.5. Too high PH is corrosive and chlorine gas is released; too low pH it doesn't work. Test strips show concentration but is the chlorine working? You need to know pH and concentration

Concentration– Relatively minor compared to pH and time. Often a 4 fold increase in concentration results in only a 50% reduction in killing time. However, concentration may influence corrosion rates greatly.

Temperature- Every 10°C increase in temperature can reduce killing time by up to 60%. This result will depend on the product and concentration. High temperature may increase the risk of corrosion.

Organic Matter -The main disadvantage of many chlorine compounds are that they are rapidly inactivated by organic matter. This creates a huge chlorine demand in dirty situations and makes surface disinfection of oranges very difficult.

Water Hardness-Calcium and magnesium levels of up to 400ppm have little effect on the activity of hypochlorites. These compounds are reasonably tolerant of water hardness.

Compatibility with Other Chemicals- Chlorine can be inactivated when in contact with surfactants and other compounds. This can lead to incompatibility with postharvest fungicides. There are usually no obvious signs of reduced activity, but the consequences can be obvious at outturn. Detailed compatibility tables are found in past issues of the Packer Newsletter.

Peter Taverner

COMPATIBILITY OF FUNGICIDE/FUNGICIDE MIXTURES IN DIPS.

FIGURE 1: ALL THREE SOLUTIONS SHOW VERY LITTLE SETTLING OF THIABENDAZOLE

Most citrus packingsheds use at least one chemical fungicide during the packing process. The reliance on these fungicides to keep fruit disease free is especially important for sheds sending fruit to export markets. Many packingsheds also now mix fungicides to ensure adequate disease control. Manufacturers are also now producing mixed products, saving time and circumventing possible compatibility issues.

Back in the late 90's, Brian Wild (ex NSW DPI) alerted packers to certain fungicide mixes that were incompatible (Packingshed Newsletter 52, 1997). He observed that thiabendazole (Tecto) in suspension concentrate form, dropped out of solution faster when mixed with the wettable soluble powder form of imazalil (imazalil sulphate). We decided to revisit this with a similar formulation of imazalil, 'Magnate' (wettable granule).

FIGURE 2: CONCENTRATE SOLUTION SHOWED A LARGER AMOUNT OF THIABENDAZOLE SETTLING THAN EITHER TECTO ALONE OR WHEN MIXED AS A SEPARATE SOLUTION WITH MAGNATE

We also examined one of the newer formulation fungicides 'Scholar' (fludioxonil, suspension concentrate) in circumstances where it was also mixed with Magnate, as well as when it was mixed with Panoctine (guazatine liquid).

Some issues that might be seen in the shed if fungicides aren't compatible:

- Settling out of active (suspension concentrates such as Tecto or Fludioxonil are at greater risk – as this happens to the products naturally when not agitated)
- Changes in pH (Imazalil sulphates can often precipitate out of solution if pH goes > 7)
- Dramatic visual changes in colour (usually obvious)
- Drop in activity of fungicide (usually only picked up when samples sent for residue analysis)

Fungicides were made up separately before mixing and also mixed together as concentrates (then water added) before pouring into a glass 1 litre measuring cylinder. Samples of solution were taken at 0 and 24 hours, and at different depths of the cylinder (total depth of solution in cylinder is 34cm). Settlement of the suspension concentrate was ob-

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served over the 24 hours and visual changes recorded. After sampling, the solutions were run through a spectrophotometer to determine if there had been any changes in concentration.

Purely visual observations of fludioxonil (Scholar SC) and imazalil sulphate (as Magnate wettable granules) were made, as was visual monitoring of a mix of Scholar with guazatine (Panoctine).

Results

Tecto compared with Tecto + Magnate (diluted separately before mixing) and Tecto + Magnate (concentrates mixed together then water added) – Solutions looked similar after a 24 hour period with a similar amount of settling in all three solutions (Figure 1). However, there did appear to be some greater settling out of Tecto in the concentrates mix (Figure 2).

The mix of Scholar with Magnate didn't show obvious visual change. However, mixing Scholar with Panoctine saw some precipitate form. After a few days Scholar, when mixed with Panoctine, had completely fallen out of solution (Figure 3). Unmixed solutions of Scholar remained stable and in suspension after a similar period of time.

Concentration readings

Spectrophotometer data showed little difference in concentration gradient between Tecto alone, Tecto + Magnate (diluted separately) and Tecto + Magnate (concentrates). See Table 1. Tecto strength at 0 hours was close to standard concentration of 1000ppm. After 24 hours, there was lower concentration at both the top and bottom of the solution (the bottom solution was sampled above the settled precipitate where the highest concentration would be). However, no significant differences could be seen between Tecto alone and when Tecto

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Figure 3: Suspension concentrate of Scholar + Panoctine shown to have precipitated out of solution after several days

Table 1. Concentration gradient of Tecto across time and depth

Solution	Sampled time	Location (gradient)	Concentration*
Tecto	0	5	965
	0	25	1445
	24	5	395
	24	25	760
Tecto + Magnate	0	5	880
(mixed separately)	0	25	790
	24	5	660
	24	25	685
Tecto + Magnate	0	5	1140
(concentrations	0	25	1070
mixed)	24	5	480
	24	25	850

Brush burn

Brush burn describes this condition well. All citrus is susceptible but especially soft skin. As production changes, more mandarins will be pushed through long orange packing lines. High 'fast' throughput along a long series of brushes is not ideal for soft rind.

CAUSE: damage to the rind by abrasion.

SYMPTOMS: the appearance can vary as red superficial staining across the surface or red/brown marks associated with raised surfaces on the rind. Often, scuffing marks can be seen on close examination.

OCCURENCE: soft rind is more susceptible (e.g., mandarins) and also late season fruit. It is more common in new packing lines and/or after installing new brushes. Waxy knobs on rollers can cause similar mechanical injury.

CONTROL: orchard treatment with a growth regulator (e.g. GA) can delay aging and reduce sensitivity to mechanical damage. New brushed may need to be pre-conditioned to soften bristle tips. Brushing dry fruit can increase damage. Brush speeds are too fast or brush beds are too long for sensitive cultivars. Install sweeper bars to ensure fruit is not spinning on brushes too long. Use purpose built equipment for packing mandarins. Tumbler trim brushes mean fruit encounter valleys and peaks as they progress, which prevent fruit from turning on a single axis. Remove waxy knobs from rollers. .

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Acknowledgements

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Major voluntary contributor:

Postharvest Snippets!

Nancy returns to work

Nancy Cunningham has returned after extended parental leave. Nancy is quickly back into work mode and is looking forward to unraveling your conundrums about decay and regaling you with the latest postharvest practices. If you want to contact Nancy; she is working 3 days per week (Tuesday-Thursday).

Good attendances at pre season packer workshops

In April, I travelled with Andrew Harty, Citrus Australia, from Griffith down the river to Waikerie presenting fungicide workshops to packers. The workshops have become an annual traditional, which was initiated by the three regional citrus marketing Boards: Murray Valley Citrus still sponsor and host the Mildura workshop. Many thanks to Mary Cannard and Andrew Harty.

The switch to carnauba wax

At the recent workshops, Andrew Harty presented some work by Helen Hoffman on carnauba waxes on mandarins. This work supports previous overseas work that clearly shows carnauba waxes are more gas permeable and reduce 'off-flavour' development.

Many have switched already, but recent increases in shellac prices, may make the remaining packers change to carnauba. Many are likely to consider morpholine-free wax formulations at the same time.

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was mixed with Magnate.

Not all combinations have been presented here – but packers need to watch out for incompatibility, irrespective of the active of the chemical in use. Incompatibility can occur with fungicide/fungicide combinations, fungicide/sanitiser combinations or even fungicide/sanitiser/GRAS compounds combinations. New chemicals are already here and how we use them efficiently is important to ensure citrus disease control.

Conclusions

If a packingshed is able, they can apply fungicides in two separate sections of line. If they have a bulk dip as an initial fungicide treatment they can follow with an inline treatment - or alternatively – an inline treatment followed by a fungicide is incorporated into the wax. In some instances neither of these scenarios will be practical and the two fungicides will be mixed together as part of an inline treatment. Whilst this has been acceptable practice for chemicals that have been around for a while, newer fungicides now on the market are 'unknowns' in regard to compatibility. Packers should exercise caution when mixing fungicides.

In this example of mixing fungicides, Tecto appeared to have been little affected by Magnate wettable granules (as imazalil sulphate). However, there was more precipitate when the concentrations were mixed together, than if fungicides were not mixed.

Scholar appeared to remain in solution when mixed with Magnate – but in this instance concentrations weren't measured.

A Scholar and Panoctine mix showed greater precipitate of Scholar in the solution after a number of days.

Packers should watch out for similar incompatibility in their sheds. Increased precipitation in non-agitated tanks may mean you are washing fungicide down the drain. Agitation helps but a suspended precipitate is likely to strip out faster, leading to higher residues on fruit– beware of exceeding MRLs.

There are some things to avoid any potential pitfalls when mixing chemicals together

- Follow label recommendations for fungicides and all chemicals used in the packingshed.
- Don't mix concentrates together (dilute concentrates before mixing).
- Monitor pH and adjust appropriately.
- Look out for visual changes.
- Watch for precipitates when washing out tanks, as this can indicate that fungicide is 'falling out' of solution.

NANCY CUNNINGHAM

[TIP: Fill tall glass jars or PET bottles with mixed and unmixed fungicides using your water. Compare the colour and precipitate of the solutions over time.]