PACKER NEWSLETTER

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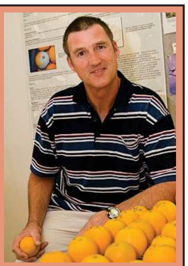

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WATER pH AND CHLORINATION

Many packers still sanitise their wash water using chlorine-releasing compounds. Bleach (sodium hypochlorite) and pool chlorine (calcium hypochlorite) are readily available and inexpensive. The concentration of free chlorine can be simply and quickly measured using a colour change test strip. However, what is free chlorine ? And, does it measure activity?

Fortunately, we only need to know some simple chlorine chemistry to answer those questions.

BASIC CHLORINE CHEMISTRY

When chlorine products are added to water they dissociate into a range of products and by-products. The figure below shows a chlorine product 'spitting' into two major products after adding to water. We are most interested with hypochlorous acid (HOCl) because it is a good disinfectant.

The test strip measures 'free chlorine;. Which is largely the combined amount of the active acid (HOCl) and the inactive ion (OCl-). As I mentioned earlier, we are interested in the acid part that is a disinfectant. So, what proportion is acid, and therefore, sanitising our wash water? Well! That depends of the water pH.

(Continued on page 2)

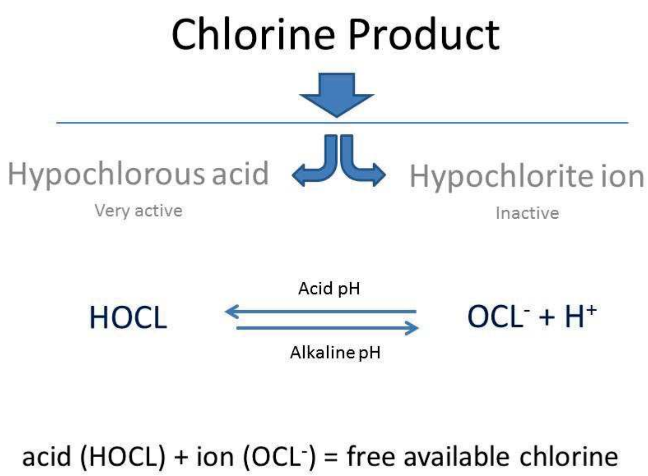

FIGURE 1. CHLORINE IS VERY REACTIVE AND READILY FORMS SECONDARY COMPOUNDS. SOME OF THE COMPOUNDS FORMED AFTER DISASSOCIATION IN WATER ARE SHOWN. THE FIGURE THE INFLUENCE OF PH ON THE COMPOUNDS FORMED IS ALSO SHOWN.

INSIDE THIS ISSUE

Read the Packer Newsletter and stop the rot.

Mature rind collapses and dehydrates during storage.

AGE RELATED BREAKDOWN

At the end of the season, mature Navel oranges can look great at harvest but deteriorate during long voyages or when marketing is disrupted. As the rind ages weaknesses will appear. Aging is delayed when growers apply appropriately timed GA sprays.

CAUSE: Rind collapse due to cell weakening and dehydration of mature fruit

SYMPTOMS: The symptoms can vary: 1) Discolouration, drying out and extensive rind collapse 2) wilting and dehydration at the stem end where the rind is thinnest (not be confused with stem-end rind breakdown , which is most prevalent in Valencia orange subjected to water stress in spring)

OCCURENCE: navel oranges are more likely to show symptoms at the end of the season. Some conditions that accelerate incidence include:

* Heavy rain and high humidity, followed by frost.
* Warm dry conditions when trees under water stress.
* Holding fruit too long between harvest and packing

CONTROL: Always be cautious marketing late season fruit as postharvest treatments provide limited benefit to aging. Orchard treatment with GA sprays is best to reduce age symptoms. CSIRO and NSW AG conducted a fine study that lead to recommendations for GA sprays to reduce postharvest rind breakdown . See link below:

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/232197/Using-gibberellic-acid-sprays-on-navel-oranges.pdf

Peter Taverner

(Continued from page 1)

CHLORINE ACTIVITY AND WATER pH

Wow! Chlorine chemistry is fun. I bet you can hardly wait to learn about pH, which is the negative log of hydrogen ion concentration in a water-based solution. But, I'm sorry to disappoint you! Let's stick to the basics. The pH scale is from 0 to 14. the midpoint of pH 7.0 is neutral. Values less than pH 7.0 are acidic and values greater are alkaline.

If you remember, we are interested in the proportion of hypochlorous acid (HOCl). The more acidic the 'chlorinated' water pH, the higher the proportion of HOCl. Conversely, low levels of HOCl are found in alkaline waters. The combined levels of acid and ion remain fairly constant but the proportion of HOCl varies considerably with pH. This can be seen in Table 1 below.

What about testing for HOCl? The test strip shows the combined HOCl and OCl- reading. Let's assume a test strip reading of 100ppm. Using the table; at pH 6.5 the HOCl concentration will be 95ppm. At pH 8.5, active HOCl will only be 15ppm Regardless of pH, the colour reading of the strip will be 100ppm. Therefore, you need the test strip and a pH meter to accurately measure the activity.

PRACTICAL IMPLICATIONS

Packers used water from different sources; rain water, mains water, rivers and dams. This water has varying pH depending on the seasonal conditions. River or dam water can be very alkaline depending on the dissolved solids. If you are not measuring the water pH, you don't know how effective your sanitation is from one time to another.

We can add acids, such as citric acid, to adjust water.

Why don't we adjust water to be very acidic and then add hypochlorite? Unfortunately, this is not ideal. There is another form of chlorine I haven't mention yet; chlorine gas. At low pH, stability is lost and chlorine gas is released into the air. Acidic conditions are also very corrosive to equipment. The best compromise for stability and activity is to aim for a pH between 6.5 to 7.5.

There may be some circumstances where maintaining this pH range is not practical. For instance, when using carbonates salt in a high pressure wash; the salts will shift the pH to 8.5 or more. This water will be full of alkaline salt, which has a high buffering capacity and would be very difficult to acidify. Hypochlorite can still work but would be less effective; i.e., take more time to kill spores in water.

This brings me to the final point. Hypochlorite has been useful for many years but there are other sanitisers; ones that are less sensitive to pH. Consider using one that fits your situation.

Peter Taverner

Solution pH	Chlorine as % HOCl	Chlorine as %OCl-
4.0	95	0
4.5	100	Trace
5.0	100	Trace
5.5	100	Trace
6.0	98	2
6.5	95	5
7.0	78	22
7.5	50	50
8.0	22	78
8.5	15	85
9.0	4	96
9.5	2	98
10.0	0	100

TABLE 1. THE PROPORTIONS OF CHLORINE FORMS IN WATER AT DIFERENT PH VALUES.

(ADAPTED FROM POSTHARVEST CHLORINATION; BASIC PROPERTIES AND KEY POINTS FOR EFFECTIVE DISINFECTION BY TREVOR SUSLOW. UNIVERSITY OF CALIFORNIA, DAVIS, USA. DOWNLOADED FROM HTTP://ANRCATALOG.UCDAVIS.EDU/PDF/8003.PDF

EFFICACY OF FUNGICIDE, PERACETIC ACID AND SALT MIXTURES ON SOUR ROT

This article compliments the compatibility work reported in Packer Newsletter 106. As mentioned in that article, fungicide and salt mixtures are being evaluated to overcome fungicide resistance and enhance 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.

In this study, we evaluated the same fungicides, peracetic acid and salt combinations used in the compatibility study (PNL 106). In addition, we have reported the potassium phosphite (KPhos) result this time. This salt has generated interest for disease control on citrus, but perhaps, not for sour rot yet. The results are speculative and these combinations have not be evaluated under commercial conditions.

For those interested, basic methods are; fruit were inoculated with a sour rot and green mould mixture (90:10 ratio; 1 x 10^6 spores per ml). The fruit were then dipped in treatments for 30 seconds, at ~16-18 hours after inoculation.

Overall, the imazalil-based fungicides showed higher control and some salt combinations also improved control. The responses differed depending on the fungicide used.

I have provided the results for Tecto SC 500 combinations only in this article (Table 1). Thiabendazole was the least responsive fungicide active and is generally regarded as having little efficacy against sour rot by itself. The interactions are less complicated making it easier to discern the relative effects of salt.

Treatments including sodium bicarbonate (NaBic) provided the lowest sour rot levels. Four NaBic treatments have 50% or less sour rot than control fruit. The other treatments had reduced levels of sour rot but where not significantly lower than controls.

The results with other fungicides were more complex, presumably, due to partial control of sour rot by fungicides themselves. The salts and peracetic acid alter pH, which may affect fungicide residue uptake, and therefore, efficacy. Recent studies in South Africa highlighted the effect of pH of the uptake of imazalil sulphate.

The results presented for TBZ combinations are typical but not the whole story. I hope to provide you with more detail on sour rot control with other fungicide combinations in the near future. Oh! And, there is still the issue of the effect of these combinations on the sanitizer's ability to control spores in water.

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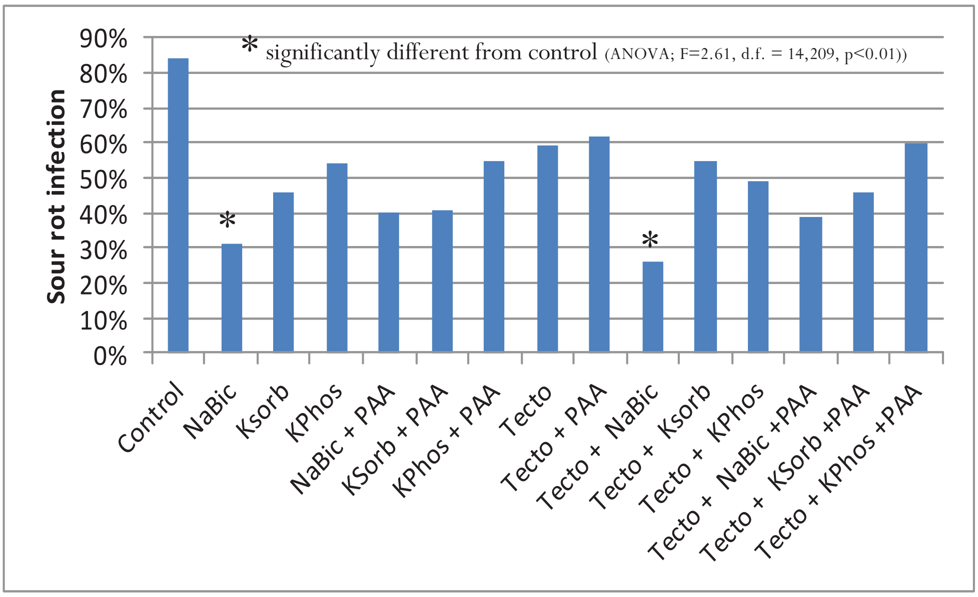
TABLE 1. SOUR ROT EFFICACY OF TECTO WITH PERACETIC ACID AND/OR OTHER SALTS



DRENCH PHYTOTOXICITY

Postharvest drench/dips have always been controversial with many packers. They need constant monitoring and changing due to the dirty nature of the fruit coming in from the orchard. Certainly, unmonitored drenches can build up phytotoxic salts through constant topping up of chemicals, such as sodium hypochlorite. There is also a tendency to add numerous chemicals together with unknown consequences. Two fungicides, a wetter or defoamer, and a sanitisers is not uncommon. In Florida, a condition called 'green ring' was identified on degreened fruit after postharvest drenching. In some instances, the cells did collapse and turn brown. The damage occurred where fruit touched and also where fruit rested on the sides of the bin; the drench solution was concentrated and dried. The symptoms disappeared when fruit was not drenched and the symptoms could be induced in the laboratory by dipping. Interestingly, water and chlorine dips did not induce symptoms but when TBZ and a surfactant were added, the dips produced classic 'green ring'. The problem occurs only in some seasons, on early season fruit and on certain cultivars. As a remedy, bins are not drenched but fruit must be processed in-line within 24 hour from harvest to avoid increased decay.

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Major voluntary contributor:

POSTHARVEST SNIPPETS!

SANDRA HARDY RETIRES

Sandra Hardy, Industry Leader, Citrus, recently retired from her position in NSW DPI.

My first memory of Sandra was a request to reprint an article from the Packer Newsletter in the Coastal Fruit Growers Newsletter. From then, I started to read her work and was impressed with her knowledge and ability to commutate to her audience.

In later years, Sandra was more involved in management but retained a 'hands on' role, especially in citrus extension. She had the lead role in a citrus ACIAR project in Bhutan, which provided benefits to both Australia and Bhutan.

Sandra is an intelligent and insightful woman, who does not suffer fools gladly. Some people have found her confronting but I have found her judgment to be impeccable. She was very well informed on the latest events in citrus and I always valued her advice. I also enjoyed her candid manner and tenacious questioning to reveal the truth.

However, her greatest legacy is undoubtedly in the newsletters, fact sheets, production manuals and other very practical documents she has written or edited during her long career. There is hardly a citrus fact sheet released by NSW DPI without Sandra's name as a contributing author. These documents will remain a key resource for citrus growers and packers for many years to come.

ARE FUNGICIDE LABEL RATES BECOMING OBSOLETE?

I was hoping that title might grab your attention. Please, read on!

I would like to start a debate about the declining usefulness of label rates for postharvest fungicide application in modern citrus packing and the concomitant emergence of fungicide residue testing. Indeed, I would suggest that fruit residues are rapidly becoming the main event, with packers using the results of regular tests to help calibrate, and adjust rates accordingly.

There are many reasons for this change in emphasis. In one sense, the label rate has been undermined by the ingenuity of postharvest researchers and packers themselves. The change to total loss systems created a new set of conditions where high volume rates did not apply. Some labels contain low volume rates but they are usually very broad to compensate for the high variability of this method. The use of heated fungicides radically changes the uptake of some fungicides, such as imazalil. The influence of pH on fungicide uptake and efficacy is substantial; if not manifest. It is likely that fruit size, rind texture and other seasonal factors also influence fungicide uptake. In addition, many packing-lines are unique in configuration and packers are constantly tinkering with them; creating variability.

At the same time, strict requirements to measure pesticide levels on fruit have been introduced, as part of quality assurance programs. These are food safety initiatives: But, provide 'signposts' for postharvest fungicides when strip-out rates are uncertain or changes are made in commercial packing practices. Residue testing is heading to a new level, where daily samples are taken explicitly as fungicide management tools.

Packers want the lowest residue that remains efficacious; for cost and safety. They understand there is variability and the need to respond quickly. As such, the turn around time of results from sampling to laboratory to packer is critical. With increased demand, I would expect refinements of test methods to provide real-time results through the use of more sophisticated methods, such as quantitative biosensors.

Overall, quantifying pesticide residue levels on fruit will be of primary importance. Reducing MRLs will drive this process, particularly when MRLs approach the level of the efficacy of the active. Fungicide companies are already marketing products with mixed actives, which allows lower rates of each active. There are reasonable resistance management grounds for this approach [it also locks new active purchase with a generic active; Oh! Cynical me]. I suggest this approach could be complicated by a total pesticide MRL; especially if limiting the number of actives on fruit. It could be argued that limiting actives would also be environmentally retrograde, with a few broad spectrum pesticides used. This is interesting conundrum to discuss another time. Suffice to say; chemical residues are important.

Ultimately, the first challenge is to develop a residue testing system that meets the changing needs of packers and regulators (in lieu of consumer needs).

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