PACKER NEWSLETTER

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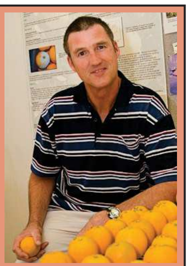

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PRIMARY INDUSTRIES & REGIONS SA
PIRSA

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Horticulture Innovation Australia

WEB INFORMATION UPDATE

The Primary Industries & Regions SA (PIRSA) website is being upgrade and, unfortunately, the packer newsletter is not available from that site for the foreseeable future.

Fear not! Citrus Australia has generously offered to host the newsletter. At this stage, we have moved the newsletters, from mid-2012 to present, onto their site. You can download those newsletters through the link below:

http://www.citrusaustralia.com.au/industry/packer-newsletter.htm

While we are talking about Citrus Australia; I hope you were able to get to the postharvest section of the Mildura Technical Forum in March. It was well supported by the packing community and feedback to me was very positive.

I was fortunate to spend extra time with Dave Sorenson (keynote speaker) during the conference. If you missed Dave's presentation or want a copy; the presentations for all speakers can be downloaded from the Citrus Australia web-site. Just follow the link below:

http://www.citrusaustralia.com.au/latest-news/citrus-technical-2015-forum-field-day-16-17-march-2015

Take a look. There is something of value in all the presentations. For instance, the talks from Geert De Wever (Janssen PMP) and Dave Antrobus (Syngenta Australia) on PHILABUSTER® and Scholar® , respectively, were very timely. Since the forum, there have been changes to the policy of Japanese supermarkets freeing up the use of these 'reduced risk' fungicides.

All change causes some disruption but using these new fungicides provide the flexibility to manage looming fungicide resistance issues. On balance, this will be recognised as a great result for our industry and consumers. Let's take the opportunity and use these new fungicides well.

As luck would have it! I wrote a guide on integrating PHILABUSTER® and Scholar® late last year. The InfoNote was written before the recent changes but it still provides some relevant advice to using these fungicides. Again, you can find this information on the Citrus Australia website using the following link;

http://www.citrusaustralia.com.au/industry/packing-postharvest.htm

Download the SARDI Info Note—Reduced risk fungicides –Oct 14

Peter Taverner

INSIDE THIS ISSUE

Read the Packer Newsletter and stop the rot.

PREMIUM FOOD AND WINE FROM OUR CLEAN ENVIRONMENT

SOUTH AUSTRALIA

Government of South Australia
Primary Industries and Regions SA

USING SODIUM BICARBONATE WITH HIGH PRESSURE WASHERS—AN ODE TO DAVE.

During his visit to Australia, David Sorenson proved to be a great advocate for the use of sodium bicarbonate and other 'generally regarded as safe' (GRAS) compounds to control postharvest decay. His Citrus Australia technical forum presentation generated a lot of interest from local packers. This article attempts to summarise sodium bicarbonate use in the same pragmatic manner (I saved the abstract but really interesting chemistry for the next article).

Sodium carbonate (soda ash) and sodium bicarbonate (SBC) were suggested for the control of mould on citrus in the 1920's. Until the 1970-80's, a heated soda ash bath was still used in California for improved cleaning and to provide some decay control before a synthetic fungicide (e.g., benomyl or TBZ). In Australia, packers relied on synthetic fungicides alone.

By the 1990's, there was interest in revisiting 'older' methods to combat mould resistance to synthetic fungicides developing in some citrus producing countries. At the same time, high pressure washing was being introduced to clean fruit of scale, sooty mould and soil. Enter Joe Smilanick and Dave Sorenson: Their research and practical direction were influential in the Californian industry moving to sodium bicarbonate for improved decay control and better cleaning in the high pressure wash.

Moving on to 2015, Australian packers maintain a two tier approach; using synthetic fungicides for decay control and hygiene (by sanitisers) in a supporting role. This has been very successful but the game is changing. The precursors to mould resistance are emerging, we are losing old reliable fungicides and there is pressure on reducing the residues of the remaining ones. Maybe, its time to revisit some of the 'older' methods ourselves. And, as Dave said, 'these chemicals are safe and very cheap—why wouldn't you use them?

So, why use SBC?

- It is cheap, easy to use and readily available
- It has been used on commercial citrus packing lines safely for many years .
- Its effectiveness on moulds and other pathogens has been known for hundreds of years.
- It is used in baking and toothpaste. So, it minimizes health and residue issues.
- SBC has half the sodium and a lower pH than soda ash. So, it minimizes environmental and disposal issues.
- It controls fungicide resistant mould spores because it has a different mode of action.

How should you use SBC?

- Use it in the pressure washer. It is a cleaning agent and compliments high pressure washing.
- Use it with 200ppm free chlorine. The spores wash off the fruit and are destroyed in water by chlorine.
- Use it at 1-3% SBC in water. Increased concentration leads to a linear improvement in decay control . Typically, 30-40% control at 1% SBC , and 70-80% control at 3% SBC for navel oranges.
- Use it to compliment your existing treatments/fungicides and not as a total replacement.
- Use a fresh water rinse after application. High salt residues on the fruit surface can cause staining or increase weight loss during long storage. But, don't high pressure wash after you apply SBC—you want the salt residues to remain in the wounds.

Key references

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Sorenson D. 2000. Use of sodium bicarbonate in a high pressure scale washer for the control of postharvest mold of citrus fruit. Pest management grants final report. Californian department of pesticide regulation contract # 98-0280.

Sorenson D. 2015. Evolving treatments strategies in the packing-house. Oral presentation at Citrus Technical Forum , Mildura, Australia.

Peter Taverner

ZEBRA SKIN

This condition is caused by the rupture of distended epidermal cells of tangerines and their hybrids causing a blacking of the rind over the individual segments. This results in a striped effect; hence, the term zebra skin. The symptoms appear on moderately to severely drought affected fruit after significant rain or irrigation. As with Oleo, it is water on the inside not the outside of the fruit that is the problem. The water stressed tree rapidly takes up moisture from the soil leading to highly turgid fruit. The cells at the surface of the rind can rupture on the tree causing damage and decay; often they fall from the tree. However, turgid fruit may remain undamaged. Fortunately, they will lose their dangerous turgidity over time, usually 5-7 days after the rain or irrigation event. If turgidity is suspected then delaying picking for a week is definitely recommended. Fruit picked before the turgidity is lost are easily damaged during normal field bin transport and packing line processes. Gentle handling and minimal brushing is recommended to minimize damage. Consider colour sorting fruit prior to degreening to avoid over-treating the higher coloured fruit. The combination of ethylene degreening and brushing damages fruit picked fully coloured or fully green more than fruit just breaking colour.

Key reference

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Peter Taverner

The cost of delaying the dumping of fungicdes

Have you ever wondered how long you can keep fungicide before you dump it? Not a problem for busy sheds but smaller operations may have down time where fungicide sits for long periods between use. Research by David Hall was conducted using imazalil EC at different pH values. I specify IMZ EC because Imazalil sulphate will react differently. As you will realize if you have read the article on your right. Hall stored 250ppm IMZ EC solutions for 19 days before treating inoculated fruit and compared them with freshly mixed solutions. He found that after 10 days the fruit treated with the aged solutions averaged 10% decay compared with a fresh IMZ solution average of 4%. Oh dear! There does seem to be increased decay when using old solutions. This loss of efficacy could also contribute to fungicide resistance. He found that the fruit treated with the aged IMZ solutions produced many more spores.

He also found some interesting pH effects. In the aged IMZ solutions, the highest sporulation was in the solutions at acid pH, while the alkaline treatments were better. This may be due to the mobility of the IMZ EC in the neutral to alkaline range (To understand, you really need to read the article on the right). He concludes that keeping your IMZ EC solution mildly alkaline will mitigate any aging effect on sporulation. Importantly, these effects were only measured after 19 days storage. It would be interesting to see if there are still significant differences for shorter storage periods. It would also be interesting to know the pH and aging effects of other fungicides, such as IMZ sulphate, TBZ, fludioxonil and pyrimethanil.

Key reference

Hall David J. 1991. Effect of pH and storage on solutions of imazalil. Proceedings of the Florida State Horticultural Society. 104: 111-113.

Peter Taverner

Using sodium bicarbonate—understanding how and why

The first stage in understanding sodium bicarbonate (SBC) is getting an idea of what happens when SBC is dissolved in water. The basic equation is:

$$NaHCO_3 + H_2O \leftrightarrow Na^+ + HCO3^- + H_2O$$

where $NaHCO_3$ is sodium bicarbonate, Na^+ is sodium ion, $HCO3^-$ is bicarbonate ion and you know what H_2O is. The ↔ symbol indicates that the products or species are reversible depending on the conditions. They are in a state of equilibrium.

Alas, it is not that simple with SBC. There are actually a series of equilibria, with new species predominating depending on pH.

Bicarbonate ions predominate in mildly alkaline conditions. At higher alkalinity (>pH 9), carbonate ions (CO_3^{--}) are increasingly more numerous.

However, the most interesting equilibrium involves carbon dioxide (CO_2). SBC in water can also form carbonic acid (H_2CO_3), which can decompose into water and CO_2.

$$Na^+ + H_2CO_3 + OH^- \leftrightarrow Na^+ + OH^- + H_2O + CO_2$$

The speed of this reaction is dramatic when an acid, SBC and water are added together. Something that anyone adding water to baking soda in cooking would have noticed. In this instance, CO_2 gas is rapidly released into the air. The pH consequence is the loss of the acid species while the hydroxides (OH^-) remain on the right of the equation, leading to more alkaline conditions and a new equilibrium.

I hear you ask—is this chemistry lesson really necessary? Not really—I just enjoy it. Seriously, it should help you understand the rest of the article better.

Factors affecting SBC solutions in packing lines

A critical factor affecting SBC solutions is pH. SBC solutions are best maintained at pH 8-8.3. Freshly mixed solutions in potable water tend to be in this range at the 0.5 to 3% SBC recommended for packing line use. But, the pH will change gradually.

SBC solutions slowly react and CO_2 is lost into the air. SBC solutions in high pressure washers are likely to lose CO_2 at a higher rate due to the agitation and greater surface exposed to allow gas losses. High –pressure pumping can slightly raise the temperature of the solution and warmer SBC loses CO_2 faster.

I have no evidence that CO_2 loss is a significant issue in packing lines. Theoretically, it should be insignificant under cool and alkaline conditions. However, I have been surprised by the rate of SBC loss in some holding tanks. This is something I want to look at further. Not necessarily for the SBC loss per se but for other associated changes. Let me explain!

The loss of CO2 results in an increase in pH. For instance, when fresh SBC solution changes from pH 8.3 to pH 9.0 over time, much of the SBC has been lost as CO_2. I wonder! Does the pH re-adjust when SBC is topped-up? In addition, what is the pH shift doing to your sanitation?

Why use high rates of chlorine in SBC solutions?

The water used in dips, drenches and high pressure washes need to be sanitized. Chlorine is commonly used at rates between 50-200ppm to rapidly inactive microbes in water. The relatively high rates are needed because fungal spores are quite tough.

Mixtures of SBC and chlorine are complimentary because they control decay and sanitise water, respectively. However, chlorine is sensitive to pH [this is another of those annoying chemical equilibriums]. The ideal pH is near neutral (pH 7.0), where 75% of the free chlorine is in the active acid phase. Fresh SBC solutions will be near pH 8.0-8.3, which will reduce the efficacy of chlorine. Under these alkaline conditions, 25% or less of the free chlorine is in the active acid phase. More detail is given in Packer Newsletter 112, pg 2.

Smilanick and co-workers (2002) found a 3% SBC solution with 200ppm free chlorine (at pH 8.3) required 32 seconds to kill 95 % of mould spores in a 24^{0}C solution. This will be slower in winter, where it will take several minutes to kill the same level of spores in a 5^{0}C solution. How long is enough? The kill time wanted is often based on the rate of recirculation. If you have a large tank, the chlorine has longer to work in the tank before the solution is re-sprayed onto more fruit.

Acknowledgements

The National Citrus Postharvest Science Program, based at SARDI, has been facilitated by HAL in partnership with Citrus Australia for the period of June 2011–Oct 2015. It has been funded by citrus grower levies and voluntary contributions. The Australian Government provides matched funding for all HAL's R&D activities. Several citrus packers and service providers have also contributed funds for specific activities.

POSTHARVEST SNIPPETS!

RESEARCH EXTENSION

As you may be aware, our current postharvest program was due to finish in March 2015. However, we have had a short reprieve thanks to Syngenta Australia and Horticulture Innovation Australia (HIA) (formerly Horticulture Australia). HIA have extend the project until mid-September, which allows us to conduct further work for Syngenta. Syngenta have commissioned us over the last few season to evaluate a new fungicide for the postharvest control of sour rot and blue & green mould on citrus. The work over the next few months completes compatibility work allowing a more robust data package and label to be presented to the APVMA for registration.

POSTHARVEST FUNGICIDES FOR JAPAN

The new options for Japan include two new fungicides, fludioxonil (Scholar®) pyrimethanil (PHILABUSTER®), as well as the two old fungicides, imazalil and TBZ. I have provided details for the use of these new fungicides (see page 1). And, many packers already have experience with using them for other markets. It is important to get the a good result from these products. Please contact your fungicide supplier if you are unsure of the best practice use for these fungicides for Japan or any other market.

Smilanick and coworkers recommended 200ppm chlorine with SBC solutions. The success of this recommendation has been supported by observations in packing line over many seasons. However, the solutions require monitoring. Over time they become turbid and more alkaline (pH 9), which would adversely impact on the chlorine's efficacy further.

Why rinse SBC off fruit prior to fungicides?

High rates of SBC (3% or higher) should be rinsed from fruit prior to waxing to avoid potential staining and increased weight loss during long storage. Lower rates of SBC need not be rinsed depending on your understanding of the risks. If in doubt—rinse before fungicide application. To remove doubt –read on!

Smilanick and coworkers conducted work on SBC and their influence on various postharvest processes. They found that SBC dramatically improved the effectiveness of IMZ EC formulations. In part, this as due to an increase in pH through the addition of SBC but there was an added effect of SBC. The combination also improved control of IMZ resistant isolate of green mould.

Mould spore growth is likely to be inhibited by increased pH in the wound site. They also speculated that IMZ would be more mobile in a neutral or higher pH. This was supported by increased IMZ residues on fruit as the solution reached pH 7 and plateaued at higher pH values. Their work and others showed that mildly alkaline IMZ solutions provided better sporulation control. Moreover, SBC with IMZ was more effective than raising the pH using other alkaline buffers.

Wow! Why are we recommending rinsing SBC off. Shouldn't we let it wash off into the fungicide tanks to improve our IMZ? Unfortunately, the answer depends on the form of imazalil you are using. Early work by Smilanick and others (including ourselves) used the EC form but granular imazalil sulphate products are more popular today. IMZ sulphate responds differently.

More recently, Erasmus and coworkers looked at IMZ residues and mould control using IMZ sulphate solutions. IMZ sulphate in water is strongly acidic (pH 3), leading to mostly water soluble IMZ. This results in an homogenous mix with a slow, consistent uptake of IMZ onto fruit. Adding SBC neutralizes the acids. As the solution becomes mildly alkaline the IMZ becomes almost insoluble in water but more soluble in the waxy fruit coating. This can result in a less reliable outcome. If the solution is well agitated, the IMZ is absorbed rapidly onto fruit leading to very high residues (possibly, well above MRLs) and rapid strip out. If the solution is not agitated, the IMZ may settle out resulting in little or no IMZ residues on fruit. Not surprisingly, Erasmus and coworkers did not recommend mixtures of SBC and IMZ sulphate for fungicide tanks. In theory, small amounts of SBC with IMZ sulphate could improved mould control but pH would need to be carefully monitored &/or adjusted The water solubility of IMZ sulphate is very sensitive above pH 6.5 and the recommended rates of SBC (0.5 to 3%) will buffer well above the optimum pH range.

The take home message is; Mixtures of SBC and IMZ EC in water that lead to mildly alkaline conditions will improve decay control. Whereas, IMZ sulphate is best left acidic.

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Smilanick J.L. et.al. 1999. Control of citrus green mold by carbonate and bicarbonate salts and the influence of commercial postharvest practices on their efficacy. Plant Disease. 83: 139-145.

Smilanick J.L. et.al. 2002. Quantification of the toxicity of aqueous chlorine to spores of Penicillium didgitatum and Geotrichum citri-aurantii. Plant Disease. 86: 509-514.

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