Packer Newsletter

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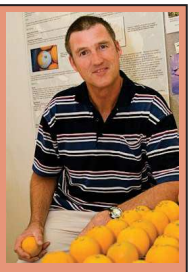

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Integrated postharvest management (IPhM)

As we all know! There are not enough acronyms in the world. So, I have made up one of my own: IPhM. You are all familiar with Integrated Pest Management (IPM). In my opinion, a good postharvest approach would complement IPM. I have is replaced the pest (P) by postharvest (Ph). The 'H' in IPhM is smaller as a reminder of the strong relationship to IPM. It is implied that IPhM should support and improve on orchard IPM.

OK! We have an acronym. But, its no use without a definition. I started by using an on-line definition of IPM from UC Davis: *Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.*

I substituted some terms that relate more to our postharvest goals: *Integrated postharvest management (IPhM) is an packing process-based strategy that focuses on maintaining product quality through a combination of physical and chemical procedures, such as controlled atmosphere, edible coatings, temperature & pH manipulation, high pressure washing, fruit culling, GRAS compounds, natural defence elicitors, hygiene and sanitation. Pesticides (e.g., fungicides) are only used as part of a systems approach, and include resistance monitoring, to enhance overall effectiveness. The goal is sustainable control with the lowest possible pesticide residue on produce. Pest control materials are selected and applied in a manner that maintains product quality and shelf-life while minimizing risks to human health and the environment.*

For me, there are many IPhM aspects to consider for both pests and diseases. A key postharvest consideration is our over reliance on fungicides. I'm not for replacing them entirely: They are very effective used carefully in rotation. This means gaining confidence and experience with alternatives. The approach is akin to using preventative medicine while having a potent antibiotic held in reserve for the intractable multi-resistant infection.

And, of course; IPhM reduces risks to human health and environment. Worthy goals and great marketing opportunities.

But, enough of this! Let's begin the on the road to IPhM. Starting with an article on integrating 'reduce risk' fungicides into current practices.

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
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ADDING SBC TO HIGH PRESSURE WASHERS

Many packers are looking to sodium bicarbonate (SBC) to improve decay control and help combat fungicide resistance. But, there is concern about increased weight loss if high carbonate salt residues remain on fruit after packing. One approach is to add SBC early in the line, which allows dilution of the salts during subsequent aqueous applications (e.g., fungicide flooding). High pressure washers are an obvious choice and anecdotal evidence suggest that this is a good place to add SBC. Before we start, let's think about want else changes if we use SBC; the solution becomes more alkaline. Many packers place calcium hypochlorite tablets on their debris screen, which adds free chlorine as return water flows over the screen. Simple but is it effective? The activity of free chlorine (= %HOCL) is closely related to pH, as the following table shows:

pH	%HOCL
5	99.7
6	96.9
7	75.7
8	28.3
9	3.0

Ideally, you want to sit in the pH 7 range. If you stray into pH 8, your 100ppm reading is equal to ~28 ppm activity. And, pH 9 results in almost no activity. Chlorine is still active at 3 ppm but it will take much longer to work. If you want to use chlorine more effectively: Check your water pH before adding SBC. Often it is already alkaline and adding SBC shifts it further. It is much better to acidify your base water to limit pH shift before adding SBC. You will not change the pH easily once SBC is added. Acidify and mix small batches to see what rate of SBC still gives a reasonable pH. You can raise your chlorine rates as pH increases but keeping pH in check is much better.

Peter Taverner

INTEGRATING 'REDUCE RISK' FUNGICIDES INTO CURRENT PRACTICE

The concept of 'reduced risk' comes from the United States EPA Reduced Risk Pesticide Program to expedite regulatory decisions on pesticides that pose less risk to health and the environment than current practices. The point is that the decision is based on comparing the proposed chemical use against currently registered chemical use. Reduce risk products are likely to be conventional pesticides rather than 'Generally regarded as safe' (GRAS) compounds.

There is no comparable regulatory program in Australia but we can use this USA program to identify products that are reduce risk. Scholar and Philabuster are two 'reduced risk' products registered in Australia, for postharvest use in citrus. Anyone leaning towards IPHM should consider these products for domestic markets. Unfortunately, there is a hurdle for exported fruit.

The active constituents in Scholar and Philabuster are designated food additives in Japan but Japanese supermarkets have been reticent to allow new fungicide actives on citrus. I assume they are concerned about adding new pesticide residues to fruit, which is unfortunate considering the reduced risk profile of these products. Obviously, it will be important to allay any fears by communicating that these products are tools to reduce reliance on older 'risker' products.

Although fungicides, such as imazalil (IMZ) and thiabendazole (TBZ), are under regular review and potential withdrawal, the major impetus for integrating these products into the packing lines is resistance. Scholar and Philabuster are the first new postharvest fungicides since IMZ, and have actives with new modes of action. But, they are not immune to resistance developing. It is highly recommended to alternate or mix fungicides with different modes of action to reduce the risk of selecting for resistance.

Alternating with reduce risk fungicides will reduce the overall use of older fungicides. Alternating is preferred, but mixing a reduced risk fungicide with IMZ or TBZ will sometimes be the best practical option. The IPHM goal will be to combine sustainable control with reduced risk. The 'sustainable' part means avoiding resistance. The approach should be effective resistance management by preferentially replacing IMZ &/or TBZ for lengthening periods during the season. Save IMZ and TBZ for high disease pressure periods.

Peter Taverner

INTEGRATING SCHOLAR

Syngenta Australia produce Scholar, which contains the active fludioxonil (FLU). FLU is primarily a protectant; its curative effect is reduced as the period from inoculation to treatment increases.

Schirra and coworkers (2005) conducted simulated shipping trials indicating that FLU residues of ~1ppm resulted in reasonable control of green mould. They were concerned about resistance developing with single use and recommended use of FLU in mixtures or heated solutions.

Zang's work (2007) suggested good control of stem-end rot and green mould decay. FLU in a dip was compatible with chlorine and controlled TBZ-resistant mould isolates. However, FLU was less effective at sporulation control than IMZ.

We also conducted some work for Syngenta Australia around this time. Our results showed that a 30 sec dip of 600ppm Flu gave excellent control of blue and green mould on lemons. However, control was inferior to IMZ (at 500ppm) on mandarins and oranges. We found FLU's curative properties were reduced if treatment was delayed more than 12 hours after inoculation. We also felt that FLU should be used in mixtures with other actives.

Kanetis and coworkers (2007 & 2008) work yielded similar results to ours. In addition, they found moderate sporulation control with a dip application of FLU but it was much more effective when applied in wax. A two stage application of aqueous dip of

(Continued on page 3)

AGE-RELATED BREAKDOWN AND FROST

It may seem strange to be writing about age-related blemish on navel orange in early September but the weather conditions in the Southern inland growing areas have been unusual. Wet and mild conditions early winter followed by several frosts may accelerate the aging process. If it becomes warm and dry; it could get worse. I have summarised the conditions below.

Cause: rind collapse due to cell weakening and dehydration as fruit matures.

Symptoms: Can be discoloured, dried out with extensive areas of rinds collapse. Sometimes the dehydration or wilting is at the stem end where the rind in thinnest.

[Note: this should not be confused with Stem-End Rind Breakdown where the cell collapse is on the 'shoulder' of the orange leaving an intact area immediately around the calyx.]

Occurrence: Navel oranges are more likely to show symptoms at the end of the season. However, some conditions can accelerate the incidence;

- Heavy rains plus high humidity, then followed by frost
- Dehydration of fruit in the orchard due hot conditions
- Holding fruit too long between harvesting and packing (low humidity shed storage).
- Warm conditions when the trees are under water stress. This leads to the dehydration of the stem end of the fruit.

Control:

- Be cautious marketing fruit later in the season. Consider short local marketing. Even the best postharvest treatments cannot extend shelf life for long voyages.
- Late winter gibberellic acid sprays (GA_3) will delay aging and prolong marketing. The decision to spray must be made according to any previous GA_3 application, cultivar, and effects on flowering.

Peter Taverner

(Continued from page 2)

FLU followed by FLU in wax greatly improved decay and sporulation control. They also looked at mixtures of fungicides. The two stage (dip & wax) combination of TBZ + FLU was effective on a TBZ/IMZ resistant mould isolate. In addition, sodium bicarbonate (SBC), with or without chlorine, improved the efficacy of FLU. Adding SBC also improved control when treatment was delayed (effective up to 24hrs after inoculation).

Later work by D'Aquino (2012) showed enhanced efficacy of TBZ + FLU + SBC mixtures; opening the possibility of a 3-way mix or rotation of TBZ + SBC and FLU + SBC.

If you're a packer and still reading this: Here comes the interesting part. What does the theory suggest you could do to integrate Scholar into your line; maintain efficacy, reduce resistance risks and meet IPHM goals?

If you are running domestic, you can introduce Scholar at any time. It could be used to give IMZ or TBZ a rest. However, its pretty clear that you shouldn't run Scholar on its own for long periods: This probably means using mixtures.

Let's assume you have a small line with IMZ cascade sometimes followed by IMZ in wax (only at times of high disease pressure). You could switch 'cold turkey' to a FLU + SBC cascade. Unfortunately, aqueous FLU alone doesn't provide the sporulation control of aqueous IMZ. So, using nothing in wax may be a bit too risky! A FLU +SBC cascade followed by IMZ does still rest TBZ.

Unfortunately, FLU is not registered for use in wax; FLU would work better as a 2 stage application (cascade + in wax) and you could then rest IMZ. If TBZ was registered in wax, I could then recommend TBZ + FLU in wax. Oh well! It appears we still have some 'use' gaps to fill before implementing more flexible rotations.

[Please note: I would recommend using a compatible sanitiser for recirculating solutions. This may be problematic for some fungicide and SBC combinations]

Another scenario is an export line (Japan during most of the navel season) and using TBZ drench, IMZ+TBZ and IMZ in wax. Firstly, it would be ideal to use FLU at either side of the Japan trade period to break the resistance cycle. It would be difficult to remove both fungicides. Let's work on one or the other at each application.

Using TBZ in the postharvest drench is a core treatment. TBZ + SBC would be an obvious option to reduce resistance risks but doesn't rest TBZ. FLU + SBC is an option that needs further verification. FLU is relatively poor when treatment is delayed (curative) unless SBC is added. Bins need to be treated promptly. Otherwise, IMZ (EC only) + SBC would rest TBZ.

[Please note: SBC creates alkaline conditions which can strongly influence IMZ sulphate and the consequent residues on fruit. Use of IMZ sulphate and SBC mixtures is discouraged]

The cascade options are similar to the domestic line. You could use FLU + SBC but if you're cautiously moving to reduced risk fungicides &/or disease pressure is high; TBZ + FLU + SBC will still rest IMZ. The option to rest TBZ by using FLU + IMZ EC + SBC needs to be verified.

Lastly, if you are resting TBZ in other stages, then continue using IMZ in wax. If resting IMZ in other applications, then your options are limited. If FLU was register in wax, you could use FLU in two stages; cascade and in wax: Allowing you to rest IMZ. If TBZ was registered in wax, I could recommend TBZ + FLU in wax. Not possible, in Australia. But, you can use Philbuster in wax (see next article).

PETER TAVERNER

Key references for this issue

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Acknowledgements

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POSTHARVEST SNIPPETS!

KAROLINA DEPARTS

Our very capable technician, Karolina Stuciuk, has left our postharvest group to pursue another career. Karolina may not be well known to packers but she maintaining the laboratory and set up experiments over the last 13 years. Many of the compatibility, fungicide evaluation and fungicide resistance results were her contribution to the industry. We wish her well as a laboratory manager in the secondary school system.

POSTHARVEST SURVEY

The citrus IAC for Horticulture Australia requested a survey of packers' opinions on the value of past postharvest programs and as a guidelines for future work. The on-line survey is now closed and many thanks to the packers that completed the survey. We had replies from all major citrus growing areas in Australia, which was pleasing. The results have been sent to Citrus Australia for analysis and comment. We will use the information to support our application to Horticulture Australia for a new postharvest program next year.

BIORATIONAL USE OF CHEMICALS

One survey respondent asked, 'Why do we concentrate on using chemicals rather than pursuing alternatives'. Well! We are reviewing chemical use in citrus production with a view to rationalising use. Be warned! You may be surveyed in coming months to establish your critical chemical use as a grower and packer.

INTEGRATING PHILABUSTER

Janssen PMP produce Philabuster, which in a mixture of IMZ sulphate and pyrimethanil (PYR). You cannot substitute IMZ out using Philabuster but you are applying 20% less IMZ (Philabuster high volume rate is 400 ppm IMZ). The PYR combines to provide decay control despite the lower IMZ rate.

Smilanick et.al (2010) provides a good summary of PYR performance. Typically, aqueous solutions yielding 1-2ppm fruit residues are effective. PYR is protective and curative due to its systemic translocation properties (effective up to 24 hours after infection). Efficacy is improved with mild heat or when mixed with SBC or potassium sorbate. PYR is incompatible with chlorine but stable with peroxyacetic acid. Efficacy is reduced in wax and sporulation control is inferior to IMZ.

A PYR + IMZ mixture provides superior resistance management. A propriety mixture shows good stewardship by Janssen PMP but it may limit flexibility. For instance, Philabuster contains IMZ sulphate, which is not suited for application under alkaline conditions. SBC creates alkaline conditions. Thus, Philabuster with SBC may pose a problem.

If you are running domestic, you can introduce Philabuster (PYR + IMZ) at any time. Ideally, use it as a tool to rotate TBZ out for a while. This mixture can also reduce the risk of IMZ resistance developing.

Let's assume you have a small line with a TBZ cascade followed by IMZ in wax. You could switch to a PYR + IMZ cascade. If you were using chlorine for sanitation with your TBZ; they would not be compatible with PYR + IMZ. If you require sanitation, peroxyacetic acid is compatible and would also help the IMZ sulphate by increasing the acidity of the solution. You could also add PYR + IMZ in wax, check fruit residues after the two applications and adjust rate to meet your residue targets.

If you are running an export line; PYR is widely accepted but check with your importer. Japanese supermarkets may not accept fruit treated with PYR.

Currently, you may be using a TBZ drench, heated IMZ+TBZ cascade and IMZ in wax. Firstly, it would be ideal to use PYR + IMZ at either side of the Japan trade period to break the resistance cycle for TBZ.

Using TBZ in the postharvest drench is a core treatment. Sodium bicarbonate (SBC) is an mixture option to help alleviate fungicide resistance. TBZ + SBC would be an obvious choice to reduce resistance risks but doesn't rest TBZ. Using Philabuster in the drench is possible depending on markets. PYR + IMZ has good protective and curative properties and would rest TBZ.

[Please note: Consider other risk factors before resting a fungicide. E.g., TBZ controls stem-end rots and alleviates chilling injury]

The cascade options are similar to the domestic line. If you're cautiously moving to reduced risk fungicides ; IMZ + SBC will still rest TBZ. Otherwise, you could use PYR + IMZ. PYR and IMZ are both very responsive to heat resulting in markedly higher residues. The rates must be lowered by trial and error on your system to meet residue targets.

Lastly, you could also add PYR + IMZ in wax. Check fruit residues after the two applications and adjust rates to meet residue targets.

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