Packer Newsletter

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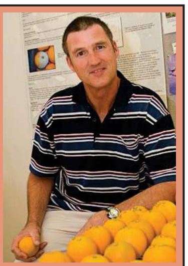

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Note the change of address

A few maintenance hints for the off season

Many packers are already having a break between the Valencia and navel orange seasons. It is a time for maintenance and making improvements. Often, this means big capital expenditure but some improvements can be made without huge cost.

I am going to suggest three areas for you to consider. Hopefully, this article will get you thinking about other areas in your operations, especially ones that can provide benefits with minimal investment.

We had an interesting year surveying packing-lines and cool rooms for fungicide resistance. Based on our observations, cool room maintenance, especially decontamination and cooling efficiency , are worth considering. I also spent time with other researchers measuring high pressure washer performance. I discovered that high pressure washers can be quickly rendered inefficient and it is difficult to see the problems. Fortunately, there are simple measures to monitor and restore them.

Refrigeration Systems

This is a simple list of ideas. A more detailed review of refrigeration systems can be found in Packer Newsletter no. 89.

Compressors

Compressors are the heart of all refrigeration systems. Small condensing equipment is cheaper to purchase but more expensive to run. Larger compressors with lower pressure differentials can have a longer life. It has been calculated that decreasing head pressure from 180 to 80 psi and increasing suction pressure from 10 to 30 psi could more than double refrigeration capacity without changing horsepower.

Evaporator coil units

High humidity can be more easily maintained in a cool room if the evaporator coil is oversized. This allows the coil to run at a relatively higher temperature , thereby reducing condensation on the coil and keeping the moisture in the cool room air.

Fan efficiency

Minimising the distance between blade tip and housing will prevent recirculation

Installing contoured fan shrouds can improve efficiency by up to 40%

Large diameter, slow turning fans are more efficient.

High efficiency fan motors can reduce electricity cost by 20%, with 2-3 year

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Inside This Issue

Read the Packer Newsletter and stop the rot.

Blue mould on one fruit only

CAN MOULDY FRUIT INFECT NEARBY HEALTHY FRUIT?

I commonly hear the statement; 'Sour rot causes nesting in cartons but mouldy fruit can't infect nearby healthy fruit.' It made me start to wonder if this is really true. A little bit of detective work and the answer is starting to reveal itself. Barmore and Brown (1982) looked at this question. They concluded that infection of healthy fruit depended on the amount of hyphae between the infected and healthy fruit in contact. The infected fruit exudes spores in an acidic solution that injures the healthy tissue allowing infection. Interestingly, green mould produces a thick 'spongy' mat of hyphae that usually prevents the acid solution reaching healthy tissue. Whereas, blue mould produces a thinner mat that allows the acid to pass onto healthy tissue. As such, blue mould is more prone to infecting nearby healthy fruit. Why is this a problem if the fruit are treated with a fungicide?

In theory, a decayed fruit oozing highly fungicide resistant spores should be able to spread to adjacent fruit. I haven't conducted work to see (but I hope to!).

Peter Taverner

Reference

Barmore C.R. and Brown G.E. 1982. Spread of Penicilllium digitatum and Penicillium italicum during contact between citrus fruits. Phytopathology 72: 116.

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payback.

Compare fans on the basis of cfm per watt rather than cfm per horsepower.

Clean louvers—3mm of dust can reduce airflow by 30%.

Thermostat control

Check the thermostat by placing a remote thermometer in the cool room (and away from the door). Calibrate the thermometer (a stirred slurry of water and ice should read ~1^{0}C).

DECONTAMINATION

The opportunity to clean up and destroy any fungicide resistant spores in the system should not be missed.

Decontamination of cool rooms commonly consists of a thorough cleaning followed by splashing about water with high rates of SOPP, chlorine or quaternary ammonium compounds.

Nothing wrong with elbow grease and sanitisers but it is difficult to get everywhere. Some fumigant action would be preferred.

An article in Packer Newsletter no. 87 goes into alternatives in some detail. Briefly, there are devices that atomise or nebulise sanitisers. The droplet size needs to light enough to drift. This drift coupled with fans can provide a good space-filling approach.

Ozone and UV-C light have been used in other industries . Check the system claims carefully to ensure it meets your needs and be aware of the precautions required to avoid unsafe exposure to workers.

Rather than a once-a-year clean, you can try to maintain a clean environment continuously. Ozone and UV-C light are well suited to maintaining low microbial levels in cool room air. I like the idea of filtering air through closed units that shield their effects from workers but draw air continuously to expose and decontaminate it.

HIGH PRESSURE WASHES

There are many maintenance issues associated with high pressure wash systems but a major issue in citrus washing is dirty recirculating water. The most frequent outcome is clogged spray nozzles. Over time, nozzles can also become corroded and worn.

It is very difficult to see changes in flow rate or detect worn nozzles visually.

Differences in flow rate between nozzles are likely signs of clogging . To measure flow rate, place a hose over individual nozzles and record volume for a given period at a specific pressure. For centripetal pumps, the overall manifold pressure is likely to remain constant with clogged nozzles. For positive displacement pumps, clogged nozzles would lead to increased pressures.

So, what do you do about it? Prevention is better than cure. Some packers use slopping screens with a coarse mesh to filter for twigs and leaves. It should be possible to have a series of screens or sieves with decreasing mesh aperture to progressively remove smaller material. Yes! The screens will need cleaning but otherwise grit ends up in the nozzles. Or, you are sand-blasting your fruit with grit.

Water is lost during washing and returning fresh water helps dilute the dirty recirculating water. A low pressure manifold (e.g., with 2 nozzles) can provide continuous fresh water. I am aware of one system that sprays~7L/min fresh water, which equated to the tank capacity (700L) every 100 minutes. Excess to capacity is diverted out the tank overflow. The fresh water rate used depends on your water conservation strategy.

Nozzles may still become blocked regardless of your best efforts. To make cleaning easier, 'quick connect' nozzles can be rapidly changed reducing down time. For instance, some packers use Veejet flat spray nozzles, which have 'quick' versions.

OK. That's it! There are a few ideas to get you thinking. However, you know your operations better than me. Give it some thought, and good luck.

Peter Taverner

THE TRIALS AND TRIBULATIONS OF CONDUCTING FUNGICIDE RESISTANCE SURVEYS

Three years ago we began a series of fungicide resistance surveys. The procedure was to survey the same packing-lines several times each season. The idea was to assess changes between seasons and within seasons for those lines. We also conducted random surveys in a range of packers to ensure our lines were representative.

I must admit that it has been a battle to make sense of the results at times but we are in a better position after three seasons. I would like to share some of my observations over this time.

It is standard practice to expose agar plates amended with fungicide to capture airborne spores and see what grows. However, what fungicide rate do you use?

There was no previous history of fungicide resistance in Australian packing lines. As such, we chose relatively low fungicide rates, according to Wild (1994) and Holmes and Eckert (1999).

This first survey indicated a high level of growth on virtually all fungicide amended plates. This didn't appear to be very useful to us because most of these packers were not experiencing rampant decay issues. We needs rates that were more discriminating and separated out the resistance leading to commercial impact.

South America came to the rescue, with a article by Perez and coworkers (2011) on discrimination doses of IMZ for surveys in citrus packinghouses. They suggested that monitoring the presence and quantity of resistant isolates should be the starting point to integrated disease management.

We adjusted our fungicide rates, repeated surveys and still found resistant isolates. We were not convinced that growth on plates necessarily translated to commercial problems. However, there was at least signs of resistance building and we needed to provide meaningful results to packers.

In response, we developed a survey record sheet that concentrated on the spore coverage of control plates ('total spores') and the proportion of resistance spores for each fungicide at a given dose ('fungicide resistant spore '/'total spores'). We also provide an interpretive guide that outlined escalating risks of developing resistance problems and remedial action required for various 'results' scenarios. In large part, we are more confident in reading trends than providing advice based on one 'snap-shot' in time (one survey).

The reason for our caution was that the plate surveys only tell part of the story. I felt that three criteria needed to be met before fungicide resistance becomes a significant problem . They are:

1. Frequency
2. Virulence
3. Sporulation capacity

The first criteria is assessed through the surveys. Surveys provide an overall spore count and the proportion of resistant spores. These two results provide an indication of frequency. However, not all criteria are assessed through the surveys. Resistance often comes at a cost to fitness; a range of fitness was demonstrated in susceptible and resistant green mould mixtures by Holmes and Eckert (1995). We attempted to use criteria two to

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SEPTORIA SPOT

Septoria spot is an occasional disease that occurs mainly in inland citrus growing area in Australia. It is more prevalent in years with higher rainfall and rapidly fluctuating temperatures. The conidia of *Septoria citri* spread from dead twigs to healthy leaves and fruit by rain splash, usually in late autumn or winter. The conidia germinate quickly but lay 'dormant' for up to 6 months until conditions are favourable. The symptoms occur most commonly after cold and frosty weather. Mild symptoms can occur on green fruit but are much more conspicuous on ripened fruit. Dark brown pits coalesce; they often have a purple tinge. The lesions develop small black specks (which are the pycnidia that produce condia). Control is achieved by copper sprays prior to significant autumn/ winter rain. This rain splash dispersal from dead twigs and latent infection also occurs with the pathogen that causes Anthracnose. Appropriately timed copper sprays can control both of these diseases.

Peter Taverner

SPORULATION TESTS ON FRUIT INFECTED WITH:

Susceptible spores cause decay and sporulation of untreated fruit (far left).

'Resistant' spores collected from TBZ amended agar plates show no sporulation on fruit (near left).

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POSTHARVEST SNIPPETS!

FUNGICIDE SURVEYS

As you have (hopefully) already read. We have been conducting fungicide resistance surveys on a limited basis for a few years. Recently, we were approached by a couple of packers to be included in future surveys. If you are interested we should be able to include a few more packers. Be warned! We are dorky guys in white coats. The survey is part of our research program. As such, we may not provide you with the most cost-effective service possible. Fortunately, most chemical suppliers should be able to arrange fungicide resistance testing services for you. Regardless, we can discuss fungicide resistance and the benefits of a regular service. Hopefully, we can point you in the right direction.

NEW RESEARCH PROGRAM

Our current research program concludes early 2015. We have one more season but are already well advanced in canvassing for our next program. We are very interested in getting feedback from you on what we do well, and want we don't do well. Also, where are the areas that need more work? Should we continue with fungicide resistance testing? Are we doing enough work on mandarins? What about wax evaluations? Maybe, you think this packer newsletter is a waste of time.

If we haven't contacted you already, we would like to get your point of view. The industry advisory committee reviews our current proposal in a few months. If we are successful we would still like to refine and add new ideas that will progress the industry.

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gauge fitness but we infected fruit rather than using plates.

Virulence is the ability of the spore to grow on its host: In this case, citrus fruit. The spores collected during surveys may grow on agar plates but do they grow on fruit? We collect spores growing on resistant plates and inoculate fruit to see if they grew on fruit.

Interestingly, we found that a significant proportion of spores growing well on fungicide amended plates did not cause symptoms on fruit at our inoculation concentrations (see photos, pg. 3). This suggests a significant cost to fitness relative to susceptible spores. However, not all spores showed weakness. We found a range of responses on untreated fruit from no decay to aggressive sporulation.

If fruit sporulated (criteria 3), we then inoculated those spores onto fruit treated with fungicide. This fruit sporulated well, whereas fungicide-treated fruit inoculated with susceptible spores did not sporulate. Houston! I think we may have a problem.

Unfortunately, we only had the resources to test a few samples on fruit across all packinglines, which limits packer specific recommendations. We have, however, accumulated the results from the same locations over several sampling periods and seasons, which provides some continuity.

This gives me some confidence to try to piece things together. I feel that the plate surveys provided a useful service to indicate trends over time. The fruit bioassays provided a better indication of the level of the resistance and the imperative to respond, but the fruit tests are labour intensive.

Plate surveys often showed increases in the frequency of resistance spores but the fruit bioassays indicated the resistant spores were relatively weak. In our surveys, it seems that resistance may have been in the early stages and that surveys provided an early warning sign. Since the resistant spores were weak, remedial action could be to rotate the current active out and introduce a new fungicide active for a short period. Susceptible spores should readily outcompete the resistance spores when their competitive advantage is removed. Any changes can be monitored through the plate surveys.

This is a much better strategy than waiting until the resistance is obvious through commercial impact. By that stage, the resistance spore may be as fit as susceptible spores, which requires a much longer period of rotation and/or costly decontamination at the end of the season to remove resistant spores.

This is speculative, as we do not have survey data during a period of fungicide rotation to support the above statements (yet). One more season to go!

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