# The importance of proper packhouse sanitation and the consequences of neglect

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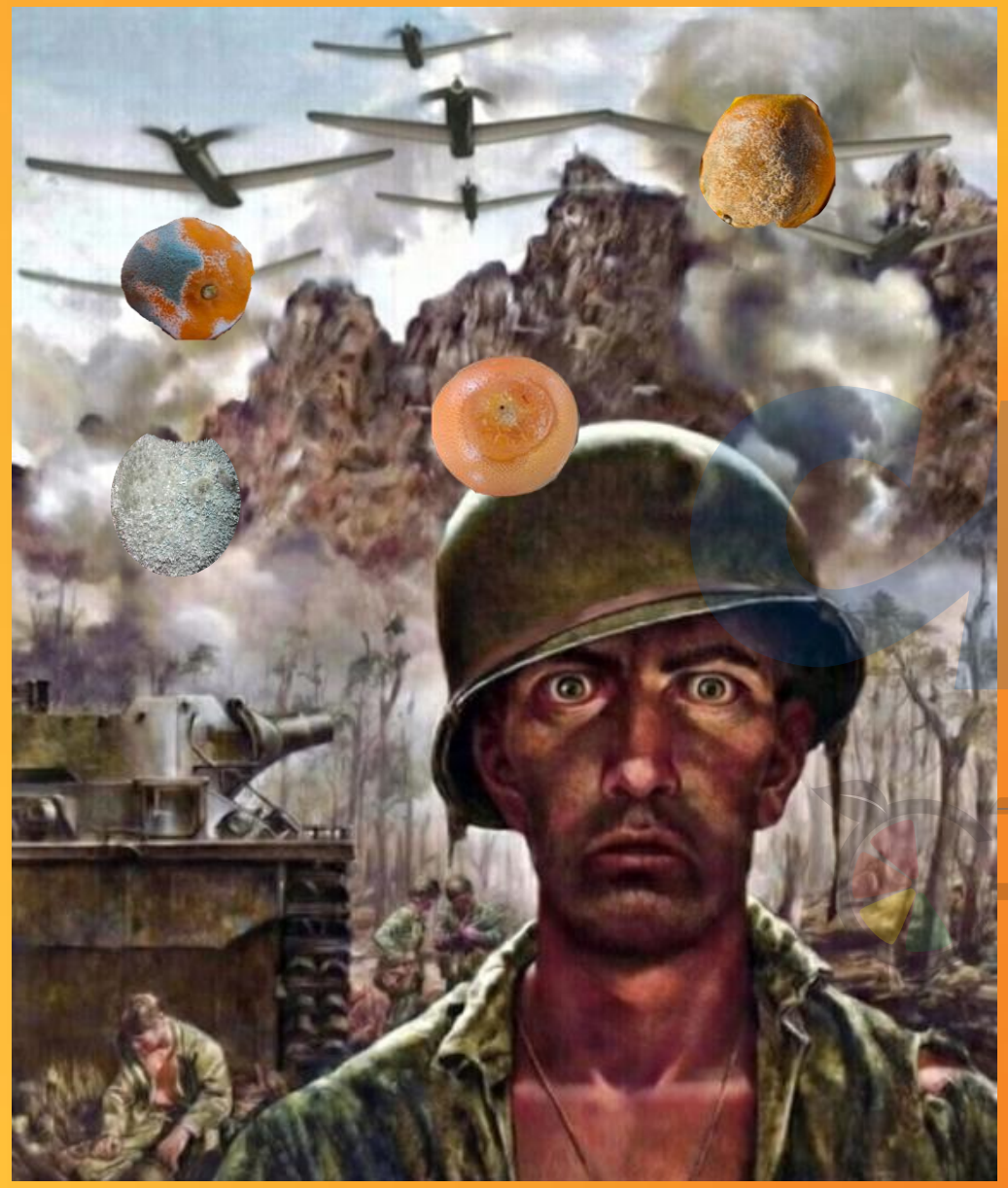
# Rain! Rain! and more Rain!

- Flooded orchards
- Saturated soils
- Low-hanging fruit submerged
- **Or** covered in contaminated soil
- **+**
- High moisture levels and temperatures
- **=**
- Perfect conditions for a pathogen inoculum **BOOM**
- Infections and disease development

- Sour rot & Brown rot
- Entire fungal family (*Penicillium spp., Alternaria alternata, Phomopsis citri, Lasiodiplodia theobromae*)



**SANITATION PRACTICES**

# Limit diseased or possibly compromised fruit from reaching the packhouse

- **Pre-harvest sanitation sprays** – e.g. peracetic acid – a week to a day before harvest.
- Read the label and consult your supplier.

- Orchard sanitation directly preceding the harvest teams
- Diseased fruit, on the floor, low-hanging, or injured = **REMOVE AND DESTROY**
- Pre-grading of unmarketable fruit in bins in the orchard.
- **DON'T SEND TO PACKHOUSE – DON'T TAKE THE RISK – YOU'LL REGRET IT!**
- Frequently wash and sanitise harvesting equipment, picking bags, and bins.
- **Every action taken should be to prevent contamination of healthy fruit, limit injuries, and reduce inoculum levels.**

- Packhouse should be notified if an orchard has severe decay problems.
- Can prepare and implement additional sanitation protocols.

# Why is sanitation always on everyone's tongue?

- Market restrictions for certain actives, consumer demands, and stringent auditing bodies (GLOBAL G.A.P, BRC, SIZA, etc.).
- Resistance risk – Fungicides

= Forced packhouses to change their modus operandi.

**Solution = Sanitation!**

- Residue-free, fruit, and human safe.
- Can be incorporated into every postharvest practice.

# THE PACKHOUSE – OUR BATTLEFIELD

# What types of sanitisers are used in the packhouse?

- Water sanitisers
- **Surface sanitisers**
- **Air sanitisers**

- **A LOT of products containing different actives are used.**

- Tested by CRI or agrochemical suppliers.
- Evidence for efficacy – Trial results or repeated microbial analysis tests.
- **Some have yet to be thoroughly evaluated by CRI.**

| Active ingredients |
| --- |
| Chlorine |
| Clove oil |
| Hydrogen peroxide |
| Hypochlorous acid |
| Orange oil |
| Peracetic acid |
| Potassium sorbate |
| Silver-hydrogen peroxide |
| Stabilised glutaraldehyde. |

# What should be considered when selecting a sanitiser?

- Only use sanitizers that have one of the following registrations or accreditations:

| | |
|---|---|
| **Act 36 of 1947:** Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act | Considers residues |
| **Act 5 of 2008 :** The National Regulator of Compulsory Specifications Act | Does not consider product residues |
| **SANS 1853:** Disinfectants coming into contact with foodstuff | Does not consider product residues |

- Make sure if the sanitizer leaves residues (even GRAS residues) that it falls under the necessary MRL's for the relevant markets
- CRI also tests sanitizers
  - Postharvest fact sheets: https://www.citrusres.com/
  - CRI cutting edges on sanitizers/ disinfectants: #144 (July 2012)

- Toxicology? Is it food-grade and human safe?
- Is it corrosive?
- Phytotoxic?
- Is it practical and easy to apply?

  - Method of application (Manual vs. automatic) and equipment needed?
  - C x T (Concentration and time required for effectiveness)?

- **ASK Around**
  - Who has heard about or has experience? Neighbour? CRI?
  - Have trials been conducted? Are these results available?

- Price of product and equipment?

- Read the label and SDS carefully – Follow the instructions accordingly.
- Will your staff be able to use it?

# Sanitation and washing are not the same thing!

## Hand - Hand

- Knowledge of both = Effective sanitation

- **Sanitisers =** kill or suppress microbes.
- **Soaps/ detergents =** Do not necessarily kill. Removes dirt.

- Most microbes of importance in the packhouse are fungi.
- The product should target either **fungi or both, fungi & bacteria.**

- Pathogens important for human health – Bacteria (*Salmonella spp., Listeria monocytogenes* & *E.coli*).

# Sanitation and washing are not the same thing!

- Surface sanitisers are also deactivated by OM and dirt.

- Layer of OM or debris = food source and shelter for microbes.

1. Wash with a food-grade detergent.
2. Physical scrubbing or pressure washing, if necessary.
3. Rinse with water.
4. Apply sanitisers – CT!

- Soap options available – Consult agrochemical representative

# Where and how can sanitation practices be incorporated and implemented into your packhouse operation?

# Intake zone:

- Located away from the wash line and packing area.
- Separate untreated fruit vs. treated.

- Pressure wash cement slab – Dust, plant material, and juice leaking.

# Drench:

- Prevent organic matter from falling into the tank.
- Manage the water sanitiser.
- Rinse, scrub, and wash the tank – Remove sludge
- If not, inoculum accumulation and sanitiser inactivation.

# Degreening rooms

- Major cause of contamination and fruit infection.
- Perfect environment for infection and disease development – Hot and Humid.
- Disease expresses fast – especially at 72 hours degreening.
- = Fruit ‘bom uit’ (green and blue mould) and rots (sour rot).
- Each fruit can contain millions of viable spores.
- Minor injuries on healthy fruit can get infected.
- Spores accumulate if not properly ventilated & sanitised.

# Disease development, post-infection, at room temperature (25°C)

| Disease | Causal organism | Days to first symptom at 25 °C |
|---|---|---|
| Green Mould | *Penicillium digitatum* | 1-2 days |
| Blue Mould | *Penicillium italicum* | 3 days |
| Sour Rot | *Galactomyctes citri-aurantii* | 6 days |
| Brown rot | *Phytophthora* sp. | 3 days |
| Stem end rot | Various | 2 Weeks |

# Degreening rooms

- Deep clean the degreening rooms between seasons.
- And as often as possible throughout.

- High-pressure washer to wash walls and floors - Sanitise afterwards.

- Remove dust and spider webs from the ceiling/ rafters (forklift) – catches spores.

- Remember to also clean extractor vans and vents.

- Fumigate, fog, or nebulise during the season.
- Effective products – food-grade, no residue, non-corrosive.
- Method of application (equipment and temperature?).

# Tipping zone

## Wet tip:

- Drain daily – If within your means.
- Remove plant material, rotten fruit, and soil.
- Rinse tank.

- Poorly managed sanitiser – spores not deactivated,
  If high inoculum from degreening.

- Elevator.
- Sanitise rollers.
- Remove fallen fruit and leaves.
- Spores – Infection
  & resistance risk.

# Tipping zone

## Dry tip:

- If not drenched, fruit surfaces have not been rinsed.
- Dust, plant material, rotten fruit, juice, and grime collect on the belt or underneath the system.

- Scrub, wash, and sanitise these belts daily.
- Permanent brush installed underneath or an automatic sanitiser system.

- Decaying fruit, leaves, and twigs:
  = Spore development
- = Inoculum increased + Resistance risk

# Bins

- **Wash and sanitise the bins after dumping, before re-use.**
- After every use, if possible.

- Plant material and dirt build up in the corners.
- Pathogen shelter and inoculum source.

- Automatic pressure washing system (Contains sanitiser solution).
- Or High-pressure spray.
- Or manual cleaning if it is a small operation.
- **PAA or surface sanitisers are mostly used.**

- Cannot just sanitise every time, a deep wash is needed.
- Broken rubber feet – dirty water.

# Pre-sorting stations

- Remove the undesirables.
- Limit spore accumulation and infections down the line.

- How is the fruit disposed of?
- A belt? A shute?
- Into a bin?

- Use bins/containers specifically designated for the task.
- Wash and sanitise often.
- Is it covered to prevent spores from being released into the air?

How often are they emptied?

**SANITATION ISSUE!**

Feet and wheels will spread sour rot!

Plastic bags or solid bins – Prevent liquid leaking

# High-pressure spray

- Shown to significantly reduce spore load on fruit.
- Sanitiser – managed properly (recirculating system).

- Clean often - Rotten fruit & plant material below and in-between.
- Net or grid to catch.

# The packline – belts, rollers, and drop plates

- Entire packline (especially drop plates) should be wiped down/ sprayed with a sanitiser several times a day.
- Pre-sorting surfaces – cleaned and sanitised daily.

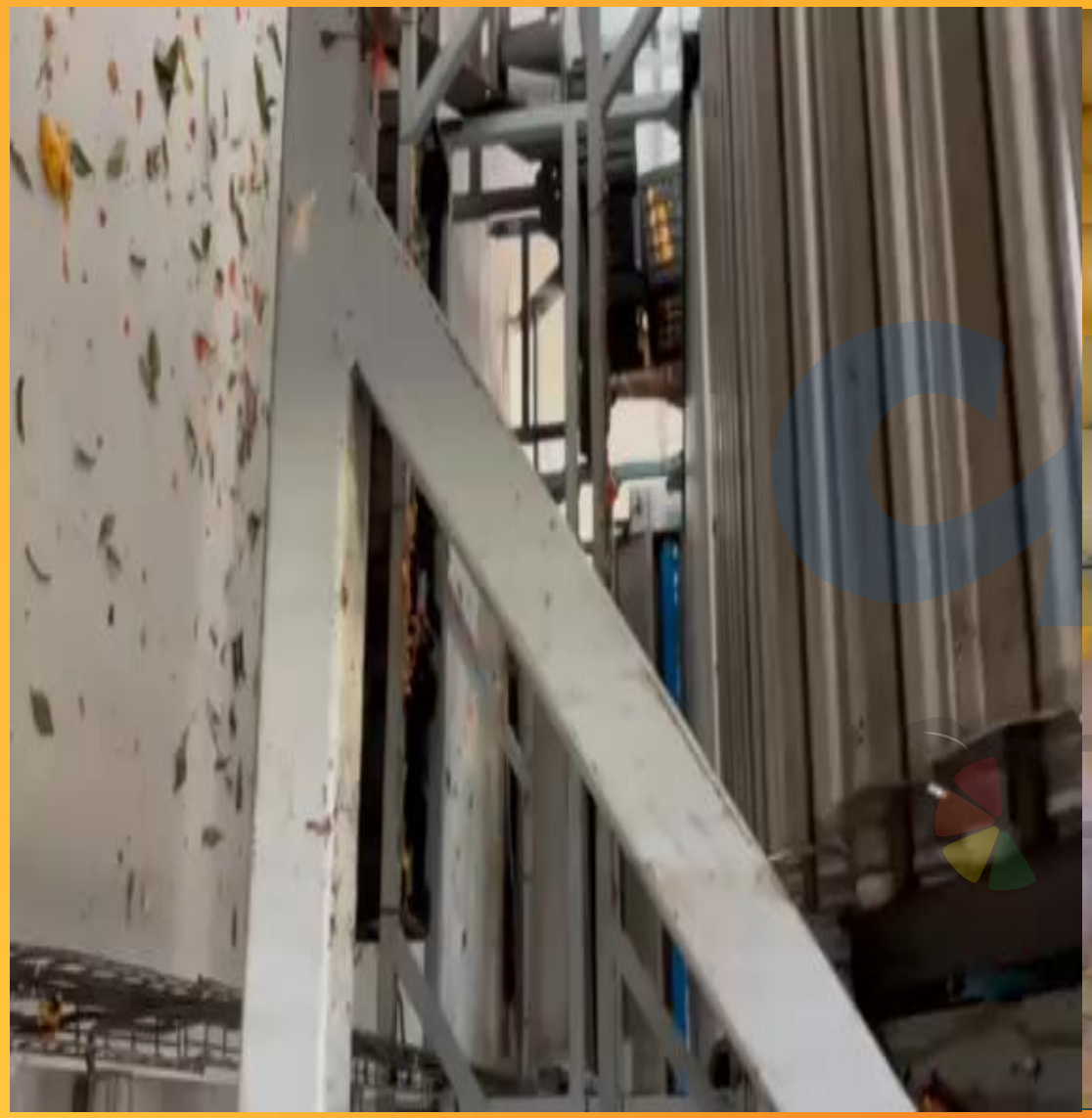
- Sour rot and creasing –> crushed fruit – > pathogen buffet.

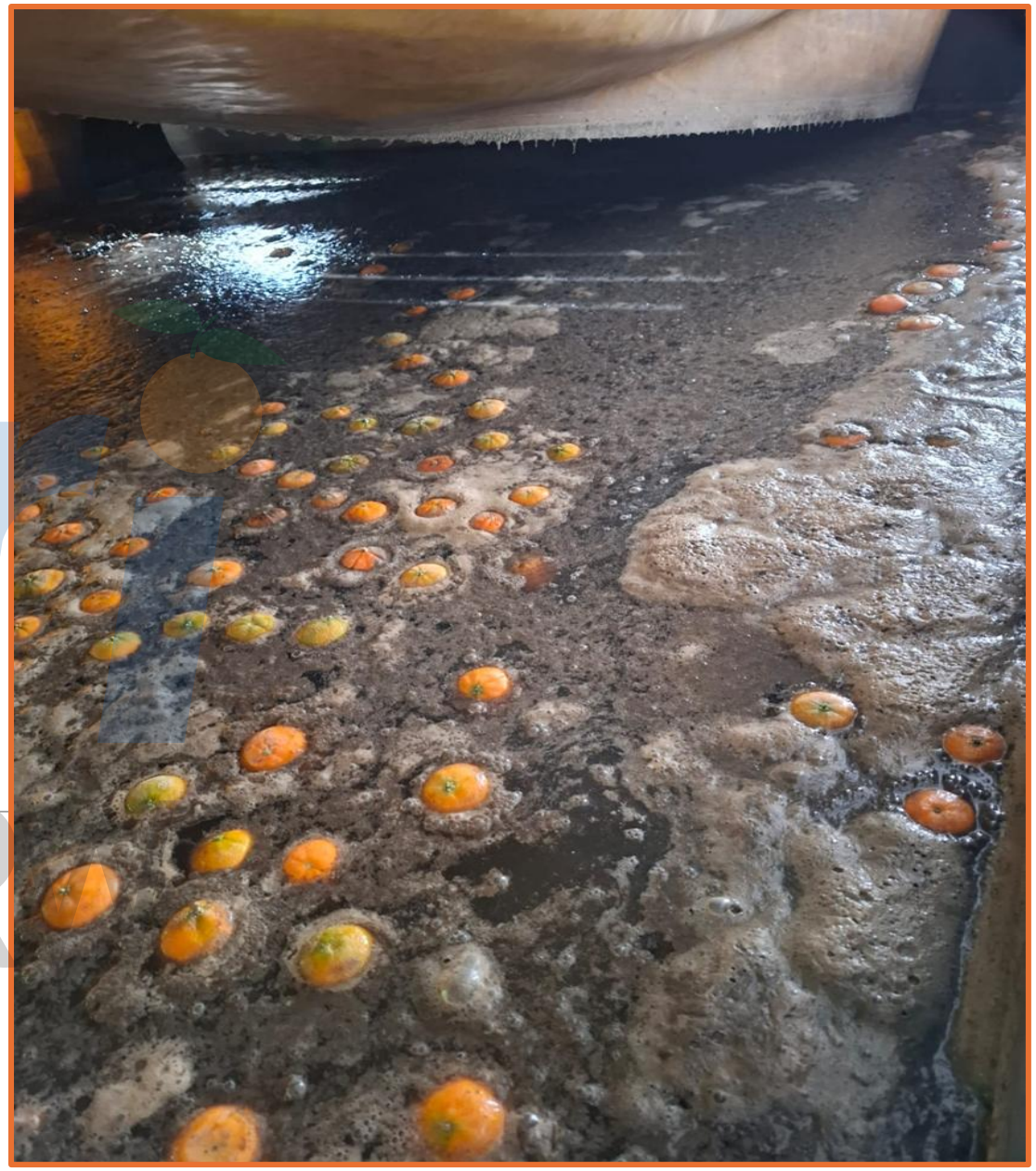
- Infects healthy fruit, develops, and releases spores – contamination and resistance risk.

- Rags are often used to wipe down the surface with a sanitiser solution.
- Rather use disposable cloths – rags not washed often.

- Spray down the packline using a knapsack at the end of the day.

- Follow label instructions - Minimum contact time.
- Replace solution often.





# Brushes and Donut Sponges

- Filth accumulates within the brushes – Microbial biofilm develops.
  - Contains pathogen spores.

- Wash brushes thoroughly when possible – sanitise after the season.

- **Donuts** – Soaks up water (and spores within) – if water sanitiser not effective.
  - Sour rot

# Non-fruit contact surfaces

- Floors, walls, ceilings, windows, walkways, etc.

- Clean floors often, where fruit has fallen, and where feet move.
- Wash with mop, spray with knapsack.

- Dust and spiderwebs on rafters and in windowsills.
- Falls to contaminate the packline.
  - Long stick with sacks or brushes attached.
  - Forklift and air hose.

- Fumigate or nebulise enclosed spaces (entire packhouse).
- Extractor fans move air throughout the packhouse – including spores.

# Carton storage

- Keep the carton storage area clean.
- Don’t forget to also sanitise this area between seasons.

- Store away cartons and packaging material left over from the previous season
- Wrap in plastic to limit dust coverage?

# Consequence of neglecting sanitation

- If proper sanitation is not done often, it could lead to:

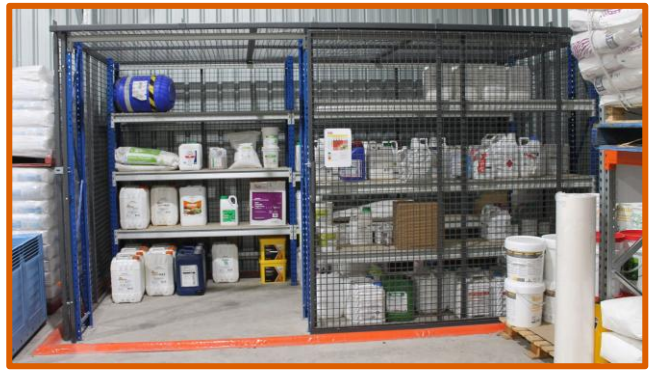
  = High levels of pathogen infection and decay development.

  = The risk of eventual resistance development.

- **If resistance/ tolerance of certain pathogens is detected**
- Replace the problem fungicide.
- Do a thorough packhouse-wide cleanup and sanitation.
- Enforce the strict sanitation regiment until resistance is lost in the path population.
- **Remember! It has been shown that green mould resistance can occur in all postharvest fungicides.**

# Also, important...

- Suitable storage of cleaning and sanitising chemicals, and equipment.
- Properly clean and sanitise the cleaning equipment (brooms, brushes, and rags) often.
- **Record keeping:** Be meticulous
  - How much of which chemicals were used?
  - Maintain accreditation of audits.
- Ensure that SOP's are in place for the sanitation of different areas of the packhouse.
- Schedule sanitation often.



# Microbial laboratory analysis

- Independent companies offer microbial presence and concentration tests.
- Test the packline surfaces (critical points), water sources, and the air.
- **Packline – Swab** samples taken of conveyor belts, sorting tables, drop plates, and packing tables.
- **Aerial** spore load – Plates.
- Indication of the packhouse's sanitation and treatment efficacy.

# Food safety

- Notify packhouse workers on **personal hygiene.**
- Human pathogens – *Listeria monocytogenes, Salmonella spp*., etc.

- Surface sanitisers should kill most microbes, including **bacteria** and yeasts.

- Provide hand washing stations, with hand soap, disposable towels, and bins.

- Separate eating, smoking and toilet facilities from the main packhouse.

- **Proper PPE** (Jackets, gloves, hairnets, etc.) – Remove during lunch and bathroom breaks - Wash PPE often.

# Take-home message

- Sanitation can be a lifesaver.

- **The war against pathogens is never over, but you can win the battles.**

- Don’t make excuses.
- High fruit volumes do not mean you can neglect sanitation

- **Sanitation = time + money**
- So do it efficiently and effectively.

- Sanitation does mean no fungicides! No legs.

# Additional resources

- Citrus academy: Citrus packhouse series.
- CRI Citrus Production Guideline Volume IV.
- Citrus Australia – Packhouse hygiene – sanitation and food safety.

- **Cutting edges:**

- **No. 246 –** Postharvest pathogen resistance monitoring in the packhouse and orchard.
- **No. 317 –** Sour rot and Brown rot warnings.
- **No. 341 –** Postharvest decay warning.

- Erasmus et al. (2015) Imazalil resistance in Penicillium digitatum and P. italicum causing citrus postharvest green and blue mould: Impact and options. 66 – 67 (107).

# THANK YOU!

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