POST HARVEST FUNGICIDE RESISTANCE IN THE SOUTHERN AFRICAN CITRUS INDUSTRY

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HOW DOES FUNGICIDE RESISTANCE DEVELOP

SELECTION PRESSURE

Intensive use of a fungicide or fungicides with the same mode of action, selectively inhibits the sensitive spores and allows the resistant spores to increase unhindered.

e.g. The benzimidazole group of fungicides

Benomyl (Benlate) – used Pre-harvest

and

Thiabendazole (TBZ) – used Post-harvest

THIABENDAZOLE REGISTERED

FOR CONTROL

OF

P. digitatum (green mould)

and

P. italicum (blue mould)

ALSO ACTIVE AGAINST

Diplodia

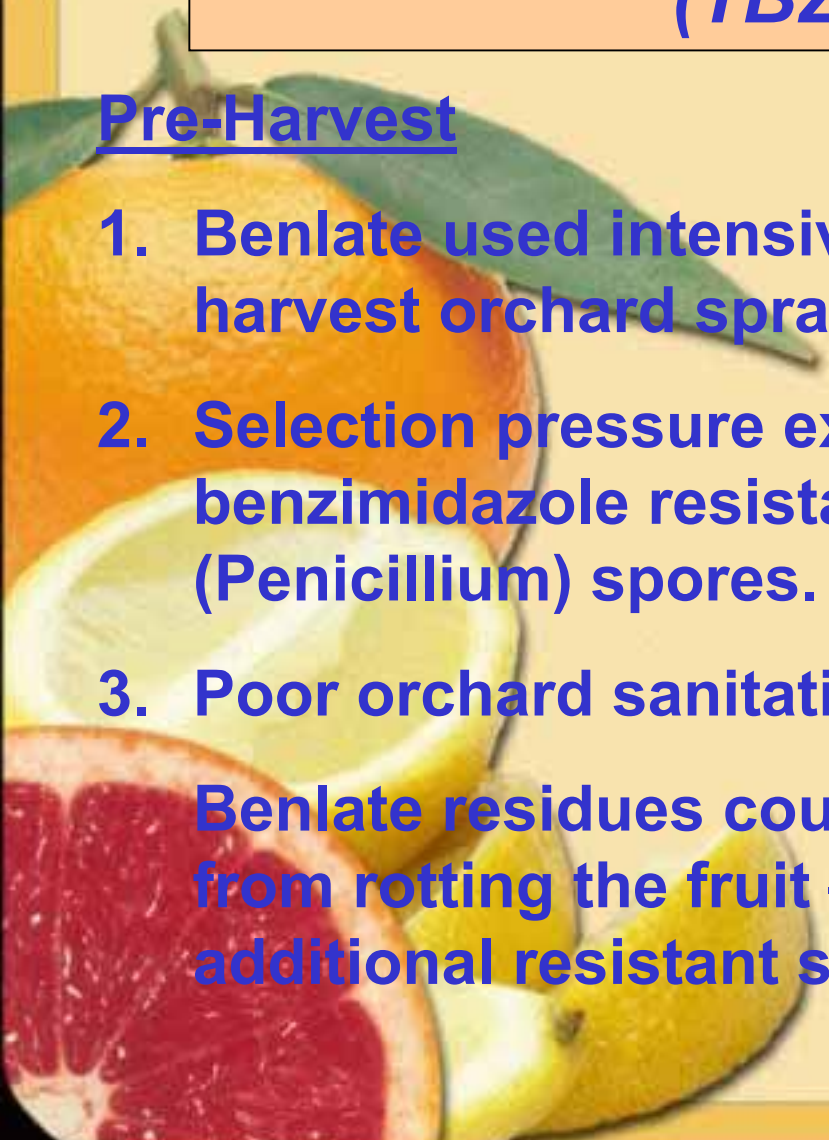
Phomopsis

Anthracnose

Fusarium

Trichoderma

HOW DID RESISTANCE TO THE POST-HARVEST FUNGICIDE THIABENDAZOLE (TBZ) DEVELOP



Pre-Harvest

1. Benlate used intensively for Blackspot control – pre-harvest orchard sprays
2. Selection pressure exerted on naturally occurring benzimidazole resistant green and blue mould (Penicillium) spores.
3. Poor orchard sanitation and injuries (insects).

Benlate residues could not prevent resistant spores from rotting the fruit – production of millions of additional resistant spores.

HOW DID RESISTANCE TO TBZ DEVELOP (Cont.)

Post Harvest

1. Transfer of increased resistant green and blue mould spores into packhouse on fruit surface.
2. TBZ packhouse treatment.
3. Selective inhibition of sensitive spores.
   More resistant spores produced.
   Allow TBZ-treated fruit to rot in or near packhouse
   More resistant spores produced.
4. Cycle of events allowed to continue until entire spore population resistant to benzimidazoles.

Result: PACKHOUSE FUNGICIDE TREATMENT INEFFECTIVE

CURRENT SCENARIO

Fungicides		Pathogen Resistant Status
Imazalil	-	First resistant isolates of green mould (*P. digitatum*) and blue mould (*P. italicum*) detected in two Southern African citrus production areas (W. Cape & Zimbabwe)
Guazatine	-	Nil
T B Z	-	Green and Blue mould – full scale resistance
	-	*Diplodia* isolates detected
	-	Anthracnose isolates detected

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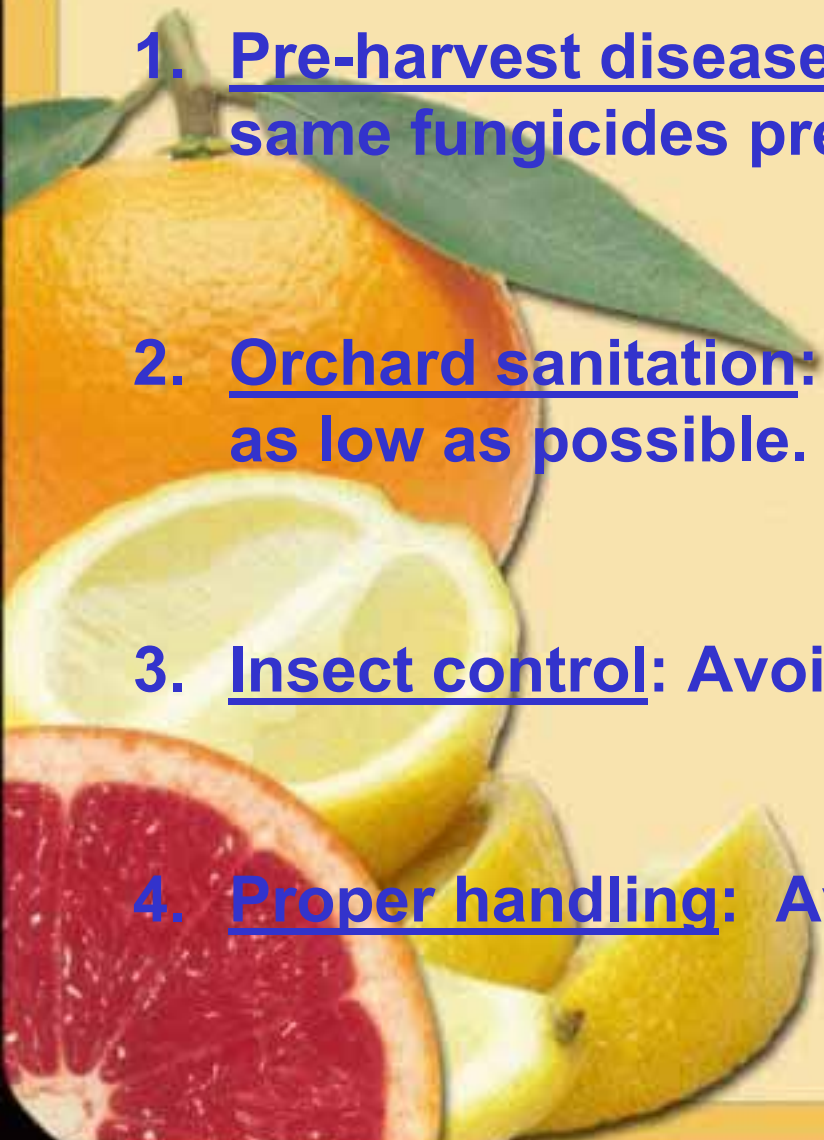
STRATEGIES TO PREVENT RESISTANCE



1. Pre-harvest disease control: Undesirable to use same fungicides pre- and post-harvest

2. Orchard sanitation: Keep total spore load on fruit as low as possible. Remove fallen fruit regularly

3. Insect control: Avoid creation of infection sites

4. Proper handling: Avoid unnecessary injuries

STRATEGIES TO PREVENT RESISTANCE

5. Sanitation of fruit washing processes: Chlorine, Deccosol, or other recommended sanitizing agent

6. Prompt treatment after harvest: Prevent sporulation of Penicilliums on fruit in lugboxes and trailers

7. Mixtures of fungicides: Use of fungicides with different modes of action will reduce onset of resistance

STRATEGIES TO PREVENT RESISTANCE

8. Alternation of fungicides: Withdraw the use of the fungicide at risk

   Using another fungicide with a different mode of action until resistant spores are not detected

   Re-introduce risk fungicide

STRATEGIES TO PREVENT RESISTANCE

9. **Sanitation in the packhouse, cold rooms and degreening rooms**

- Avoid production of spores on fungicide-treated fruit in the packhouse, cold rooms and degreening rooms
- Store local market fruit in another building
- Remove factory-bound fruit regularly
- Destroy fungicide-treated culled fruit before spores are formed on them
- Do not repack decay rejected fruit at ports or inland packhouses
- Clean and disinfect packhouse regularly

DEGREENING

- Integral part of citrus production
- Multiple exposure of fruit to fungicides in pre-degreening drench and packhouse. If not conducted in a proper and correct manner, could lead to resistance

Avoid

- Using Imazalil in the pre-degreening drench as well as packhouse
- Returning degreened, packhouse-treated fruit to degreening for second time

Remember: Resistance could occur at any packhouse at any inopportune point in time