

Spot the post-harvest difference

Pre-harvest prevention remains better than post-harvest cure when it comes to citrus black spot, but this study confirms that packhouse treatments do provide a safety net.

CITRUS BLACK SPOT (CBS) is a major threat to South African citrus fruits' continued access to Europe – their main export market. Despite the disease being purely cosmetic, it has been given A1 quarantine status. As a result, EU market regulators constantly threaten to ban South African imports.

CBS is best managed in the orchard and during fruit set, and much is done to ensure pre-harvest control. However, latent infections can escape these measures, pass unnoticed during local inspection, and only develop into lesions while the fruit is in transit.

Post-harvest treatments may therefore hold the key to inhibiting the development of latent infections – except that not much is known about CBS and its post-harvest behaviour.

In terms of normal packhouse treatments for the control or inhibition of CBS, a 1998 study showed *in vitro* that the post-harvest fungicides imazalil (IMZ), thiabendazole (TBZ), prochloraz, guazatine (GZT) and sodium ortho-phenylphenate (SOPP) significantly reduced conidial germination and appressorium formation of CBS.

A later study showed a three- to sevenfold reduction in CBS lesion viability as a result of post-harvest treatments. However, neither the effects of treatments on the reproductive ability of CBS lesions (latent or visible), nor modern packhouse treatments have ever been evaluated.

A two-year study led by Dr Wilma du Plooy, Post-harvest Research and Programme Coordinator at Citrus Research International, has gone a long way to fill this knowledge gap.

This industry and PHI Programme-funded



WHAT IS CITRUS BLACK SPOT?

Citrus black spot is a fungal disease caused by *Guignardia citricarpa*. This Ascomycete fungus affects citrus plants in subtropical climates, causing a reduction in both fruit quantity and quality.

Source: Wikipedia



research project, which started early in 2015, has three objectives:

1. Compile a thorough literature review of published research conducted in this field.
2. Investigate the singular and combined effects of standard fungicide post-harvest treatments and cold-storage regimes on the viability and reproductive ability of CBS lesions.
3. Investigate the singular and combined effects of new and alternative fungicides, as well as non-fungicide compounds in heated or ambient aqueous applications on the viability and reproductive ability of CBS lesions.

In addition to updating treatment protocols, the study will identify areas for future research.

"Our project contributes directly to market access and hence competitiveness," says Dr Du Plooy. "Improved post-harvest CBS control will reduce the risk of interceptions, making our fruit more marketable."

Methodology

A significant challenge at the outset was finding trees with potential CBS infection, given how

well most producers control the disease in their orchards. Initially, two lemon orchards were sourced, one in Brits, in the North West Province, and the other in Kirkwood, in the Eastern Cape.

Two more lemon orchards were later on found closer to Nelspruit, in Mpumalanga.

STANDARD TREATMENTS THAT WERE EVALUATED

Packhouse fungicide applications:

- Drench (TBZ, PYR, GZT and 2,4-D)
- Wash (Chlorine)
- IMZ (Dip 60 seconds at 25°C, 35°C, 45°C and 55°C)
- Wax (TBZ, IMZ and 2,4-D)

Cold-storage regimes:

- Shipping protocol: five weeks at 7°C for 'Eureka' lemons and 4°C for Valencia oranges
- Cold sterilisation trials: 24 days at -0,5°C for Valencia oranges
- Ambient protocol: five weeks at 22,0°C



PROJECT TITLE

Singular and combined effects of post-harvest treatments on viability and reproductive ability of CBS infections on citrus fruit

PRINCIPAL INVESTIGATOR

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CONTACT DETAILS

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DURATION

Two years

PHI PROGRAMME & INDUSTRY CONTRIBUTIONS

R419 606 & R269 606

LEAD INSTITUTION

Citrus Research International (Pty) Ltd

BENEFICIARY

Citrus industry

FOCUS AREA

Post-harvest disease and insect control, including phytosanitary compliance, and post-harvest physiology

HUMAN CAPITAL DEVELOPMENT

One MSc Plant Pathology student

PUBLICATIONS

Two

PRESENTATIONS AND PAPERS

Eight



1 Project leader, Dr Wilma du Plooy.

2 Much is done to ensure pre-harvest control of citrus black spot. However, latent infections present in perfectly healthy looking oranges (3) can pass unnoticed during local inspections and only develop into lesions while the fruit is in transit.





NEW AND ALTERNATIVE TREATMENTS THAT WERE EVALUATED

Fungicides and alternatives:

- Fludioxonil
- Propiconazole
- Azoxystrobin
- Imazalil + Fludioxonil
- Pyrimethanil + Fludioxonil
- Fludioxonil + Azoxystrobin
- Sodium bicarbonate
- Phosphite salts
- Potassium sorbate

Temperature: 25°C, 35°C and 45°C

Exposure time: 15, 45, 90 and 180 seconds

(Propiconazole + Pyrimethanil).

A particularly important finding was that lesions that developed on packhouse-treated fruit did not have reproductive capability and, as such, were not a viable pathway to transmit the disease to unaffected areas abroad.

Dr Du Plooy emphasises that post-harvest treatments can never replace the meticulous pre-harvest management of orchards in areas at risk of CBS infection. However, the study showed that post-harvest measures can provide a valuable safety net.



1 Wouter Schreuder Jnr (left) and Dr Wilma du Plooy pose with Jon Pinker, CRI process manager and key contact person between CRI and the PHI Programme research project.

2 Standard packhouse treatment protocols, combined with a brief warm water dip and cold-storage at 7°C, offered significant control of new lesion and pycnidia development, with very low viability of pycnidiospores on 'Eureka' lemons.



Two orange orchards were sourced in the area of Nelspruit, and a further two near Brits.

The Valencia oranges and 'Eureka' lemons were subjected to the standard packhouse treatment protocol. In addition, alternative remedies with maximum residue levels (MRLs) accepted in export markets, the European Union in particular, were included in the study.

Applications were first done in 2015 and repeated in 2016. However, in 2016, changes to the MRL for the pesticide guazatine resulted in it being replaced with propiconazole as a post-harvest chemical.

The fruit was stored under export conditions, removed after five weeks and then placed in ambient storage for another three weeks.

During this time, lesion development was monitored on a weekly basis, per fruit, per treatment. Lesions were also induced to ooze pycnidiospores during the storage period, and these were single-spored and plated out for viability testing.

Results and conclusions

The existing packhouse protocol was shown to have a suppressive effect on the development of new lesions. In addition, a brief warm water dip at 55°C, as well the cold-storage combination (Valencia oranges at 4°C and 'Eureka' lemons at 7°C) treatments, offered significant control of both new lesion and pycnidia development, with very low viability of pycnidiospores.

Three alternative single treatments showed potential to control latent infections: fludioxonil, potassium sorbate, and Propirly 270 EC

THE SOUTH AFRICAN CITRUS INDUSTRY TAKES A PROACTIVE APPROACH TO CITRUS BLACKSPOT RISK MANAGEMENT

Despite substantial efforts by the South African citrus industry, an agreement has yet to be reached with the European Union (EU) on the risk of Citrus Blackspot (CBS) transmission by fruit to orchards in the EU. Since 1992 until present day an immeasurable number of actions have been taken by the Citrus Growers' Association (CGA), Department of Agriculture, Forestry and Fisheries (DAFF), and stakeholders within the industry, and procedures put in place to ensure a robust CBS Risk Management System (RMS) can adequately tackle the issue of CBS faced by growers, and the South African export industry at large.

The CGA has engaged grower members at every step of the process, disseminating vital information that has seen the industry stay ahead of the curve, and manage and maintain its position as a leading force in the citrus export market. Communication has taken many forms—weekly newsletters, CBS advisory's and bulletins, research publications, information sessions and briefings, websites (www.cri-phytrisk.co.za), CGA roadshows, and the CGA Citrus Summit—and feedback from industry experts, as well as updates on outcomes of meetings held with various international bodies, continues to be presented to grower members on a regular basis.

Compliance measures to further reduce risk of exporting infected fruit in response to the EU's decision to ban citrus imports from South Africa at the end of the 2013 season, saw growers incurring additional and estimated costs of about R1 billion. Furthermore, the submission of its pest risk assessments, by the European Food Safety Authority, who concluded there is a risk of CBS establishing in the EU, are being actively challenged, and have been over the past three years.

Deon Joubert, employed by the CGA as the industry's EU representative in 2014, has been active in addressing the CBS challenge in 2014 and beyond.

CGA and DAFF, together with the Perishable Products Export Control Board, and industry stakeholders, continue to actively work and rework the South African CBS RMS to strengthen its effectiveness, maintaining close relations with grower members, to ensure compliance until such time as a resolution regarding the scientific dispute surrounding the CBS issue is achieved. At incredible cost to the industry, the positive trend of results over the recent years pertaining to CBS risk management clearly demonstrates that it works.



“Lesions that develop on fruit treated in the packhouse do not have reproductive capabilities.”

Dr Wilma du Plooy