

New OPP formulations to control citrus decay

Fungicide formulations to control IMZ-resistant isolates, sour rot and peduncular mould

Previously, OPP (ortho-phenylphenol) was formulated as its soluble sodium salt, SOPP. However, due to its association with phytotoxicity in certain scenarios, use of this formulation has been terminated.

With safety in mind, Citrosol developed three modern formulations of OPP to take advantage of its wide-spectrum fungicidal efficacy. OPP controls the major decay causing pathogens of citrus fruit, including *Penicillium digitatum*, *Penicillium italicum*, *G. candidum*, *Cladosporium*, *Rhizopus*, *Alternaria*.

Main benefits for decay control programmes in South African citrus packinghouses

Because of its high efficacy and control of *Penicillium* sporulation, imazalil (IMZ) is the cornerstone of post-harvest disease control

programmes worldwide. However, resistant isolates to IMZ can develop. The population of resistant spores to IMZ grows in tandem with a decline in the efficacy of this fungicide. And the proliferation of resistant strains of the two *Penicillium* species is a rising threat. In experiments presented by Erasmus et al., (2015) decay control efficacy for IMZ diminishes from higher than 90% to only 35.3% when oranges are inoculated with an IMZ-Resistant isolate of *P. digitatum* (Figure 1).

In Figure 1, authors found that SOPP controlled *Penicillium digitatum* resistant isolates as much as Pyrimethanil, and much better than Fludioxonil. Being these two fungicides the ones that commonly are used in combination with IMZ to control the resistant strains, this data establishes that OPP makes a much better job. This is our industrial experience, measured in several controlled experiments. The high efficacy of the 450 ppm IMZ treatment vs. *P. digitatum* IMZ-sensitive strains decreases from an average efficacy of 98% to 78% in an experiment with oranges when the fruit are inoculated with a



Image 1. Peduncular mould on easy peelers. Appearance of the fruit after unloading.

resistant isolate. Though the efficacy with Ortocil® (2 000 mg/ℓ OPP) is 97%, and results for the mix Ortocil® + Citrocil® (2 000 mg/ℓ OPP + 450 mg/ℓ IMZ) recorded zero decay (Murciano et al., 2023, Citrosol publication available on demand).

Regarding these results, somebody may think that SOPP and OPP are different chemicals. However, SOPP is the Na salt of OPP and, in the acidic environment of the rind wounds, it dissociates to OPP. It has been proven that SOPP and OPP have similar efficacy regarding citrus decay control and both leave OPP residues (Smilanick et al., 2020, “Postharvest Pathology of Fresh Horticultural Produce”, 5-53).

Additionally, after the prohibition of guazatine and propiconazole in most countries of the world, OPP is the only fungicide available to control *Geotrichum candidum* (Ismail and Zhang, 2004, *Outlooks Pest Management* 15, 29–35).

OPP is also very effective to control *Cladosporium*, this being the main pathogen causing the saprophytic cottony white mould on the calyx after long transportation (Image 1).

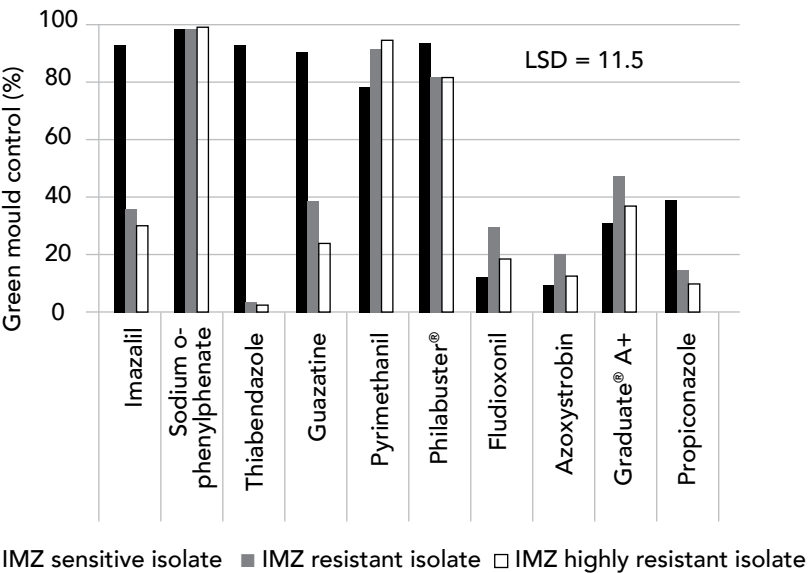
Citrosol has registered three OPP formulations in the Republic of South Africa: **Ortocil** (10% OPP w/v), **Citrocil** (10% OPP w/v + 7.5% IMZ sulphate w/v) and **Ortosol 6500** (SOPP 28.6% w/v). **Ortocil** and **Citrocil** are to be used in drenchers, flooders or water tanks and **Ortosol 6500** is to be incorporated into the wax, when long transportation periods are expected, to avoid peduncular moulds.

OPP Maximum Residue Levels (MRLs) are established in almost every country in the world (EU, USA, CODEX, UK, Canada, Japan, etc.). MRLs for OPP are high ranging from 5 mg/kg in Argentina to 10 mg/kg in the rest of the world. Citrus fruits treated with OPP can be exported to most of the world.



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Figure 1. Mean percentage green mould control on orange fruit inoculated with an imazalil (IMZ) sensitive, resistant or highly resistant *Pencillium digitatum* isolate, 24 h prior to 60 s aqueous dip treatment with different fungicides (A. Erasmus et al., 2015, “Postharvest Biology and Technology” 107 66–76)



“Safe” citrus trees cornerstone of citrus biosecurity

The CRI Biosecurity Division goal is to protect the Southern African citrus industry through timely identification of biosecurity threats. By Paul Fourie, Wayne Kirkman, Elma Carstens and Vaughan Hattingh (CRI)

Citrus Research International (CRI) established a biosecurity division in 2016, with a mission to protect the Southern African citrus industry through timely identification of biosecurity threats; the development of preparedness; awareness, early detection, rapid response and impact mitigation plans; and ensuring effective application of the associated actions. Citrus growers are the primary stakeholders of biosecurity, but close collaboration is required with all other role players, such as the National and Provincial Departments of Agriculture, biosecurity service providers, research collaborators, as well as citrus and retail nurseries.

Starting clean is the first line of defense

Planting disease-free propagation material is the primary measure in biosecurity, on citrus farms and in home gardens. Importantly, the South African Citrus Improvement Scheme (CIS) supplies nurseries with the rootstock seed and budwood required to grow citrus trees, and certifies commercial citrus nurseries participating in the South African Citrus Nursery Certification Scheme and the trees produced in these nurseries.

Most citrus trees made in Southern Africa are made with CIS-certified budwood and



Figure 1. African Greening buffer zone in Gqeberha



Figure 2. Open Day at the CRI Citrus Foundation Block to support biosecurity awareness in the retail nursery sector in Gqeberha, East London and Knysna

seed. However, a small percentage – mostly in the retail and informal nursery sectors – are made from sources that are not certified and are potentially unsafe, posing a major biosecurity risk. Devastating diseases have spread to, and within, other countries via the distribution of trees for home garden planting. Citrus is the most popular fruit tree in home gardens. Therefore, it is important to ensure safe and responsible trade in this sector.

Source citrus trees legally

In SA, it is illegal to import citrus trees (or propagation material) from other countries without a permit. Importantly, the permit conditions require cleaning and testing procedures to ensure the material is free from pests and diseases prior to use in the country. This safeguard is vitally important.

Additionally, movement of citrus trees is also prohibited from areas where certain diseases (Citrus Black Spot and African Citrus Greening) occur (KwaZulu-Natal, Mpumalanga, Limpopo, Gauteng and North-West), to disease-free areas (Free State, Western Cape, Northern Cape and Eastern Cape). For more detail, see specific areas detailed in Regulation 110 of the Agricultural Pests Act. While the commercial citrus nurseries comply with these regulations, non-compliance is common in the public trade of citrus trees for home garden and non-commercial planting, often due to a lack of awareness regarding the requirements and related dangers. This highlights an important public awareness challenge that must be addressed in the interest of biosecurity.



Figure 3. CRI Biosecurity Field Officers, Xolani Sibiya, Tshepang Makitla, Chuma Situnda and Njabulo Mngomezulu, with Biosecurity Operations Coordinator, Wayne Kirkman and Biosecurity Manager, Paul Fourie at the SANA Spring Trade Fair in Krugersdorp, 13 August 2025



Paul Fourie



Wayne Kirkman



Figure 4. Lizeth Swart and Dr Elma Carstens at the Cape Green Trade Day outside Paarl, 27 August 2025

African Citrus Greening has recently been detected in East London, Gqeberha and Knysna, in areas that were previously regarded as African Greening disease-free. The disease was most probably spread to these areas via retail nurseries that (illegally) sourced citrus trees from nurseries in areas where African Greening occurs, or via informal traders or residents buying trees in areas where African greening occurs. They may have travelled in such areas and planted the trees in their home gardens. The Department of Agriculture (DoA) has declared affected areas in these cities as buffer zones, and actions are being taken to contain the disease in these zones. Importantly, movement of trees from these Greening-areas to disease-free areas is now prohibited (the buffer zone in Gqeberha is shown in **Figure 1**). CRI will work closely with the DoA and the Provincial Departments of Agriculture to ensure compliance with the Control Measures as published in Regulation 110 of the Agricultural Pests Act.

Focused awareness campaigns directed at the retail nursery sector

Crucially, biosecurity awareness ensures that all stakeholders understand the risks

and safeguards. CRI has been “preaching the Biosecurity gospel” to citrus growers over many years. However, there’s a lack in awareness aimed at the public, and informal and retail nursery sectors.

CRI Biosecurity personnel have visited all the retail nurseries in East London, Gqeberha and Knysna to inform them of the new regulations, and to assess compliance with national movement restrictions. An Open Day was held at the CRI Citrus Foundation Block for these nurseries, to improve their understanding of the key role of the citrus industry in Southern African agriculture, as well as the biosecurity safeguards required to ensure its sustainability.

CRI also liaised closely with the South African Nurseryman’s Association (SANA), to emphasize the importance of compliance with the regulations. SANA invited CRI Biosecurity to exhibit at the SANA Spring Trade Fair in Krugersdorp (Gauteng), which proved to be an excellent forum to create citrus biosecurity awareness amongst wholesale and retail nurseries (**Figure 3**). Through SANA, CRI also exhibited at their Cape Green Trade Day outside Paarl in the Western Cape, as another awareness exercise (**Figure 4**).

Interaction with nurseries at these trade days, as well as during nursery visits, clearly highlighted the commitment of the sector to biosecurity in general, as well as their willingness to support citrus biosecurity measures. Importantly, the wholesale and retail nurseries clearly highlighted the need for “safe” sources of citrus trees in their regions. Please scan the QR code to download the list of CIS-certified nurseries.

Next, CRI will provide nurseries with guidelines on growing citrus trees in home gardens. Citrus in Southern Africa will certainly be more biosecure if citrus trees are sourced and grown safely in home gardens.

All interactions to date have been extremely well received, and the citrus industry is already benefitting from these



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initiatives. CRI will continue to expand citrus biosecurity awareness to the retail and informal nursery sector. Over time, the retail nursery sector and the many garden enthusiasts it serves across the country will become an invaluable resource to broaden the citrus biosecurity awareness and surveillance footprint to (1) prevent incursions of exotic pests and diseases, (2) support early detection of such incursions, and (3) to support eradication or containment measures. 



CIS-certified
nurseries

