

New mandarins cope with the cold

South Africa's newest export-quality citrus cultivars have shown that they can withstand sub-zero sterilisation without losing quality. The industry has every reason to be pleased.

CONSUMERS' TASTE IN fresh fruit – as in fashion – changes. Therefore, in order to remain competitive, exporting countries like South Africa have to continuously update their cultivar catalogue.

The citrus industry, through Citrus Research International (CRI), the Agricultural Research Council, CitroGold and other partners, has responded to this challenge by developing a new selection of soft mandarin cultivars, all with promising internal and external qualities.

Spoiling the industry's fun, however, is growing populations of *Bactrocera invadens*, a recently identified fruit fly species. Given its status as a phytosanitary pest, exporters already have to take strictly regulated precautions to prevent fruit fly infestation in consignments. As expected, the arrival of a new variety only made matters worse: sub-zero cold sterilisation has been passed as a mandatory treatment against eggs and larvae in fruit.

While cold sterilisation eliminates the pests, it also has the potential to cause cold damage, or chilling injury, in most tropical and subtropical fruit. Chilling injury is physiological rind damage, which manifests as dark spots or lesions and reduces the marketability of fruit after storage.

According to Dr Nhlanhla Mathaba, from the Post-harvest Technologies Division of the Agricultural Research Council's Institute for Tropical and Subtropical Crops (ARC-ITSC), cultivars that cannot withstand the required phytosanitary treatments have no place in the export portfolio. "Therefore, before these new mandarin cultivars could be fully registered, sub-zero cold sterilisation experiments had

to be performed. Sterilisation at $-0,6^{\circ}\text{C}$ is a phytosanitary requirement for lucrative markets such as Japan and USA. The new cultivars have potentially superior characteristics; the missing piece of the puzzle is their physical and physiological response to sub-zero temperatures."

To fill the gap in knowledge, Nhlanhla embarked on a two-year study (funded by industry and the PHI Programme), working with Professor Tieho Paulus Mafeo from the University of Limpopo, to evaluate the effect of sub-zero cold sterilisation and ethylene degreening on the internal and external quality of the new mandarin cultivars.

Three objectives were formulated to achieve this aim; these were the following:

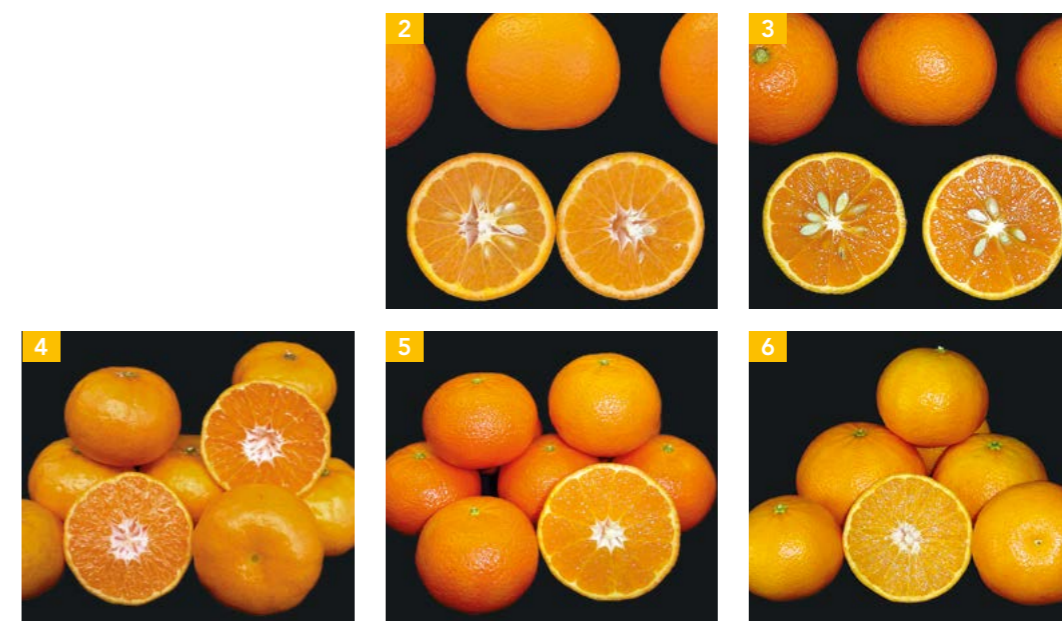
1. To establish the response of the newly bred mandarin selections to sub-zero sterilisation under export simulation conditions;
2. To establish if ethylene degreening has an effect on the development of rind disorders in the newly bred mandarin selections after withdrawal from cold sterilisation; and
3. To establish the effect of sub-zero cold sterilisation on the internal quality of the newly bred mandarin selections after withdrawal from cold-storage.

The tested cultivars were 'Sonet ARC', 'B24', 'I22', 'M37', 'Nova' and 'Nova ARC'.

Research methodology

De-greened and non-degreened 'Sonet ARC', 'Nova' and 'Nova ARC', 'B17', 'I22' and 'M37' mandarins were sourced from an Addo farm in the Eastern Cape. The fruit was waxed with polyethylene citrus wax, packed and then transported to the ARC-ITSC laboratory in Nelspruit.

At the laboratory, the fruit was repacked into smaller cartons, each containing 50 mandarins. Cartons were stored at three different temperatures ($-0,5^{\circ}\text{C}$, $2,0^{\circ}\text{C}$ and $0,4^{\circ}\text{C}$) – three



cartons per temperature – for up to 28 days.

After withdrawal from cold-storage, the fruit was kept at ambient temperature for seven days to allow for the development of rind disorders, mainly chilling injury.

Rind and juice were evaluated for the following physicochemical parameters: chilling injury, fruit weight loss, electrolyte leakage, membrane damage, juice total soluble solids, titratable acidity and rind colour.

Results

The study found that sub-zero cold sterilisation only affected cultivar 'M37'; no effect on the physical and juice quality of the other cultivars was noted.

'M37' showed a significant decrease in fruit firmness and weight loss, and an increase in rind electrolyte leakage after cold-storage, irrespective of degreening treatment and cold-storage temperature. The impacts on the quality of 'M37' were associated with severe rind chilling injury. Interestingly, the Brix index of 'M37' improved after cold sterilisation, which might be due to the significant water loss.

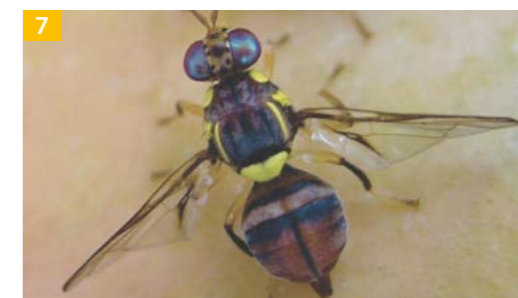
None of the chilling resistant cultivars showed any change in juice quality after withdrawal from cold sterilisation, irrespective of degreening treatment.

The external colour of the non-degreened fruit seemed to improve during cold-storage, although not significantly.

"Our results are good news for the industry," says Nhlanhla. "Given that sub-zero cold

sterilisation had a detrimental effect on only one of the new cultivars, South Africa now has the option to register five new cultivars for export to America and Japan."

This export diversity increases the local industry's competitiveness, while increased plantings of the new selections will lead to increased employment on farms, in packhouses and along the logistics value chain.



The new Mandarin varieties that were tested: 'I22 ARC' (2), 'M37' (3), 'Sonet ARC' (4), 'B24' (5) and 'Nova ARC' (6).

7 A recently identified fruit fly species, *Bactrocera invadens*, is yet another phytosanitary pest that producers have to control. (Courtesy: Peter Stephen from Citrus Research International)

8 Prof. Tieho Paulus Mafeo, from the University of Limpopo, evaluated the effect of sub-zero cold sterilisation and ethylene degreening on the internal and external quality of the new mandarin cultivars.



PROJECT TITLE

Investigating cold-storage potential of new mandarin citrus selections/cultivars and the effect of ethylene degreening on rind disorders

PRINCIPAL INVESTIGATOR

Dr Nhlanhla Mathaba

CONTACT DETAILS

+27 (0)13 753 7000
mathaban@gmail.com

DURATION

Two years

PHI PROGRAMME & INDUSTRY CONTRIBUTIONS

R154 500 & R74 500

LEAD INSTITUTION

Post-harvest Technologies Division of the Agricultural Research Council's Institute for Tropical and Subtropical Crops (ARC-ITSC)

BENEFICIARY

The South African citrus industry

FOCUS AREA

Post-harvest physiology and phytosanitary compliance

HUMAN CAPITAL DEVELOPMENT

One MSc Agric student

PRESENTATIONS AND PAPERS DELIVERED

Four

PUBLICATIONS

Pending



1 Dr Nhlanhla Mathaba, project leader.

