Report on Symposium - Postharvest 2024 - Handre Viljoen (ExperiCo)

Postharvest 2024 incorporated three symposia — The IX ISHS International Postharvest Symposium, the VII International Symposium on Postharvest Pathology, and the X International Symposium on Human Health Effects of Fruit & Vegetables (FAVHEALTH 2024)

Dates, Venue and Program

11-15 November 2024

Rotorua Events Centre, New Zealand

Symposium Program – Annexure A (see attachment)

Pre-conference student workshop

A pre-conference student workshop was held to provide opportunities for the younger members of the research community to feel welcome, and to get to know each other, before the event proper started later that day.

This was for all M.Sc. and Ph.D. students, and early career researchers (who obtained a Ph.D. within the last 2 years) who were attending Postharvest 2024.

I was asked to participate as a member of the Industry and Development panel, with the brief to:

- Discuss what you do as a researcher / scientist / industrial specialist on daily jobs
- Proactively and positively answer questions in a panellist format about your career pathway
- What are your goals from the conference
- What things do you do to make sure you have a successful presentation
- Willingness to mingle, talk and to provide positive advice to our younger colleagues

PLANNED PROGRAM FOR POSTHARVEST 2024 STUDENT WORKSHOP

Session chair: Prof Andrew East (Massey University)

1300	**Introduction and Discussion of Purpose of Workshop**
1305	**Quick Panel Introduction** All Panel Members
1315	**Mixer activity** **All Participants**
1325	**Tips on Scientific Publishing** Phil O'Brien (Australasian Plant Pathology) Chris Watkins (Postharvest Biology and Technology)
1405	**Mixer Activity** All Participants
1415	**Careers in Academia** Romina Pedreschi, Pontificia Universidad Católica de Valparaiso, Chile Olaniyi Fawole, University of Johannesburg, South Africa Srdjan Acimovic, Virginia Tech, USA Huertas Maria Diaz-Mula, Universidad Miguel Hernández de Elche, Spain
1445	**Afternoon Tea Break**
1510	**Careers in Research Institutes** Maryam Alavi, Plant and Food, New Zealand Noam Alkan, Volcani Center, Israel Rujira Deewatthanawong, Thailand Institute of Scientific and Technological Research Mahya Tavan, Riddet Institute, New Zealand
1540	**Mixer Activity** All Participants
1545	**Careers in Industry** Adam Goldwater, Applied Horticultural Research, Australia Handre Viljoen, ExperiCo, South Africa Wendy Schotsmans, Janssen, Belgium Leo Lai, Zespri, New Zealand
1615	**Session Wind-Up and Final Discussions**
1630	**Session Close and Conference Registration Open**

Report on selected presentations by other researchers

Summary of selected presentations:

1. Sugar metabolism as a key determinant of chilling injury development during peach cold storage and subsequent shelf-life (Macarena Farcuh)

   To assess the correlations relating to chilling injury (CI) incidence and sugar metabolism. Yellow melting flesh peach cultivar 'Red Haven' was used and found that CI development was associated with decreased Sucrose (increased breakdown, decreased biosysnthesis), increased Glucose and Fructose (increased sucrose breakdown) as well as decreased sugar alcohol Sorbitol levels (increased breakdown) within the fruit.

2. Postharvest treatments with sodium nitroprusside and methyl salicylate synergistically enhanced chilling tolerance of tomato fruit subjected to cold storage (Huertas Maria Diaz Mula)

   Methyl salicylate (MeSA) is an endogenous signal molecule in plants that plays essential roles in regulating abiotic stress responses (regulates plant growth, regulates ethylene production, delays ripening, induction of disease resistance, increased proline content and maintains cell membrane stability).

   There is growing interest in sodium nitroprusside (SNP) as a pre-harvest treatment in the field to enhance plant growth and yield under salinity stress or drought conditions. In this study, the protective effect against chilling injury of SNP and MeSA, applied alone or in combination, was investigated on tomatoes.

   The combination reduced ethylene production, while MeSA maintained firmness better than the combination of chemicals. MeSA contributes to maintaining higher acidity levels and enhances the maturity index by delaying the ripening process in strawberries (Gacnik *et al*., 2021). MeSA application improved cell membrane stability and reduced oxidative stress by reducing electrolyte leakage and MDA concentration (Min *et al*., 2018)

3. SmartFresh™ in the preservation of mangoes postharvest quality after long periods of cold storage (Hannah James)

   SmartFresh reduced the internal browning of mangoes at refrigerated temperature (10 °C), being effective from 35 to 55 days of storage and delaying the advance of mango maturity. SmartFresh did not affect the TSS concentrations and has been used in Brazil since 2022 to commercially prolong postharvest life of mangoes transported to far markets.

4. A new 1-MCP delivery system opening up opportunities for small packaging (Wendy Schotsmans)

   This is a sticker printed layer of 1-MCP matrix and gas release stimulated by humidity produced by the fruit within the packaging. It can be used in bags, punnets and flow packs. Strawberries maintained flesh firmness better with the 1-MCP stickers at $8cm^2/L$, and also exhibited a better calyx score with less decay development.

5. Using a semi-permeable fruit coating as an alternative to CA/MA for international marketing of tree-ripe mango – internal atmospheres (Jeffrey K. Brecht)

   Can semi-permeable fruit coatings serve as an alternative to MA for internationally transported tree-ripe mangoes. Akorn Tech semi-permeable fruit coatings are Zein-based coatings that create internal modified atmospheres. Fruit was stored at 7 °C for 28 days at different O_2 and CO_2 concentrations and it was concluded that CA of 4-6 kPa O_2 + 5-10 kPa CO_2 maintained tree-ripe mango quality for 4 weeks at 7 °C plus 6 days at 20 ° without appearance of chilling injury symptoms.

   Coated mangoes had lower O_2 and ethylene concentrations and higher CO_2 concentrations compared to the uncoated control fruit. Coated fruit developed less chilling injury, lenticel spotting and decay, and exhibited slower ripening by 4 days compared to the untreated fruit.

6. Application of remote supply chain monitoring for optimising temperature management and extending mango shelf life (Hung Duong)

   The aim was to remotely monitor temperature through the supply chain to improve fruit quality and extend mango shelf life. Fruit was harvested at commercial maturity (DM≥15%), treated with vapor heat treatment with temperature & relative humidity loggers inserted onto mango trays. The temperatures were monitored during air shipment, with top, middle and bottom of pallet monitored. Temperature increased steadily over time and was warmer in the middle of the pallet. Remote monitoring supported informed decision making to reduce supply chain risk, it improved temperature management and enabled greater collaboration along the supply chain.

7. Influence of the innovative HDCOLD® air-cooler technology on fruit quality (Séverine Gabioud Rebeaud)

   The innovative HDCold® algorithm and air-cooler technology enables storing of fruit at high humidity levels. It keeps fresh produce at high, stable humidity without humidification or the need for defrosting, at temperatures above 0 °C. It operates in regular (RA) and controlled atmosphere (CA), limits variations of temperatures and the formation of condensation with energy savings.

   They stored apples and pears up to 8 months in CA, and apricots & cherries for 2 weeks at RA. It reduced average weight loss percentage by 26% to 37% across fruit kinds at RA. Cracking of fruit sensitive to high RH may increase with HDCold®.

8. Non-destructive measurement of mechanical properties during browning development in the compressed area of apples and nectarines (Magdalena Urbanska)

   A few non-destructive flesh firmness instruments have been developed in the past, like the SoftSort (1997) and the Sinclair Tapper IQS used on avocados (2003) and some didn't survive.

   KiwiFirm is a simple and inexpensive handheld device developed in the early 1990's and only used in studies till 2015. Then it was redeveloped and went through 3 versions from 2016 to 2020, until the latest version in 2022 which is a commercial optimised unit with dedicated custom software UI (Willowbank Electronics). Repeated impacts on the same locations only left a mark on kiwi fruit after more than 50 impacts. In comparison with the penetrometer, the last mentioned is more sensitive earlier when the fruit is firmer, while KiwiFirm is more sensitive later when the fruit is softer. It also worked better on stone fruit versus pome fruit. The impact response analysis (IRA) will vary by fruit type and will need some minor calibration. The KiwiFirm is commercially available.

9. A non-contact acoustic resonance method for fruit firmness measurement (Sam Langdon-Arms)

   The Resonance Sensor used triple air bullets each 8ms apart and measured and used the median of these frequencies. It was shown that the sensor is capable of rapid on-line non-contact and non-destructive firmness measurements that were completed in 15ms. On-line grading trial results compared favourably with most benchtop firmness sensors, achieving R^2 values around 0.9.

My presentation (see Annexure B):

My paper (Submitted for publication in Acta Horticulture)

Detection of internal heat damage and identification of techniques to prevent the expression of the disorder in cold-stored 'Laetitia' plums

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Abstract

Internal heat damage in cold-stored plums is on the increase. Previous trials showed that rapid cooling to -0.5 °C after harvest can induce internal disorders and that internal browning can be prevented with 1-MCP. Thus, the 1st objective of this research was to determine if a risk assessment method could be developed to detect internal heat damage in *Prunus salicina* 'Laetitia' plums. Plums exposed to high ambient temperatures were harvested to the extent that external heat damage was visible on some fruit on the trees. Fruit was cooled rapidly (6 hours) or slowly (24 hours) to -0.5 °C and stored for 3 and 2 days, respectively, then examined for internal heat damage. A second examination was conducted after 2 days of ripening at 20 °C. The 2nd objective was to determine if internal heat damage can be reduced in 'Laetitia' plums by 1-MCP and/or slower cooling rates. Fruit were cooled to -0.5 °C within 6, 24, 48 or 72 hours. Half of the fruit of each cooling treatment were treated with 1-MCP. Fruit cooled within 6 hours served as a reference. The results indicated that the rapid cooling risk assessment method can be used as a quality management tool for 'Laetitia'. This is 6 hours rapid cooling, 3 days storage at -0.5 °C, followed by 2 days at 20 °C. It was confirmed that rapid cooling may exacerbate internal heat damage in pre-disposed 'Laetitia' plums. Cooling using 48 and 72-hour rates gave the lowest internal heat damage. 1-MCP-assisted flesh firmness maintenance in slow-cooled fruit.

Keywords: Heat damage, plum, cold storage, cooling, 1-MCP, 'Laetitia'

INTRODUCTION

Fruit of certain plum cultivars subjected to extremely high air temperatures in the week or two before harvest may develop heat damage in different forms. External heat damage (Figure 1) is typically caused by exposure to direct sun (Hortgro-Science App) and manifests as "discoloured" areas on the surface of the fruit. The damaged areas tend to sink in during cold storage. It is usually visible on fruit at packing and can therefore be removed from commercial consignments. Internal heat damage is difficult to identify since it is not externally visible, and usually not present at harvest. Literature on this disorder is scant. It is likely caused by high ambient temperatures rather than direct sun. It is postulated that under heat wave conditions, the temperature of fruit escalates higher than ambient with concomitant damage to cells. The resultant internal disorder development can be immediate but is more likely to develop progressively postharvest. The Hortgro-Science Stone Fruit App. indicates that heat wave conditions that may cause internal heat damage in plums are air temperatures above 35 ˚C for 3 consecutive days, 38 ˚C for two days or 40 ˚C for a day. Internal heat damage is characterised as the breakdown of the plum mesocarp tissue at different locations, most typically between the stone and the epidermis (Figure 2), but damage may also occur at the shoulders or as random brown spots in the fruit flesh.


Figure 1: External heat damage


Figure 2: Internal heat damage

Irrespective of whether the internal disorder is gel breakdown, internal browning, bladderiness, overripeness, or heat damage as described, quality problems are unacceptable. This study was to generate information to assist risk management of internal heat damage in 'Laetitia' plums. The first objective was to develop a method to detect internal heat damage in the fruit before export, bearing in mind heat waves frequently occur within days of harvest. This tool may enable contingency interventions on high-risk fruit before despatch. The second objective was to reconfirm if slow cooling after harvest reduces internal heat damage compared to rapid cooling (Khumalo et al., 2006). Since research has shown that 1-Methylcyclopropene (1-MCP) assists maintenance of storage quality of certain plum cultivars (De Kock and Taylor, 2010), the effect of 1-MCP in combination with cooling rate manipulation on fruit quality after cold storage was also ascertained.

MATERIALS AND METHODS

Risk assessment for detection of internal heat damage

'Laetitia' plums were sourced after exposure to high ambient temperatures a week or two before harvest. This was > 38 ˚C in 2020 and > 32 ˚C in 2021. Fruit was harvested at optimum export maturity and packed on trays in 5 kg double-layer corrugated cartons using high-density polyethylene plum liners with 54 x 2 mm perforations.

At harvest, maturity indexing was conducted using five replicates comprising 30 plums each. Parameters measured were flesh firmness (after removing the skin from the cheeks of fruit, using an Effegi penetrometer fitted with an 11-mm plunger), total soluble solids (TSS- on a pooled sample of juice, using an Atago DBX-30 digital refractometer) and malic acid (MA - on a pooled sample of juice by titrating a 10 g aliquot with 0.1N NaOH to a pH endpoint of 8.2, using a Metrohm 605 Dosimat titrator).

The temperature methods tested to detect internal heat damage in 'Laetitia' plums during 2020 and 2021 entailed: rapid cooling (6h) and slow cooling (24h) followed by storage at -0.5 °C for 3 or 2 days, respectively. The internal quality was determined using five single-carton replicates per treatment (60 fruit per carton). Fruit was examined at the start and end of an additional 2-day ripening period at 20 °C. The liners were removed at the start of ripening and 30 fruit per replicate were used per examination. The fruit was cut in half through the equatorial axis and the two halves twisted in opposite directions to enable visual inspection for internal disorders. A complete randomised design was used with data analysis by Two-way ANOVA with Factor A =

cooling rate and Factor B = ripening days. Least significant differences (LSD) were calculated to compare the treatment means.

Effect of cooling rate and 1-MCP on the development of internal heat damage

'Laetitia' plums from the same populations sourced for internal heat damage risk assessment were used. The treatments entailed: cooling fruit within 6, 24, 48 and 72 hours. Hald the fruit of each cooling rate (except the 6h reference treatment) was subjected to 1-MCP. The 1-MCP applications, where applicable, were conducted on the day of intake, using 24 hours exposure to SmartFresh^{SM} in airtight containers. Following 1-MCP applications and cooling, the fruit was cold stored according to a dual-temperature regime, comprising -0.5°C for 10 days, 7.5°C for 7 days, and 25 days at -0.5°C. After the 42 days cold storage, a shelf life comprising 5 days at 10°C was applied, with fruit quality evaluations at the start and end of shelf life. Perforated liners were removed at the start of shelf life.

At harvest, fruit maturity was assessed in terms of flesh firmness, TSS and MA as described for detection of internal heat damage. Five replicates of 10 plums each were used per treatment. Fruit quality after cold storage was determined at the start and end of shelf life, also using five replicates per treatment. Flesh firmness was assessed using 10 fruit per replicate, while external quality was determined in terms of shrivel, decay and skin cracks, using 30 fruit per replicate. Internal fruit quality was assessed by cutting the fruit in half through the equator and twisting the two halves in opposite directions to enable visual inspection for internal disorders. Data were analysed according to a completely randomised design. Start and end of shelf-life data were analysed separately using One-way ANOVA. Least significant differences (LSD) were calculated to compare the treatment means at the 5% significant level.

RESULTS AND DISCUSSION

Fruit maturity at harvest

The research was done in the Western Cape, South Africa. On 21 January 2020, 'Laetitia' plums were harvested from an orchard in Simondium at optimum maturity for sea freight export, as indicated by flesh firmness (6.1 Kg), TSS (11.8%) and MA (1.50 %). This fruit sourced from a population exhibiting external heat damage on the tree. On 5 February 2021, fruit was sampled from an orchard in Bonnievale. This fruit was also at optimum maturity with flesh firmness (6.9 Kg), TSS (12.2%) and MA (1.58%).

Risk assessment for detection of internal heat damage

No significant interaction occurred between the factors cooling rate and ripening days for internal heat damage in 'Laetitia' plums sampled in 2020 (Table 1). Therefore, data were pooled across factors. The 6-hour rapid forced-air cooling (FAC) resulted in significantly more internal heat damage at 14.0%, than the 24-hour cooling rate at 5.3%. While 6% internal heat damage was already present at the start of the ripening period (0 days after cooling and 4 days after harvest), it was significantly higher after an additional two days of ripening, at 13.3%. The cooling rate and ripening days interaction was significant in 2021 (Table 1). Significant levels of internal heat damage of 9.2% occurred in plums cooled in 6 hours succeeded by storage at -0.5°C for 3 days and further ripening at 20 °C for 2 days. By contrast, cooling in 24 hours revealed an insignificant level of 0.5% internal heat damage after ripening. No internal heat damage occurred at the start of ripening for either cooling rate.

This research showed that the risk assessment method: 6h FAC; 3d @ -0.5 °C; 2d @ 20°C, worked well to ascertain if internal heat damage triggered near harvest is likely to develop in cold stored 'Laetitia' plums.

Table 1: Internal heat damage in 'Laetitia' plums following rapid cooling of 6 hours followed by 3 days at -0.5 °C and 2 days ripening at 20 °C as well as standard cooling of 24 hours followed by 3 days at -0.5 °C and 2 days ripening at 20 °C

[1] The 6 and 24 hour cooling were followed by 3 and 2 days ripening, respectively
[2] Two-way ANOVA table

Effect of cooling rate and 1-MCP on the development of internal heat damage

Internal heat damage (%)								
Year	Cooling rate[1] (Hours) (Factor A)	Ripening days (Days) (Factor B)		Cooling rate[1] (Hours) (Factor A)		Prob > F [2]		
		0 days after cooling	2 days after cooling	6h	24h	A	B	A x B
2020	-	6.0a	13.3b	14.0b	5.3a	0.0149	0.0053	0.4675
2021	6H	0.0a	9.2b	-	-	0.0000	0.0000	0.0000
	24H	0.0a	0.5a	-	-			

In 2020, after 42 days dual-temperature storage, both the start (Table 2) and end of shelf life (Table 3) fruit quality results revealed similar trends. Internal heat damage was confined to levels of 4% and lower by slower cooling in 48 and 72 hours. This compared to faster cooling in 6 and 24 hours with between 12% and 23% damage. Across cooling rates, 1-MCP resulted in significantly firmer fruit at the start of shelf life and additionally, benefitted by giving significantly less shrivel and skin cracks compared to non-treated plums (Table 2). These effects were still evident at the end of shelf life (Table 3). The trend at the end of shelf life was for higher shrivel levels with slower cooling. No significant differences occurred in gel breakdown across treatments at the start of shelf life. However, 1-MCP gave a significant reduction in levels of this disorder for each cooling rate category at the end of shelf life. Hence, total internal disorders were less. No differences across treatments occurred for decay and overripeness. The best fruit quality after storage was achieved using 1-MCP applied directly after harvest combined with slower cooling rates of 48 and 72 hours. These treatments gave good control of internal heat damage and simultaneously gave good maintenance of flesh firmness, while reducing shrivel, skin cracks and gel breakdown.

The population of 'Laetitia' sourced in 2021 exhibited low levels of decay, skin cracks, gel breakdown and overripeness at the start (Table 4) and end of shelf life (Table 5). Once again, the impact of cooling rate on the control of internal heat damage was clear, with plums cooled in 48 and 72 hours generally showing significantly lower levels compared to faster cooling. The 6-hour cooling (Treatment 5) forced the highest internal heat damage at levels near 60%. This showed the value of using this rapid cooling tool for risk assessment of the disorder. Application of 1-MCP assisted flesh firmness maintenance across cooling rate treatments and proved beneficial to offset fruit softening associated with slower cooling. At the start of shelf life, there was a tendency for 1-MCP to lower shrivel levels. This was probably due to ripening inhibition in this population of plums, but this effect was lost by the end of shelf life (Table 5). Shrivel was significantly less in 1-MCP treated fruit cooled in 48 hours compared to 72 hours. As was the case in 2020, the 2021 research showed that the combination of 1-MCP with slow cooling between 48 and 72 hours gave the best fruit quality. From a shrivel control and practical point of view, 48 hours of cooling with 1-MCP was the best.

Table 2: 2020 Season - Effect of cooling rate and 1-MCP applied directly after harvest on quality of 'Laetitia' plums after 42 days dual-temperature cold storage at start of shelf life.

Treatment	Examination Parameters[1]							
	Flesh firmness (kg)	Shrivel (%)	Decay (%)	Skin cracks (%)	Internal heat damage (%)	Gel break-down (%)	Overripe-ness (%)	Total internal disorders (%)
1 (24h + 1-MCP)	3.4a	16.9a	1.6	37.1ab	12.0b	4.0	2.0	18.0ab
2 (24h – 1-MCP)	2.5b	67.1d	0.7	65.1c	19.0b	2.0	1.0	22.0bc
3 (48h +1-MCP)	2.9b	48.7c	1.6	26.1a	2.0a	4.0	6.0	12.0ab
4 (48h –1-MCP)	2.0c	72.5d	0.0	54.3c	4.0a	5.0	4.0	13.0ab
5 (72h +1-MCP)	2.7b	30.6b	1.8	28.6a	2.0a	2.0	3.0	7.0a
6 (72h –1-MCP)	2.0c	62.4d	0.0	51.6bc	1.0a	11.0	7.0	19.0b
7 (6h –1-MCP)	2.0c	15.2a	3.2	60.2c	18.0b	9.0	5.0	32.0c
Prob.>F[2]	0.0000	0.0000	0.6376	0.0001	0.0000	0.0838	0.2307	0.0035

[1] Values in the same column followed by different letters indicate significant differences (P<0.05) according to the LSD test
[2] One-Way Table

Table 3: 2020 Season - Effect of cooling rate and 1-MCP applied directly after harvest on quality of 'Laetitia' plums after 42 days dual-temperature cold storage followed by 5 days at 10 °C

Treatment	Examination Parameters[1]							
	Flesh firmness (kg)	Shrivel (%)	Decay (%)	Skin cracks (%)	Internal heat damage (%)	Gel break-down (%)	Overripe-ness (%)	Total internal disorders (%)
1 (24h + 1-MCP)	2.7a	21.1a	1.6	28.9ab	23.0b	0.0a	3.0	26.0abc
2 (24h – 1-MCP)	2.4b	22.6a	0.8	61.2c	19.0b	9.0bc	8.0	36.0c
3 (48h +1-MCP)	2.8a	40.2ab	3.2	26.8a	0.0a	8.0abc	6.0	14.0ab
4 (48h –1-MCP)	2.1bc	46.8b	0.0	49.1c	2.0a	15.0cd	11.0	28.0bc
5 (72h +1-MCP)	2.9a	51.9b	0.8	19.7a	1.0a	6.0ab	5.0	12.0a
6 (72h –1-MCP)	2.1bc	49.5b	1.5	48.4bc	1.0a	23.0d	7.0	31.0c
7 (6h –1-MCP)	2.0c	33.1ab	0.0	47.3bc	23.0b	12.0bc	4.0	39.0c
Prob.>F[2]	0.0000	0.0443	0.2725	0.0016	0.0000	0.0002	0.3730	0.0044

[1] Values in the same column followed by different letters indicate significant differences (P<0.05) according to the LSD test
[2] One-Way Table

Table 4: 2021 Season - Effect of cooling rate and 1-MCP applied directly after harvest on quality of 'Laetitia' plums after 42 days dual-temperature cold storage at start of shelf life

Treatment	Examination Parameters[1]							
	Flesh firmness (kg)	Shrivel (%)	Decay (%)	Skin cracks (%)	Internal heat damage (%)	Gel break-down (%)	Overripe-ness (%)	Total internal disorders (%)
1 (24h + 1-MCP)	4.8ab	12.8a	0.0	0.0	12.0b	0.0	0.0a	12.0b
2 (24h – 1-MCP)	4.1bc	12.6a	0.6	0.0	12.0b	0.0	0.0a	12.0b
3 (48h +1-MCP)	5.1a	17.8a	0.0	0.0	0.0a	0.0	0.0a	0.0a
4 (48h –1-MCP)	3.4c	38.2c	0.6	0.0	3.0ab	0.0	0.0a	3.0ab
5 (72h +1-MCP)	4.8ab	23.5ab	0.0	0.0	0.0a	0.0	0.0a	0.0a
6 (72h –1-MCP)	4.1bc	30.9bc	0.6	0.0	0.0a	0.0	2.0b	2.0a
7 (6h –1-MCP)	4.8ab	15.0a	0.0	0.0	59.0c	0.0	0.0a	59.0c
Prob.>F[2]	0.0027	0.0003	0.6771	NS	0.0000	NS	0.0357	0.0000

[1] Values in the same column followed by different letters indicate significant differences (P<0.05) according to the LSD test
[2] One-Way Table

Table 5: 2021 Season - Effect of cooling rate and 1-MCP applied directly after harvest on quality of 'Laetitia' plums after 42 days dual-temperature cold storage followed by 5 days at 10 °C

Treatment	Examination Parameters[1]							
	Flesh firmness (kg)	Shrivel (%)	Decay (%)	Skin cracks (%)	Internal heat damage (%)	Gel break-down (%)	Overripe-ness (%)	Total internal disorders (%)
1 (24h + 1-MCP)	4.2a	27.8a	0.0	0.0	7.0ab	0.0a	0.0	7.0ab
2 (24h – 1-MCP)	2.8c	27.6a	0.0	0.0	11.0b	0.0a	0.0	11.0b
3 (48h +1-MCP)	3.7ab	35.6a	0.6	0.0	3.0ab	0.0a	0.0	3.0ab
4 (48h –1-MCP)	2.9c	37.6ab	0.0	0.0	1.0a	0.0a	0.0	1.0a
5 (72h +1-MCP)	4.0ab	53.7b	0.0	0.0	0.0a	0.0a	0.0	0.0a
6 (72h –1-MCP)	2.7c	26.9a	0.0	0.0	1.0a	2.0b	0.0	3.0ab
7 (6h –1-MCP)	3.3bc	21.9a	0.7	0.0	57.0c	0.0a	0.0	57.0c
Prob.>F[2]	0.0003	0.0205	0.5525	NS	0.0000	0.0357	0.3668	0.0000

[1] Values in the same column followed by different letters indicate significant differences (P<0.05) according to the LSD test
[2] One-Way Table

CONCLUSIONS

For detection of internal heat damage during cold storage of 'Laetitia' plums, a method was formulated to force development, namely: 6h FAC; 3d @ -0.5 °C; 2d @ 20 °C. Slow cooling in 48 to 72 hours gave significantly lower levels of internal heat damage compared to cooling faster than 24 hours, while 1-MCP applied directly after harvest limited fruit softening associated with slower cooling.

ACKNOWLEDGEMENTS
Thanks to Hortgro Stone who through Hortgro Science financed this research.

Literature cited

De Kock, A., and Taylor, M. (2010). Quantum advances in the cold storage maintenance of plum fruit quality using SmartFresh^{SM} combined with other handling and packaging changes. SA Fruit Journal 9(6), 45-48.

Khumalo, P., De Kock, V.A., Davids, J., and Jooste, M. (2006). Forced-air cooling recommendations for plums. SA Fruit Journal 5(3), 17-19.

Hortgro-Science App. – Harvest, storage and quality management of export stone fruit. Link: https://app.hortgro-science.co.za

Contacts

Rubens Technologies for non-destructive maturity indexing – Initial contact was with Daniel Pelliccia (daniel@rubenstech.com) but this business has been bought over by AgroFresh (Hannah James was the person I made contact with).

Adam Goldwater from Applied Horticultural Research in Australia, they do similar work to us.

Reconciliation of costs

DETAILED BUDGET LISTING ALL EXPENDITURE		
Items	**Budget Cost**	**Reconciled Cost**
Visa	R 2 200.00	R 2 200.00
Flights	R 22 598.80	R 22 598.80
Symposium	R 14 441.18	R 14 441.18
Accommodation	R 12 053.19	R 14 178.22
Meals (08/11-17/11)	R 6 000.00	R 3 923.60
Car hire	R 2 630.00	R 2 187.96
Total	**R 59 923.17**	**R 59 529.76**