Department of Primary Industries

PACKER NEWSLETTER

A newsletter for Australian citrus growers and packers

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John Golding
NSW Department of Primary Industries
email john.golding@dpi.nsw.gov.au
telephone 02 4348 1926

Australian Citrus Postharvest Science Program (Hort Innovation CT15010)

2018 update of sanitation and fungicide resistance testing survey

The 2018 research survey of packinghouse hygiene and resistance to postharvest fungicides across Australia was continued from the previous season (2017). This survey was part of the Horticulture Innovation Citrus Postharvest Program. The survey assessed the presence of decay-causing fungi in the different citrus packinghouses around Australia and identified if these fungi had any technical resistance to common postharvest fungicides.

Postharvest fungicides are an important method to control decay and breakdown during handling and marketing. However postharvest fungicides can sometimes fail to work due to the development of resistance by the decay fungi to the fungicide. Fungicide resistance is a serious and important postharvest problem which needs to be actively managed in the packinghouse to minimise any potential losses.

Fungicide resistance can occur in packinghouses and coolrooms with poor hygiene and the continuous use of the same postharvest fungicide. Resistance arises when a single decay fungi spore that is resistant to a fungicide multiplies. The continued selection of these resistant spores can happen when the same fungicide is used and these spores can multiply resulting in full resistance.

The survey put out agar petri dishes which contained different fungicides and then exposed them to the air in different packinghouses across Australia during the packing season, to estimate the levels of fungicide resistance present. The plates were put into the start of the packing line, the end of the packing line, and in the cool room. The postharvest fungicides assessed were thiabendazole (TBZ) (Vorlon® or Tecto®), imazalil (Magnate® or Fungaflor®) and fludioxonil (Scholar®). If decay spores in the air of the packinghouse landed on the plates with fungicide and grew, then there was some technical resistance to that fungicide.

A summary of the results of this season's survey are presented in Table 1. The results show there were large differences in sanitation and technical resistance between the different packinghouses around Australia. Some packinghouses had excellent hygiene and sanitation with very few decay causing fungi detected, while other packinghouses had very high levels of decay causing fungi both in the packinghouse and in the coolroom. In general the highest levels of decay causing fungi were detected at the start of the line. This is not unexpected as this is where the fruit is dumped from the orchard. However it is important

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to improve hygiene and reduce the numbers of decay causing fungi in all areas of the packinghouse and particular attention should be made in this area, as these spores can remain in the packinghouse and coolroom and be a risk for decay and resistance development.

A comparison of the 2018 results from the 2017 season showed there had been some reductions in the levels of total decay causing spores in the packinghouses and coolrooms in 2018. This is an excellent result and shows that packers have been active in their sanitation programs, particularly in the coolrooms, where total decay causing fungi detections were significantly lower. This lower pressure in the number of decay causing spores reduces the risk of decay and development of resistance.

Technical resistance to the postharvest fungicide, TBZ was detected in most packinghouses around Australia. Over half of the samples assessed had technical resistance to TBZ, whilst over 20% of samples at the start of the packingline, had very high levels of technical resistance to TBZ (Table 1). These levels of technical resistance to TBZ are a concern and improvements in packinghouse hygiene and rotation of fungicides is recommended.

The uses of other fungicides (such as imazalil and fludioxonil) with other modes of action against green and blue mould are widely used and essential to help manage postharvest decay. However this survey also showed some packinghouses had low levels of technical resistance to imazalil in some packinglines and coolrooms. Although this was an un-common observation (<8 % samples), this is a big concern and needs to be eliminated. It is crucial to maintain the effectiveness of postharvest fungicides such as imazalil which is the mainstay of postharvest fungicides. Fortunately no technical resistance to fludioxonil was detected in this Australia-wide survey, but this was probably because this fungicide is not widely used by industry.

S = Start of the line, E = End of the line, C = Coolroom, T = Total score for all different packinghouse locations (S + E + C). The maximum (worst) total score is 12. The lower the number, the better the result.

Untreated (control) plates measured hygiene, where a score of;

1 =very low spore levels,

2 = low spore levels,

3 = moderate spore levels,

4 = high spore levels.

Table 1. Summary table of the results from the 2018 sanitation (hygiene) and fungicide resistance packinghouse survey

		Untreated				TBZ				Imazalil				Fludioxonil			
	Shed	S	E	C	T	S	E	C	T	S	E	C	T	S	E	C	T
NSW	A	1	2	2	5	4	1	1	6	1	1	1	3	1	1	1	3
NSW	B	4	1	1	6	1	2	1	4	1	1	1	3	1	1	1	3
NSW	C	4	4	1	9	2	2	1	5	1	1	1	3	1	1	1	3
NSW	D	4	4	4	12	1	1	1	3	1	1	1	3	1	1	1	3
NSW	E	4	4	1	9	2	1	1	4	1	1	1	3	1	1	1	3
NSW	F	1	1		3	1	1		3	1	1		3	1	1		3
NSW	G	4	4	2	10	1	2	2	5	1	1	1	3	1	1	1	3
NSW	H	2	3	1	6	1	3	4	8	1	1	1	3	1	1	1	3
NSW	I	4	4	1	9	1	3	1	5	1	1	1	3	1	1	1	3
Average		3	3	2	8	2	2	2	6	1	1	1	3	1	1	1	3
Qld	A	4	2	2	8	2	1	1	4	1	1	1	3	1	1	1	3
Qld	B	1	1	1	3	1	1	1	3	1	1	1	3	1	1	1	3
Qld	C	4	3	2	9	4	4	4	12	1	1	1	3	1	1	1	3
Qld	D	4	4	4	12	4	2	2	8	1	1	1	3	1	1	1	3
Qld	E	3	3	2	8	2	2	1	5	1	1	1	3	1	1	1	3
Qld	F	1	1		3	1	1	1	3	1	1	1	3	1	1	1	3
Qld	G		1	1	3	1	1	1	3	1	1	1	3	1	1	1	3
Qld	H	1	1	1	3	1	1	1	3	1	1	1	3	1	1	1	3
Qld	I	1	1	1	3	2	2	3	7	1	1	1	3	1	1	1	3
Average		2	2	2	6	2	2	2	6	1	1	1	3	1	1	1	3
WA	A	4	2		7	1	1		3	1	1		3	1	1		3
WA	B	4	4	3	11	1	1	2	4	1	1	1	3	1	1	1	3
WA	C	4	3	1	8	4	3	1	8	1	1	1	3	1	1	1	3
WA	D	4	4	2	10	4	4	3	11	1	1	1	3	1	1	1	3
WA	E	4	3	1	8	4	4	1	9	1	1	1	3	1	1	1	3
Average		4	3	2	9	3	3	2	8	1	1	1	3	1	1	1	3
SA	A	3	3	4	10	1	4	3	8	1	1	1	3	1	1	1	3
SA	B	1	1	1	3	1	2	1	4	1	1	1	3	1	1	1	3
SA	C	4	3	1	8	2	2	1	5	1	1	1	3	1	1	1	3
SA	D	4	4	1	9	2	3	1	6	1	1	1	3	1	1	1	3
SA	E	4	3	2	9	4	4	4	12	1	1	1	3	1	1	1	3
SA	F	2	1	1	4	1	1	1	3	1	1	1	3	1	1	1	3
SA	G	4	1	1	6	3	3	1	7	1	1	1	3	1	1	1	3
SA	H	4	4	4	12	4	4	4	12	1	2	1	4	1	1	1	3
SA	I	3	1	1	5	1	1	1	3	1	1	1	3	1	1	1	3
SA	J	2	1	1	4	1	1	1	3	1	1	1	3	1	1	1	3
SA	K	3	3	1	7	2	2	2	6	1	2	1	4	1	1	1	3
SA	L	2	2	1	5	3	4	3	10	1	1	1	3	1	1	1	3
SA	M	3	4	3	10	4	4	4	12	2	1	1	4	1	1	1	3
SA	N	4	3	3	10	1	1	1	3	1	1	1	3	1	1	1	3
SA	O	4	3	1	8	1	3	1	5	1	1	1	3	1	1	1	3
SA	P	4	4	1	9	3	4	1	8	1	1	1	3	1	1	1	3
Average		3	3	2	8	2	3	2	7	1	1	1	3	1	1	1	3
Vic	A	3	3	1	7	2	4	1	7	2	1	1	4	1	1	1	3
Vic	B	3	1	1	5	2	2	1	5	1	1	1	3	1	1	1	3
Vic	C	1	3	2	6	2	3	2	7	2	2	1	5	1	1	1	3
Vic	D	3	3	2	8	3	3	2	8	1	2	2	5	1	1	1	3
Average		3	3	2	8	2	3	2	7	2	2	1	4	1	1	1	3

For TBZ, imazalil and fludioxonil amended plates, a score of;

1 = very low resistance detected,

2 = low levels of resistance detected,

3 = moderate levels of resistance detected,

4 = high levels of resistance detected.

The management of resistance to postharvest fungicides requires a whole-of-system approach, starting from harvest through to packing and storage. Some of key management factors have been described in previous *'Australian Citrus News*' articles (Summer 2017) and in the 'Packer Newsletter', but in summary reducing the risk of fungicide resistance includes:

Optimise fruit health. Good postharvest practice to minimise physical damage to the fruit during harvest and handling.

Use best hygiene practices. Lowering the populations of decay-causing spores in the packinghouse, cool room and on the fruit are keys to a successful management program. This includes removal of rotten fruit from the packinghouse and coolrooms, the regular sanitation of equipment, coolrooms and packingline by washing (or using fogging technology).

Optimise fungicide use. Understand the way each fungicide works to develop strategies to minimise the development of resistance by using rotations and mixtures whenever possible and before resistance selection occurs.

Optimise fungicide efficacy. The correct fungicide concentration and coverage determines the efficacy of the treatment and minimises the chances of decay spores surviving following treatment.

Monitor fungicide resistance. The early detection of resistance increases the chance that its development can be managed and stopped.

An example of the efficacy of good cleaning and sanitation activities is presented in Table 2, which shows the results of different packinghouses at different sampling times. The packinghouses were sampled during the packing season (Time 1) and also after cleaning and improvements in hygiene (Time 2). The results showed a decrease in the total number of decay causing fungi and levels of technical resistance to TBZ in all packinghouses, particularly in packinghouses A and C. This shows that with both monitoring and targeted cleaning and sanitation, the risk of the failure of decay management can be minimised.

Table 2. Comparison of the results of untreated, TBZ, imazalil and fludioxonil amended plates both before (Time 1) and after intensive sanitation (Time 2) from the same packinghouses. There were three different packinghouses (A, B and C) assess at two different sampling times (Time 1 and 2). The scores are the same as described in Table 1.

		Untreated				TBZ				Imazalil				Fludioxonil			
Shed	Time	S	E	C	T	S	E	C	T	S	E	C	T	S	E	C	T
A	1	3	3	4	10	1	4	3	8	1	1	1	3	1	1	1	3
A	2	3	1	1	5	1	1	1	3	1	1	1	3	1	1	1	3
B	1	4	4	2	10	4	4	3	11	1	1	1	3	1	1	1	3
B	2	4	3	1	8	4	4	1	9	1	1	1	3	1	1	1	3
C	1	4	3	2	9	4	4	4	12	1	1	1	3	1	1	1	3
C	2	1	1	1	3	2	2	3	7	1	1	1	3	1	1	1	3

The article was also published in Australian Citrus News. Summer 2018/29, pages 36-37.

Postharvest research presented at Australian Citrus Technical Forum in Adelaide. 6-7 March 2019

Postharvest handling and fruit quality were the key focus of dedicated postharvest workshops at the Australian Citrus Technical Forum in Adelaide on 6-7 March 2019.

Talks

Session 5. Protecting Australia's brand of safe food

Food borne illness in citrus fruit: understanding the food safety risk
SP Singh

Australian fungicide resistance survey
John Golding, NSW DPI

Session 6. Postharvest Workshop 1

Introducing Chairman: sour rot control and resistance management
Shaun Hood, Syngenta

New foggers and sanitisers
Craig Wooldridge, EE Muirs

Citrosol post-harvest precision technologies
Dr Benito Orihuel, Iranzo

Fungicide-free control of citrus postharvest diseases
Lluis Palou, Postharvest researcher. IVIA. Spain

Prof. Lluis Palou (IVIA Spain) at the Australian Citrus Technical Forum in Adelaide.

Session 7. Postharvest Workshop 2

Trends in Spanish postharvest
Lluis Palou, Postharvest researcher. IVIA. Spain

Hort Innovation postharvest project - Fungicide use, timing, irradiation and chilling review.
John Golding, NSW DPI

Queensland supply chain research project
Andrew MacNish, QDAF

Update of cold plasma project
SP Singh, NSW DPI

Reducing export compliance costs
John Golding, NSW DPI

Lemon degreening and chilling risk
Andrew MacNish, QDAF

New reefer technology
Nick McKenna, MSC

Dr SP Singh (NSW DPI) presenting the cold plasma update.

The Citrus Australia pre-conference tour visiting orchards and packinghouses in Sunraysia and the Riverland was well attended.

CAL pre-conference tour and talks to Sunraysia and Riverland. (John Golding NSW DPI)

Poster presentations at Australian Citrus Technical Forum

1. Exposure to low ethylene and storage temperatures delays button (calyx) aging and maintains 'Afourer' mandarins and Navel oranges quality during storage

2. Evaluating the effects of plastic film packaging on postharvest quality of Navel oranges

3. Alternative decay control strategies using citrus essential oils

4. Effects of temperature and time on postharvest fungicide efficacy

5. Effect of postharvest washing on residues of preharvest sprays in lemons

6. Development and assessment of new citrus fruit coatings

7. Antifungal activity of citrus by-product aqueous extracts against Alternaria

8. Assessment of postharvest UV-C treatments to maintain quality of limes

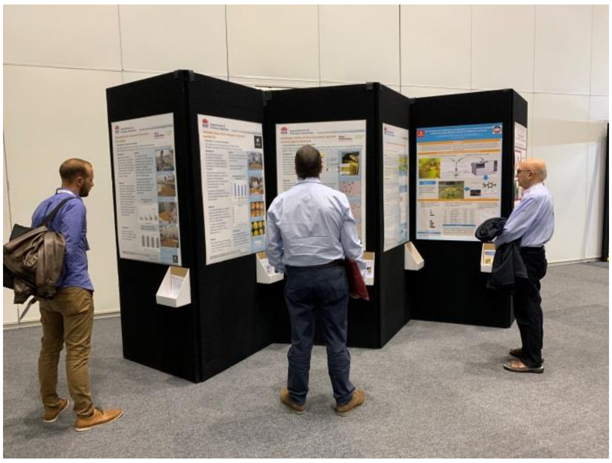
9. Combined postharvest treatments of UV-C and 1-methylcyclopropene (1-MCP) to maintain the quality of limes

10. Effect of postharvest UV-C light on postharvest decay and Navel orange fruit quality

11. Evaluating the effects of low pressure and low oxygen on the postharvest growth of green mould

12. Reducing export phytosanitary compliance costs

13. Managing sour rot of oranges with postharvest heat treatments and food additives



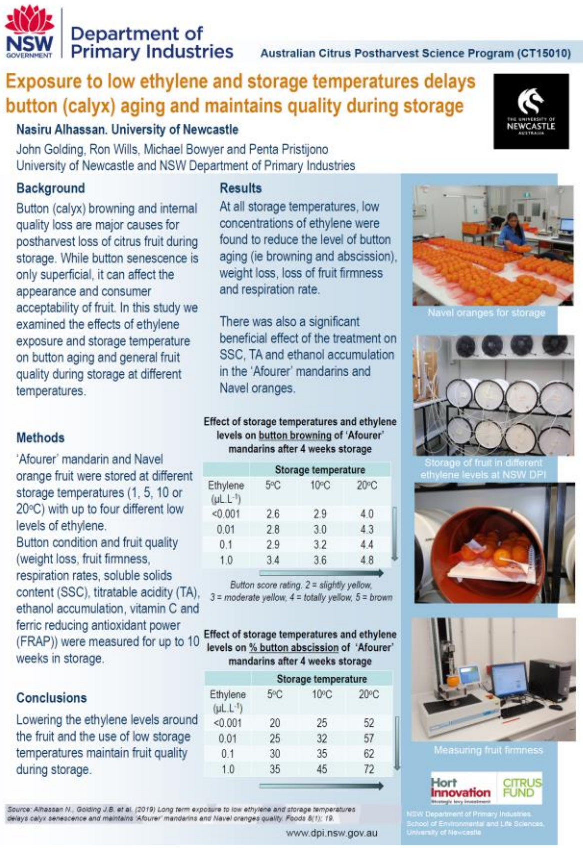
Postharvest posters at the Australian Citrus Technical Forum in Adelaide.

Poster 1.

Exposure to low ethylene and storage temperatures delays button (calyx) aging and maintains 'Afourer' mandarins and Navel oranges quality during storage

Nasiru Alhassan, John Golding, Ron Wills, Michael Bowyer and Penta Pristijono

Button (calyx) browning and internal quality loss are major physiological causes for postharvest loss of citrus fruits during storage. While calyx senescence is only superficial, it can affect the appearance and consumer acceptability of citrus fruit. In this study we examined the effects of ethylene exposure on postharvest calyx senescence and biochemical qualities in 'Afourer' mandarin and Navel orange fruit at different storage temperatures and times. Ethylene is a naturally produced by citrus fruit and can effect fruit quality. At all storage temperatures, low concentrations of ethylene were found to decrease the level of calyx senescence, weight loss, loss of fruit firmness and respiration rate. Also there was a significant beneficial effect of the treatment on total soluble solids, titratable acidity, and ethanol accumulation in the 'Afourer' mandarins and navel oranges. These results suggest that lowering the ethylene level at reduced storage temperatures maintain fruit quality.

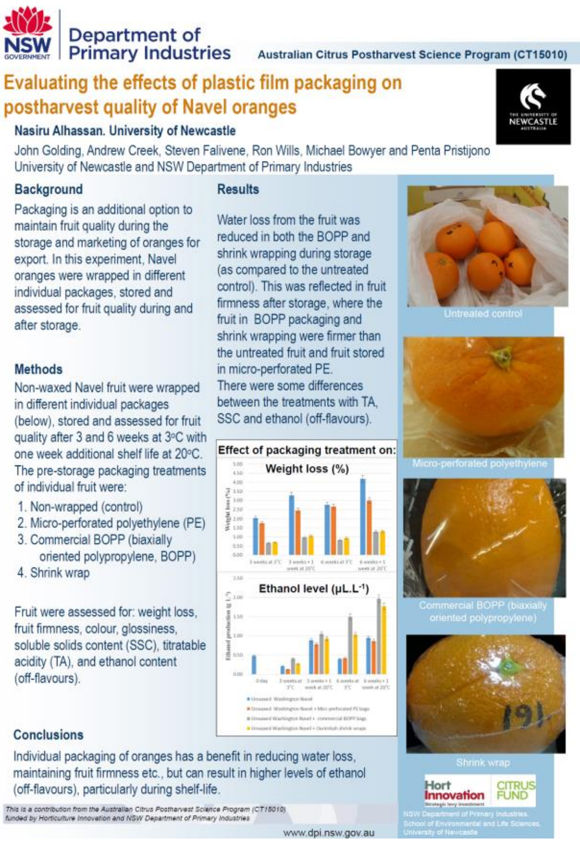


Poster 2.

Evaluating the effects of plastic film packaging on postharvest quality of Navel oranges

Nasiru Alhassan, John Golding, Ron Wills, Michael Bowyer and Penta Pristijono

Packaging is an additional option to maintain fruit quality during the storage and marketing. Navel fruit were wrapped in different individual packages, stored and assessed for fruit quality during and after storage. The packaging treatments of individual fruit included micro-perforated polyethylene (PE), biaxially oriented polypropylene (BOPP) and shrink wrap which were compared to untreated fruit. The results showed that water loss from the fruit was significantly reduced in both the BOPP and shrink wrapping during storage, as compared to the untreated control. This was also reflected in the firmness of the fruit after storage where the BOPP packaging and shrink wrapping were firmer than the untreated fruit and fruit stored in micro-perforated PE. There were some differences between the treatments with titratable acidity (TA), total soluble solids level (TSS), and off-flavours (ethanol) and these will be discussed.

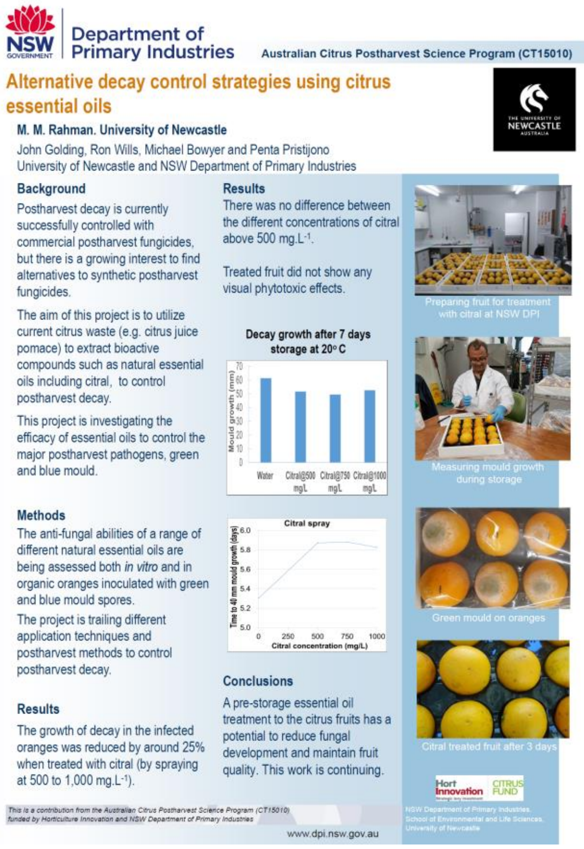


Poster 3.

Alternative decay control strategies using citrus essential oils

M. M. Rahman, John Golding, Ron Wills, Michael Bowyer and Penta Pristijono

Postharvest decay is currently successfully controlled with commercial postharvest fungicides, but there is a growing interest to find alternatives to synthetic postharvest fungicides. The aim of this project is to utilize current citrus waste (e.g. citrus juice pomace) to extract bioactive compounds to control postharvest decay. This project is investigating the efficacy of essential oils to control the major postharvest pathogens green mould (*Penicillium. digitatum*) and blue mould (*P. italicum*). A range of different natural essential oils are being assessed both in *vitro* and on oranges. The project is trailing different application techniques and postharvest methods to control decay. Some preliminary results will be presented.

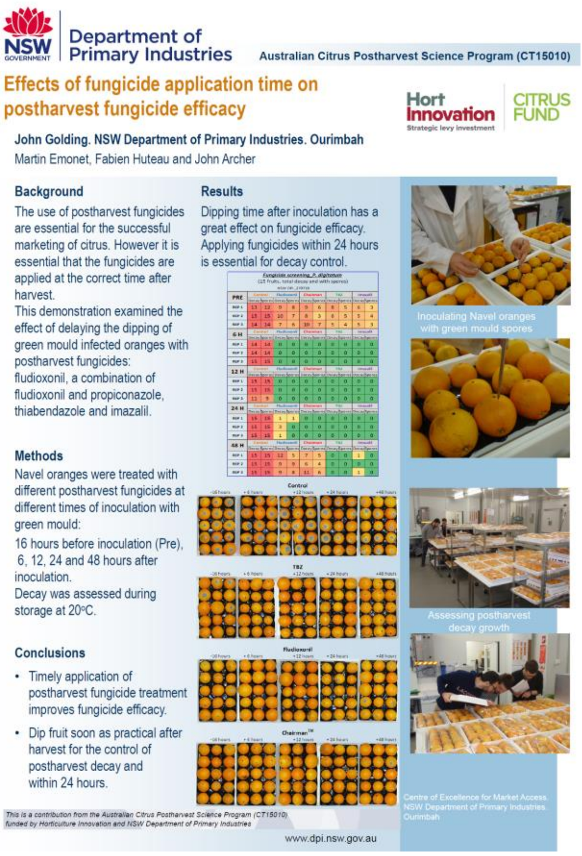


Poster 4.

Effects of temperature and time on postharvest fungicide efficacy

John Golding, Martin Emonet, Fabien Huteau and John Archer

Postharvest fungicides are essential for the successful marketing of citrus. However it is essential that the fungicides are applied at the correct time after harvest. This demonstration examined the effect of delaying the dipping of green mould infected oranges with postharvest fungicides: (a combination of fludioxonil and propiconazole), fludioxonil, thiabendazole and imazalil. A water dip treatment was used as the control. Fruit were treated: 16 hours before inoculation (Pre), 6, 12, 24 and 48 hours after inoculation. The results showed significant differences in decay controlling ability of the different treatment times and highlights the necessity for treatment as soon as practical after harvest for the control of postharvest decay. Results of different fungicide treatment temperatures will also be presented.

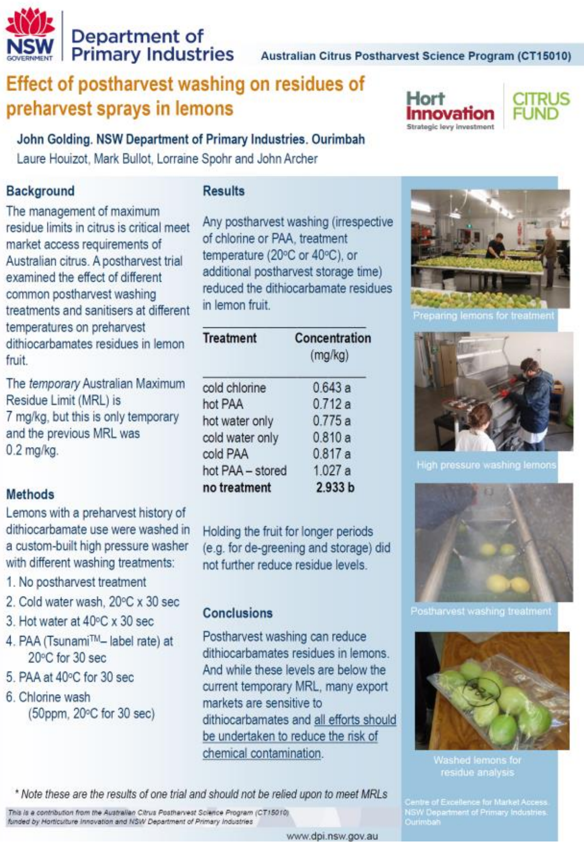


Poster 5.

Effect of postharvest washing on residues of preharvest sprays in lemons

John Golding, Laure Houizot, Mark Bullot, Lorraine Spohr and John Archer

The management of maximum residue limits in citrus is critical meet market access requirements of Australian citrus. A postharvest trial examined the effect of different common postharvest washing treatments and sanitisers at different temperatures on preharvest residues in lemon fruit. The sanitisers used in the trial were chlorine and peroxyacetic acid (PAA) which are widely in the Australian citrus industry. The results showed that any postharvest washing (irrespective of chlorine or PAA, treatment temperature (20 °C or 40 °C), or additional postharvest storage time) reduced the residue levels in fruit, as compared to non-washed fruit. These reductions in the levels residues were significant and contribute to lowering the MRL in the fruit. However it is critical to ensure preharvest chemical label rates are followed and all efforts should be undertaken to reduce the risk of chemical contamination.

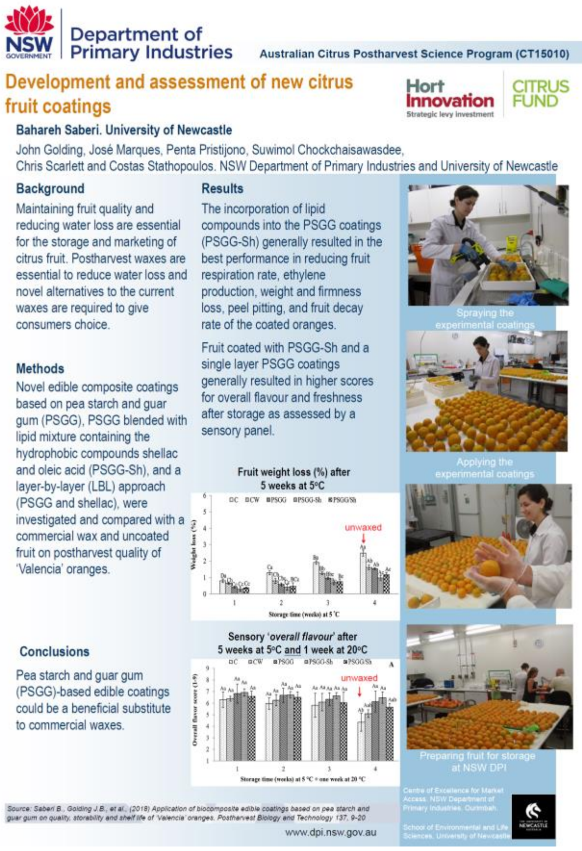


Poster 6.

Development and assessment of new citrus fruit coatings

Bahareh Saberi, John Golding, José Marques, Penta Pristijono, Suwimol Chockchaisawasdee, Chris Scarlett and Costas Stathopoulos

Novel edible composite coatings based on pea starch and guar gum (PSGG), PSGG blended with lipid mixture containing the hydrophobic compounds shellac and oleic acid (PSGG-Sh), and a layer-by-layer (LBL) approach (PSGG and shellac), were investigated and compared with a commercial wax and uncoated fruit on postharvest quality of ‘Valencia’ oranges. The incorporation of lipid compounds into the PSGG coatings (PSGG-Sh) generally resulted in the best performance in reducing fruit respiration rate, ethylene production, weight and firmness loss, peel pitting, and fruit decay rate of the coated oranges. Fruit coated with PSGG-Sh and a single layer PSGG coatings generally resulted in higher scores for overall flavor and freshness after storage as assessed by a sensory panel. Overall results suggested that PSGG-based edible coatings could be a beneficial substitute to common commercial waxes for maintaining quality and storability, as well as extending shelf life.

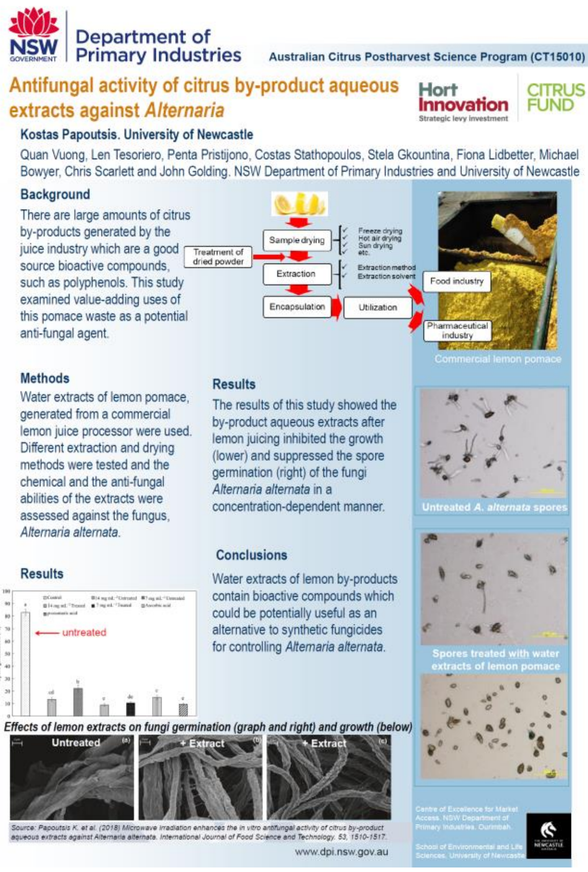


Poster 7.

Antifungal activity of citrus by-product aqueous extracts against *Alternaria*

Kostas Papoutsis, Quan Vuong, Len Tesoriero, Penta Pristijono, Costas Stathopoulos, Stela Gkountina, Fiona Lidbetter, Michael Bowyer, Chris Scarlett and John Golding

There is a large amount of citrus by-products which are generated by the juice industry and are a good source bioactive compounds, such as polyphenols. The results of this study showed the by-product aqueous extracts after lemon juicing inhibited the growth and suppressed the spore germination of the fungi *Alternaria alternata* in a concentration-dependent manner. The *in vitro* antifungal and antioxidant activities of lemon by-product aqueous extracts can be enhanced by treating with microwave energy. The antifungal effects of lemon by-product extracts were attributed to the presence of phenolic acids and ascorbic acid into the aqueous extracts. Lemon by-product extracts significantly changed the morphology of fungus hyphae, leading to a cell wall collapse and loss of linearity. These results show that the aqueous extracts of lemon by-products contain bioactive compounds which could be potentially useful as an alternative to synthetic fungicides for controlling *A. alternata*.

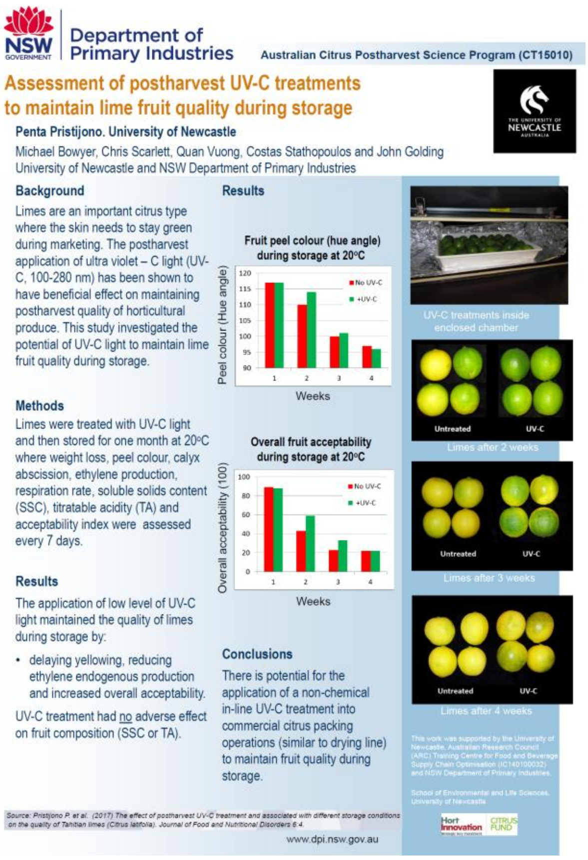


Poster 8.

Assessment of postharvest UV-C treatments to maintain quality of limes

Penta Pristijono, Michael Bowyer, Chris Scarlett, Quan Vuong, Costas Stathopoulos and John Golding

The postharvest application of ultra violet – C light (UV-C, 100-280 nm) has been shown to have beneficial effect on maintaining postharvest quality of horticultural produce, including citrus. Limes were treated with UV-C irradiation and stored for one month at 20 °C where weight loss, peel colour, calyx abscission, ethylene production, respiration rate, soluble solids content (SSC), titratable acidity (TA) and acceptability index were regularly assessed. The results showed that the application of low level of UV-C irradiation significantly maintained the quality of limes during storage by delaying yellowing, reducing ethylene endogenous production and increased overall acceptability. UV-C treatment had no adverse effect on fruit composition (SSC or TA). There is potential for the application of an in-line UV-C treatment into commercial citrus packing operations (similar to drying line) to utilize these benefits to fruit quality.

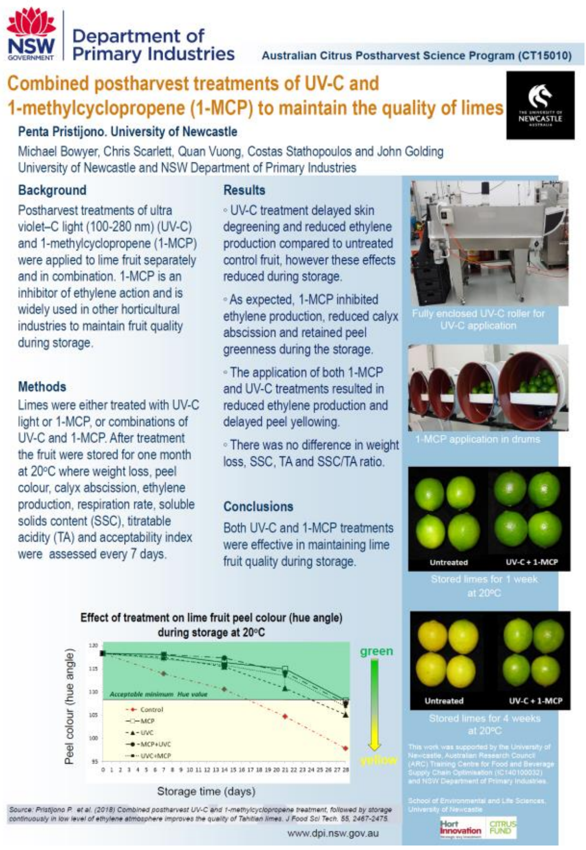


Poster 9.

Combined postharvest treatments of UV-C and 1-methylcyclopropene (1-MCP) to maintain the quality of limes

Penta Pristijono, Michael Bowyer, Chris Scarlett, Quan Vuong, Costas Stathopoulos and John Golding

Postharvest treatments of ultra violet – C light (100-280 nm) (UV-C) and 1-methylcyclopropene (1-MCP) were applied to lime fruit separately and in combination. 1-MCP is an inhibitor of ethylene action and is widely used in other horticultural industries to maintain fruit quality during storage. In this experiment, UV-C treatment delayed skin degreening and reduced ethylene production compared to untreated control fruit, however these effects reduced over the storage time. As expected, 1-MCP inhibited ethylene production, reduced calyx abscission and retained peel greenness during the storage. The application of both 1-MCP and UV-C treatments resulted in reduced ethylene production and delayed peel yellowing. There was no difference in weight loss, SSC, TA and SSC/TA ratio. The results suggest that a pre-storage UV-C treatment improves the quality of limes, with the additional improvement when combined with 1-MCP treatment prior or after UV-C irradiation.

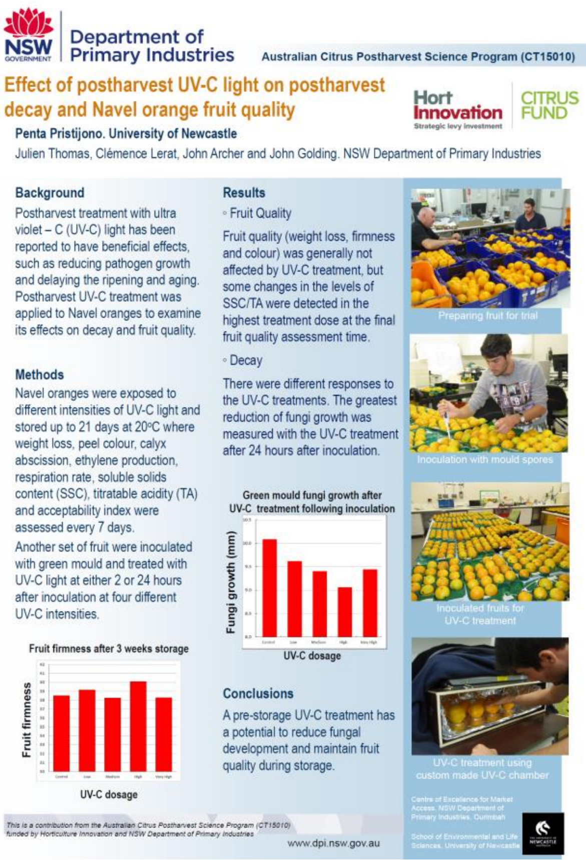


Poster 10.

Effect of postharvest UV-C light on postharvest decay and Navel orange fruit quality

Penta Pristijono, Julien Thomas, Clémence Lerat, John Archer and John Golding

Postharvest treatment with ultra violet – C (UV-C) light has been reported to have beneficial effects, such as reducing pathogen growth and delaying the ripening and aging. Navel oranges were exposed to different intensities of UV-C light and stored up to 21 days at 20 °C. Fruit quality (weight loss, firmness and colour) was generally not affected by UV-C treatment, but some changes in the levels of SSC/TA were detected in the highest treatment dose at the final fruit quality assessment time. Navel oranges were also inoculated with green mould (*Penicillium digitatum*) and treated with UV-C light at either 2 or 24 hours after inoculation at four different UV-C intensities. The results showed there was a different responses to the UV-C treatments. The greatest reduction of fungi growth was measured with the UV-C treatment after 24 hours after inoculation. These results suggest that a pre-storage UV-C treatment has a potential to reduce fungal development and maintain fruit quality.

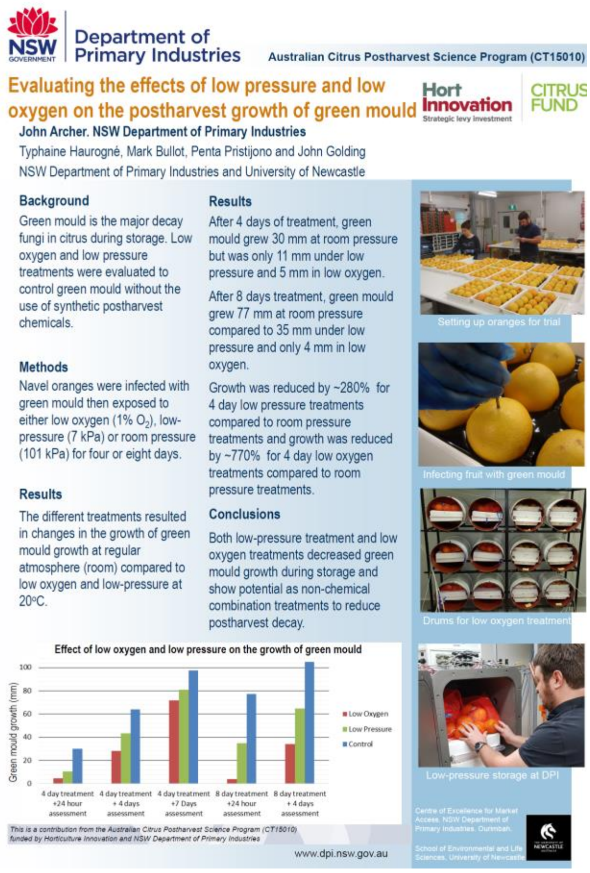


Poster 11.

Evaluating the effects of low pressure and low oxygen on the postharvest growth of green mould

John Archer, Typhaine Haurogné, Mark Bullot, Penta Pristijono and John Golding

Green mould (Penicillium digitatum) is the major decay fungi in citrus during storage. Low oxygen and low pressure treatments were evaluated to control green mould without the use of synthetic postharvest chemicals. Green mould infected Navel oranges were exposed to either a low oxygen or low-pressure at room pressure for either four days and eight days. The results showed that both low pressure and low oxygen treatments reduced mould growth compared to that of the non-treated control fruit. The low oxygen treatment was most effective treatment and more work is continuing to optimize this treatment and potentially fit this treatment into current commercial supply chains.



Poster 12.

Reducing export phytosanitary compliance costs

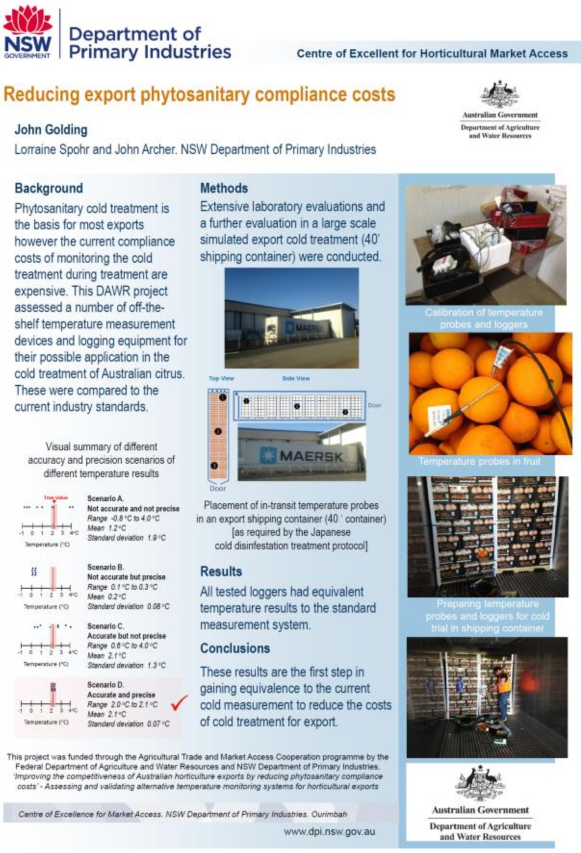
John Golding, Lorraine Spohr and John Archer

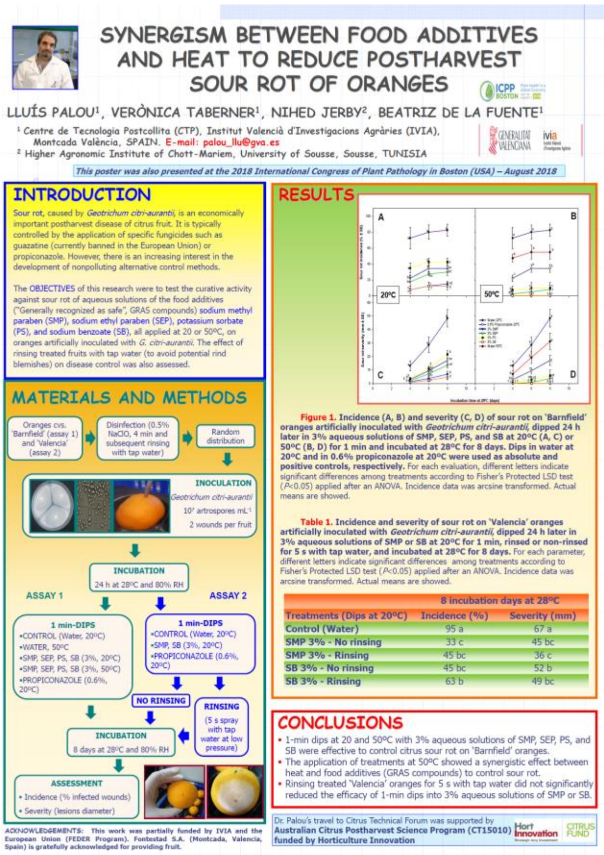
Phytosanitary cold treatment is the basis for the export of Australian citrus to phytosanitary markets, however the current compliance costs of monitoring the cold treatment during treatment are expensive. This project assessed a number of off-the-shelf temperature measurement devices and logging equipment for their possible application in the cold treatment of Australian citrus. These were compared to the current industry standards. Extensive laboratory evaluations and a further evaluation in a large scale simulated export cold treatment (40 foot shipping container) were conducted. The results showed there was no statistical difference in the temperatures between the standard in-container temperature probes. All loggers had equivalent temperature results to the standard measurement system. The results of this project is the first step in gaining equivalence to the current cold measurement to reduce the costs of cold treatment and export of Australian horticultural produce.

Managing sour rot of oranges with postharvest heat treatments and food additives

Lluis Palou, Veronica Taberner, Nihed Jerby and Beatriz de la Fuente

Sour rot of citrus fruit is a major postharvest decay during storage and is typically currently controlled with the application of specific fungicides such as guazatine (currently banned in many markets) and propiconazole. However there is an increasing interest in alternative control methods. In this research done in Valencia, Spain, aqueous dip solutions of food additives such as sodium methyl paraben (SMP), sodium ethyl paraben (SEP), potassium sorbate (PS) and sodium benzoate (SB) were applied at 20 or 50 ºC on fruit inoculated with sour rot. All treatments significantly reduced the incidence (percentage of infected fruit) and severity (lesion diameter) of the disease, and a strong synergy between food additives and heat was observed. However heat increased the slight incidence of rind spots caused by some salt treatments. These treatments show some promise in alternative sour rot control. More work is continuing.





3. EU review of imazalil

The European Food Safety Authority (EFSA) is reviewing the use of imazalil due to lack of some information which was required by the regulatory framework was missing and possible risks had been identified by the EFSA. Imazalil is the work-horse of the citrus postharvest around the world and it critical to the Australian citrus industry.

This review is being closely watched by all citrus industries around the world, as it may have broad consequences to its use and market acceptance. More information and the outcomes of this review will be presented in future issues of the *Packer Newsletter*.

For further information, please contact John Golding, NSW Department of Primary Industries

Telephone 02 4348 1926

or email john.golding@dpi.nsw.gov.au

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