IFIS International Food Ionizing Processing Symposium

Dr. John Golding NSW Department of Primary Industries. Australia

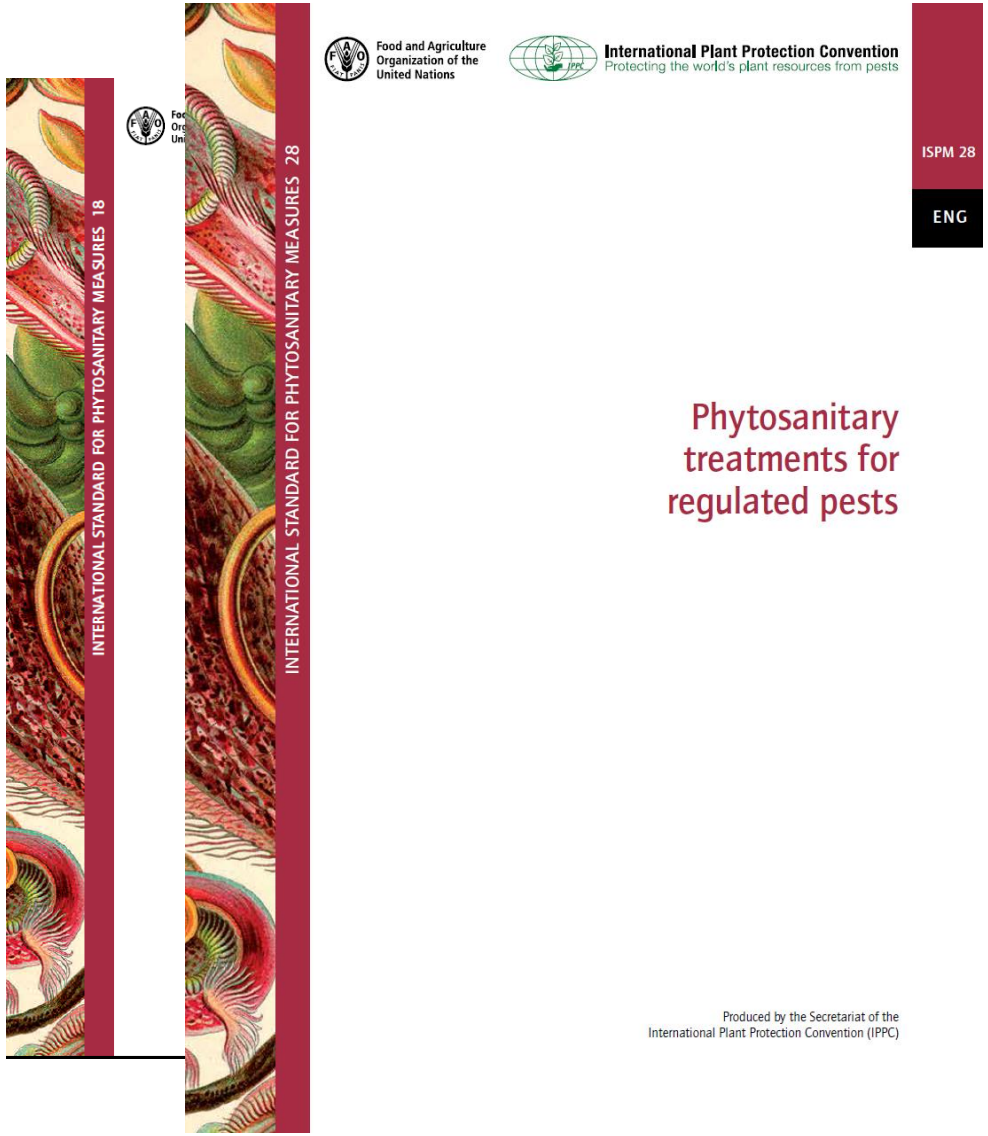
Phytosanitary irradiation and fresh produce quality

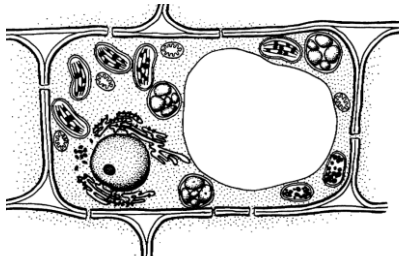
Introduction
Phytosanitary Irradiation

Phytosanitary irradiation facilitates trade

- ‘Guidelines for the use of irradiation as a phytosanitary measure’ – ISPM18
- ‘Phytosanitary treatments for regulated pests’ – ISPM28

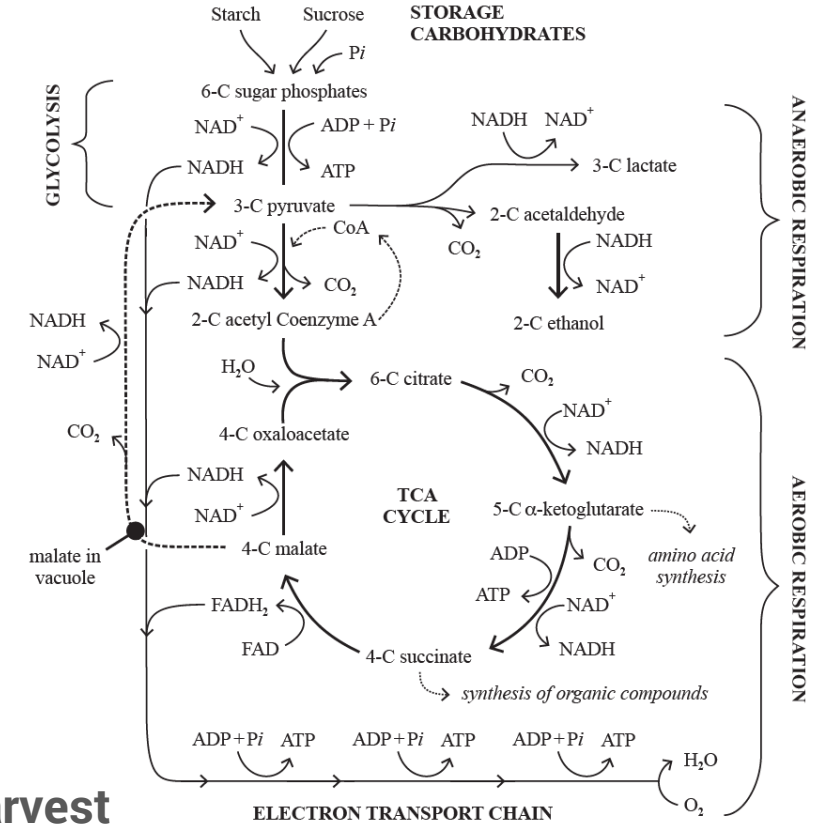
Internationally accepted standard for fruit flies (family Tephritidae) is 150 Gy





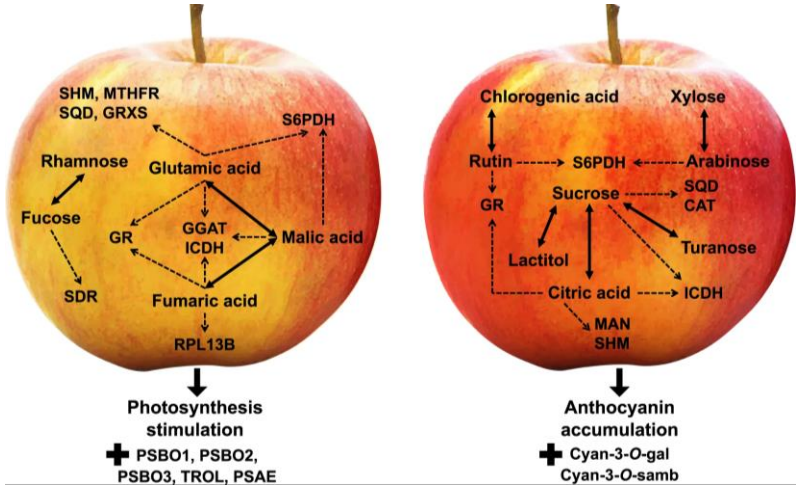
Introduction

Fresh fruit and vegetables are living products

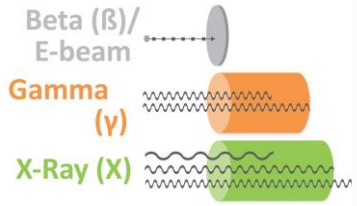


Fresh fruit and vegetables continue to live and breath after harvest

Complex biological and biochemical systems are maintained during ripening and senescence through storage and supply chains



Hortic Res 7, 120 (2020)

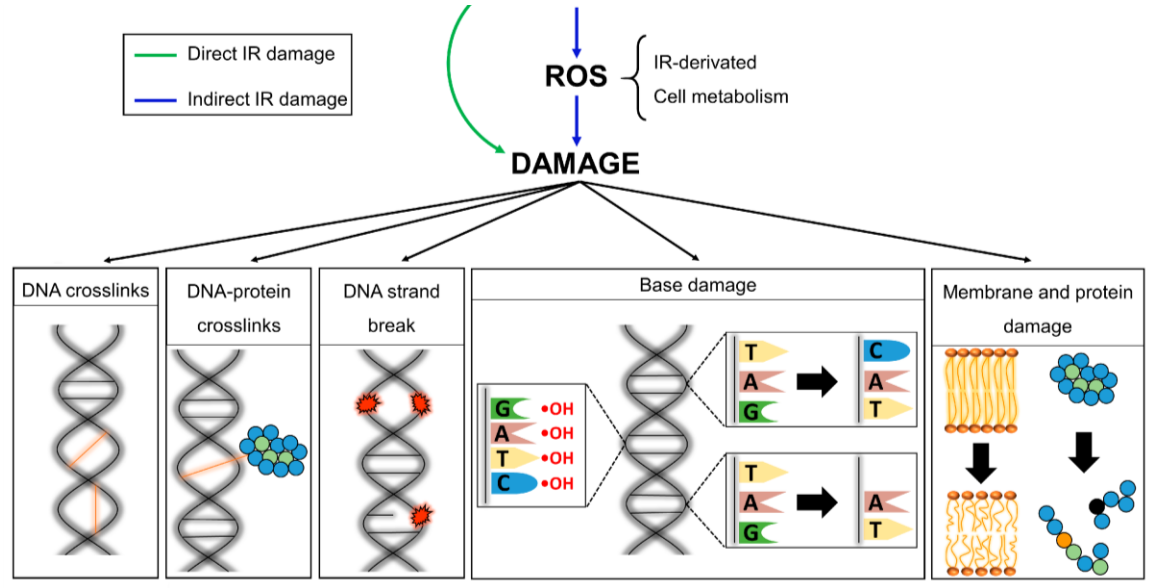


Phytosanitary irradiation

Introduction

Phytosanitary irradiation causes irreversible damage to insect DNA

Phytosanitary irradiation can also cause damage to product / fruit DNA and physiology



Adapted Jill Koh, 2020; *Plants* 2023, 12(5), 1178

Can affect many biological and biochemical processes:

- Fruit respiration, ripening, fruit softening, senescence and others → **Fruit quality**

Market access treatments

- Comparison of *end-point* market access treatments
- All phytosanitary treatments affect final fruit quality

	Cold treatment	Methyl bromide fumigation	Irradiation treatment
Example of treatment	1°C for 14 days	32 g methyl bromide per m^3 at 15°C for 3.5 hours	150 Gy
Air freight compatible	Limited	Yes	Yes
Acceptance of treatment	General	General	Limited markets
Additional packaging requirements	None	Yes	None
Maintenance of cold chain	Yes	No	Yes
Potential chemical residues	No	Yes	No
Relative cost of treatment	Medium	Medium	High
Availability of treatment	Registered grower and packing facilities	Registered grower and commercial facilities	Limited
Effect on fruit quality	Potential impact – chilling injury	Potential impact	Potential impact
Overall comments	Potential chilling injury	Chemical fumigant that disrupts cool chain	Limited market acceptability

Phytosanitary irradiation can have no commercial effects on fruit quality - Blueberry and raspberry.

Golding J.B., Blades B.L, Satyan S., Jessup A.J., Spohr L.J., Harris A.M., Banos C. and Davies J.B. (2014) Low dose gamma irradiation does not affect the quality, proximate or nutritional profile of 'Brigitta' blueberry and 'Maravilla' raspberry fruit. *Postharvest Biology and Technology* 96, 49–52. http://dx.doi.org/10.1016/j.postharvbio.2014.05.002

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Phytosanitary irradiation can have no commercial effects on fruit quality

- Cherry (different varieties, doses, growers etc)
- Passionfruit
- Persimmon
- Lemon
- Tablegrapes.

Grower 9. Lapin

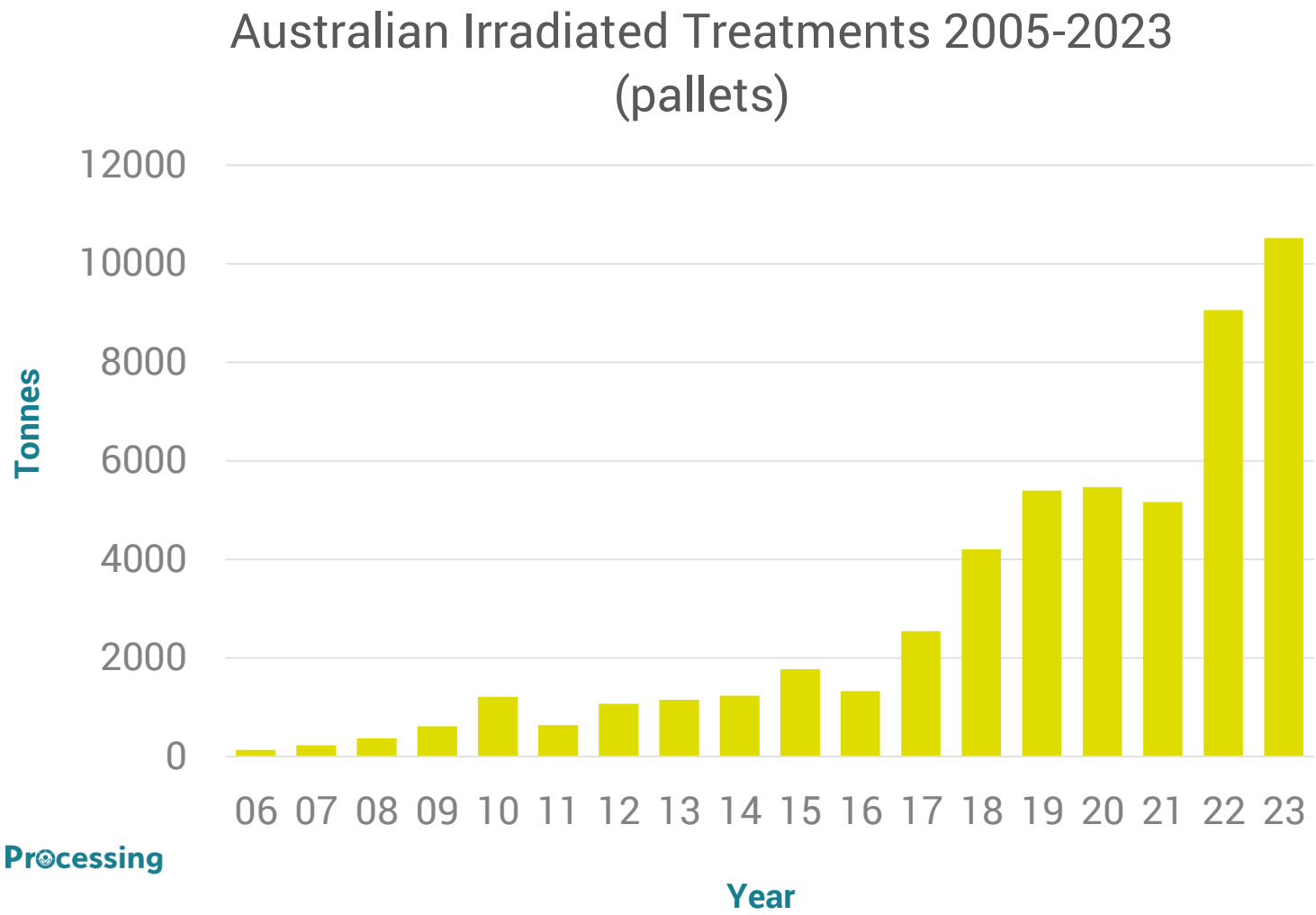
Treated Untreated

Golding J.B., Blades B.L., Satyan S., Spohr L.J., Harris A., Jessup A.J., Archer J.R., Davies J.B. and Banos C. (2015) Low dose gamma irradiation does not affect the quality or total ascorbic acid concentration of 'Sweetheart' passionfruit (*Passiflora edulis*). *Foods* 4, 376-390. doi:10.3390/foods4030376

Golding J.B., Pristijono P. and Wang B. (2020) Effect of phytosanitary irradiation treatment on the storage life of 'Jiro' persimmons at 15°C. *Horticulturae* 6 92

Phytosanitary irradiation can have no commercial effects on fruit quality

Increased trade and use of irradiation demonstrates no commercial effects



Dekapon citrus treated at 150 Gy

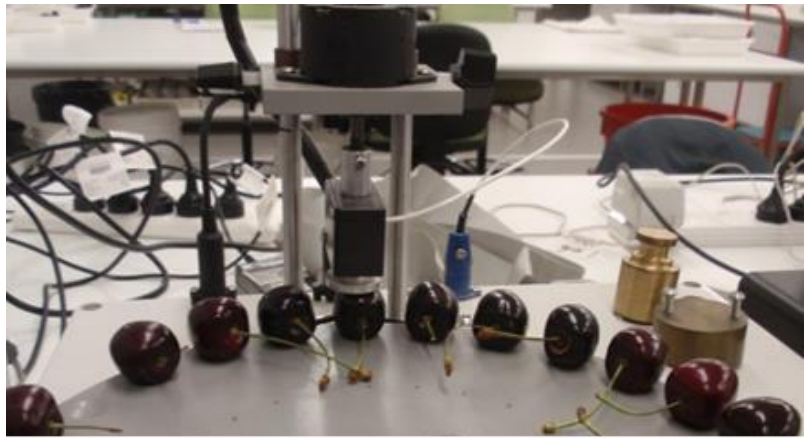
BUT

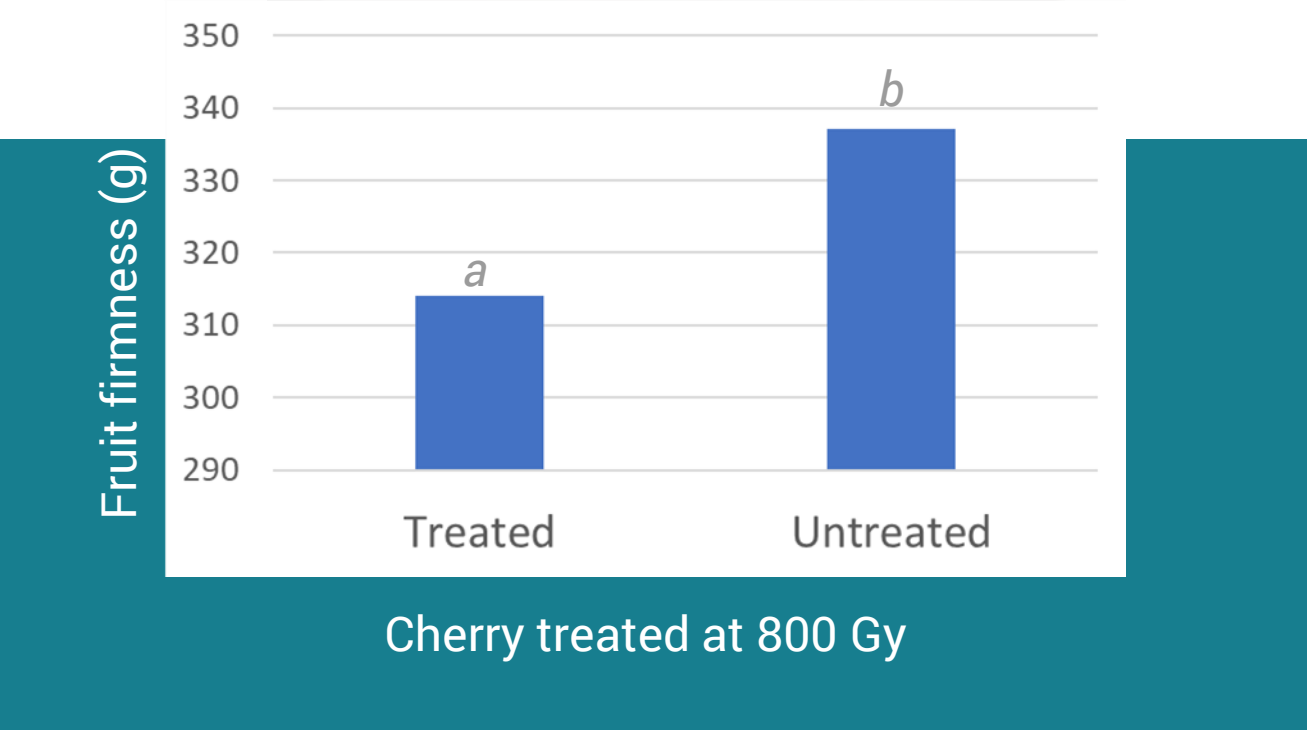
Phytosanitary irradiation can negatively effect fruit quality.

Sometimes….

increased rind disorders

phyto-toxicity





BUT

Phytosanitary irradiation can negatively effect fruit quality.

Sometimes…..

increase fruit softening*

Hass avocado treated at 150 Gy

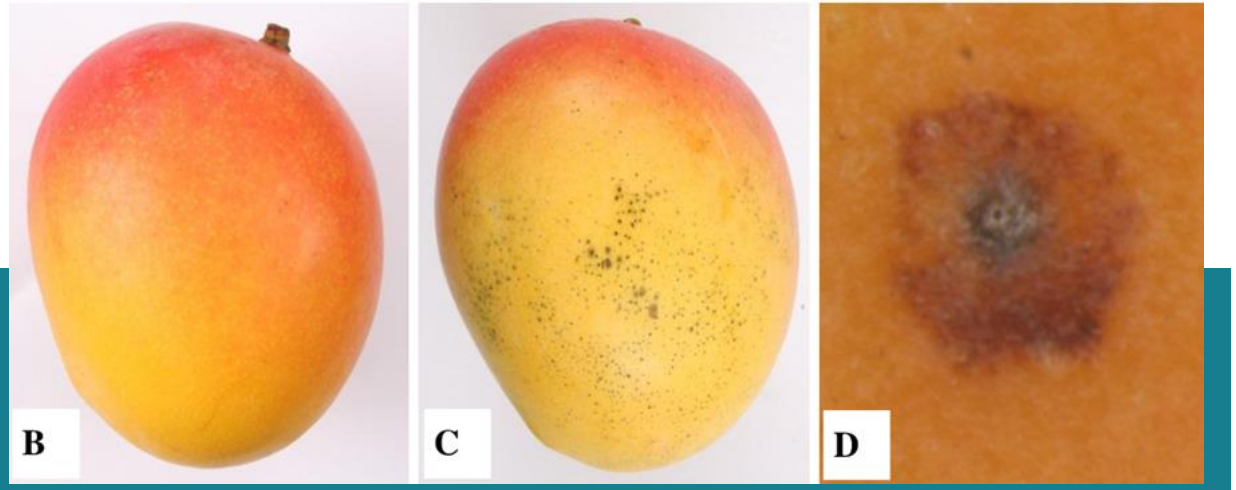
BUT

Phytosanitary irradiation can negatively effect fruit quality.

Sometimes…

increased disorders

vascular browning



induced lenticle damage in B74 mango

From Roberto Marques et al (2022) Australia

BUT

Phytosanitary irradiation can negatively effect fruit quality.

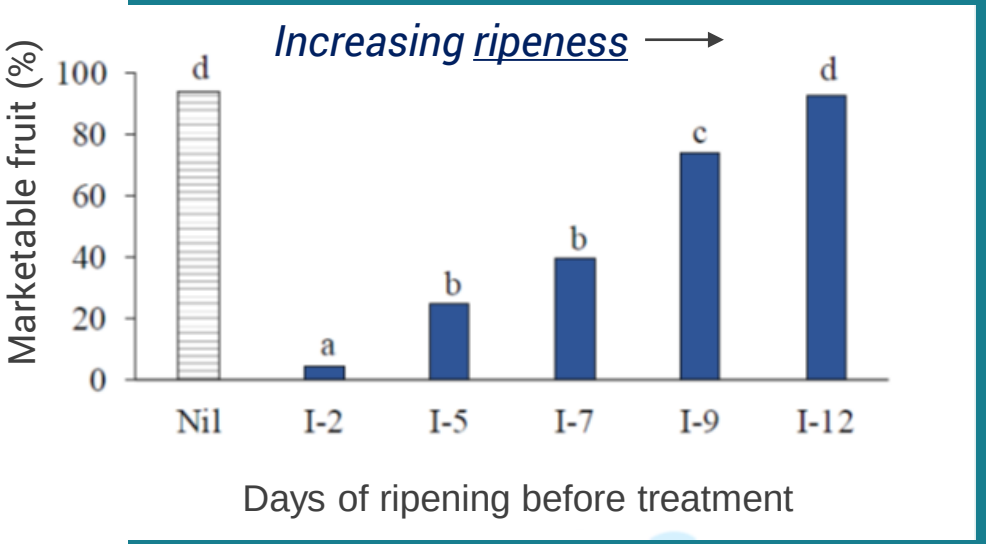
Sometimes…

increased disorders

induced lenticle damage

Applied research to overcome issues

Research over many seasons and different growing regions was conducted to effectively manage induced lenticle damage…..



Fruit maturity and ripeness

Increasing ripeness reduces lenticle browning

Postharvest treatments

(eg. coatings / waxes) also affect the development of the damage

✓**Harvest at more 'mature' stage – better eating quality but shorter supply chain**

Marques *et al.* (2022) Irradiation-induced lenticel discolouration in 'B74' mango fruit is modulated by ripeness. *The Journal of Horticultural Science and Biotechnology.* 97:5, 665-672

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Department of Agriculture and Fisheries

Achievement

Mangoes successfully and consistently traded within Australia and exported using irradiation

Export outcomes

Mangoes exported using irradiation treatment.

To ensure commercial outcomes → alter commercial practice to ensure no lenticle browning

Harvest at more 'mature' stage =

→ better eating quality but shorter supply chain

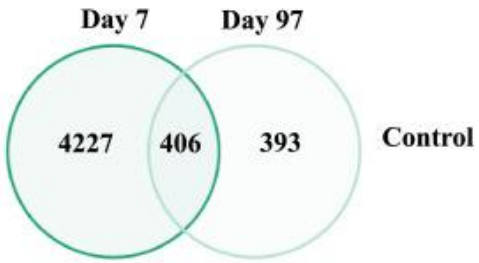
Next frontier…

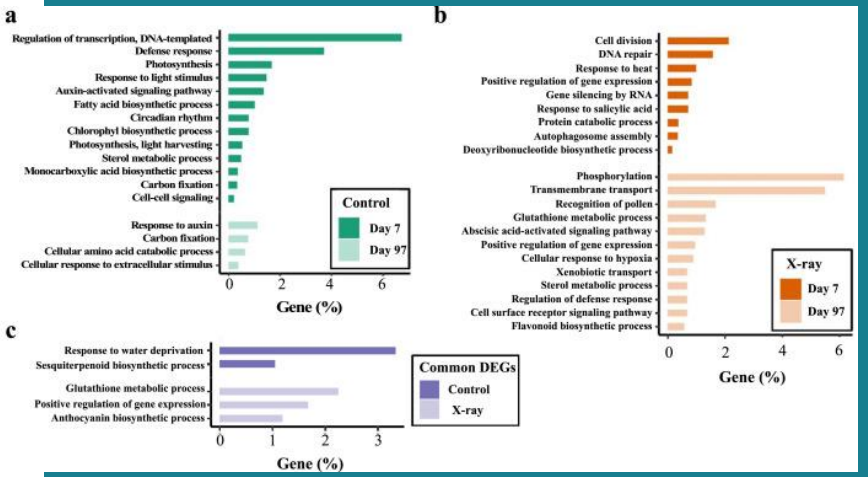
Fundamental understanding of irradiation on fruit quality

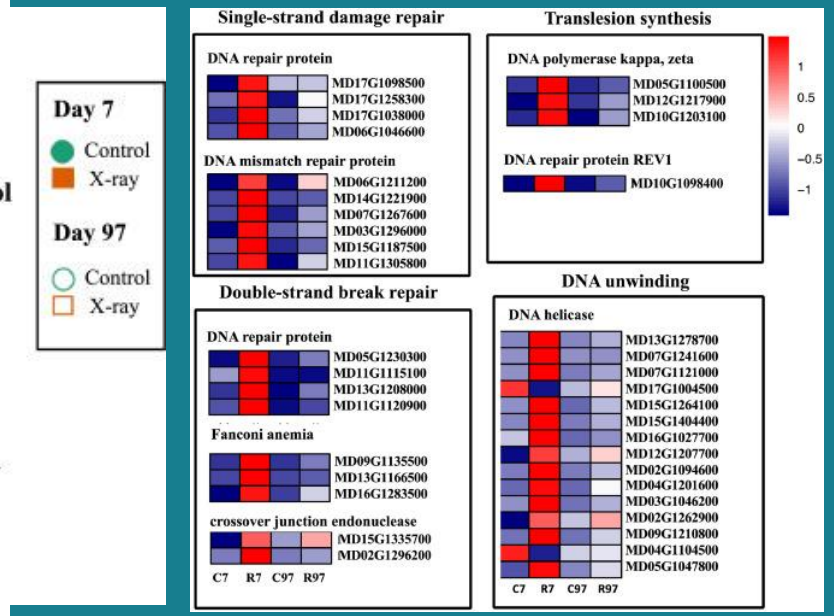
Moving from empirical studies to understand the molecular, biochemical and physiological processes affected by irradiation

Prof. Anuradha Prakash and team
Chapman University. CA, USA

→ *next session* ☺







Atamian *et al.* (2023) *Sci Hort* 311 p.111777

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Atamian, H.S., Davila, F.E.L. and **Prakash, A.** (2023)
A transcriptomic study of 'Granny Smith' apple fruit response to x-ray irradiation using RNA-Seq. *Scientia Horticulturae,* 311, p.111777.

Acknowledgements.

RAS5087
Promoting Food Irradiation by Electron Beam and X Ray Technology to Enhance Food Safety, Security and Trade (RCA)

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STERITECH Protecting what matters

Australian Government
Department of Agriculture and Water Resources

Hort Innovation AVOCADO FUND

Thanks.

Dr. John Golding. Principle Research Scientist

https://www.dpi.nsw.gov.au/staff/profiles/john-golding

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