AM19002 Building capacity in irradiation

Phytosanitary Irradiation:

Understanding Commercial Barriers for Efficient and Effective Development

Steritech

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Author: Ben Reilly, Steritech

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Contents

ACRONYMS

PI	Phytosanitary Irradiation
DAFF	Commonwealth Department of Agriculture, Forestry and Fisheries
FSANZ	Food Standards Australia New Zealand
PSiP	Phytosanitary Irradiation Platform
IIA	International Irradiation Association

INTRODUCTION

This report assists in identifying and understanding the barriers to the commercial development and use of phytosanitary irradiation in Australia, for the benefit of stakeholders in the Australian horticultural Industry.

Australia is a leader in the development of regulations, trade protocols and treatment facilities that today facilitate the most diverse trade of irradiated fresh produce in the world. This trade has a strong record of growth, creating new opportunities that support the continued profitability of Australia's horticultural industry.

Phytosanitary irradiation (PI) is a reliable, flexible, and sustainable end-point treatment that is helping Australian industry meet biosecurity requirements. It is helping industry maintain trade in an evolving environment with increasing examples where it reduces dependence on chemical treatments and fumigation or is the only commercially and technically viable solution. By creating a clearer, common understanding of the barriers to irradiation development, industry will be better positioned to realise the potential of this end-point-treatment. PI remains a novel treatment with limited reference material on the barriers to development and the pathways to resolve these barriers.

The treatment is an alternative to other common end-point treatments including fumigation (methyl bromide), chemical dips and sprays (dimethoate), vapor heat treatment and cold disinfestation. Phytosanitary irradiation is unique among phytosanitary treatments as a broad-spectrum treatment for almost all important regulated arthropod pests (Follett and Neven 2006).

This report draws largely upon the relationships, experience, and knowledge of Steritech, Australia's sole provider of PI services. Steritech is a privately owned Australian business that has five decades of experience in operating irradiation treatment services. The company operates both of Australia's existing PI facilities, which brought world-leading treatment capabilities to Australia. Steritech has been involved in almost every aspect of Australia's development of PI regulations, protocols and treatment. In doing so, Steritech has become a common, central connector between government and industry, building awareness of the biosecurity and trade outcomes that can be achieved through PI for Australia's horticultural sector.

What is Phytosanitary Irradiation

Phytosanitary Irradiation is chemical-free, heat-free, sterilising treatment that targets unwanted pests found on commercial shipments of fresh produce. The process is rapid and maintains the cold chain throughout helping maintain the natural shelf life and quality of the produce.

PI uses wavelengths of energy including X-Ray and Gamma Ray which pass directly through the fresh produce and packaging depositing energy that sterilizes insects with minimal change in the produce. The energy disappears instantly once the energy source is switched off.

The treatment is an alternative to other existing end-point treatments including Methyl Bromide, Dimethoate, vapour heat treatment and cold disinfestation. Unlike these other treatments, phytosanitary Irradiation is recognised as effective for any fruit fly on any crop at 150 Gy by ISPM 28 (FAO IPPC 2007) and on almost any insect at 400 Gy under the USDA treatment manual (USDA, 2006) and ICA 55 (Agriculture Victoria, 2022a). The generic nature of the treatment is unique and reduces the R & D requirements needed to demonstrate efficacy

The treatment process and capacity vary, dependent on several factors including the facility design and source type. Australia's two existing facilities can treat fully palletized product in final packaging, with the Queensland facility using a Cobalt-60 source and the Melbourne facility using an x-ray source. Both sites use a single conveyor that moves whole pallets of produce past the source at a controlled speed.

The existing facilities provide Australia with treatment capacity of up to 1000 pallets per day. Each facility delivers the same treatment outcome irrespective of source type but has slightly different operational capabilities and requirements. As an example, the Cobalt-60 facility in Queensland has greater treatment capacity for large volumes of a single product, while the Melbourne x-ray facility has greater flexibility to treat a wider variety of products more efficiently.

The main variables that impact the treatment dose include the source power (MeV x current (mAmps), exposure time, product configuration and density. PI enables a high level of process control that contributes to the extremely high reliability of the process.

PI is a rapid, reliable broad-spectrum solution that is increasingly significant to the security and growth of Australia's fresh produce supply chains. Compared with its alternatives, the combined benefits for industry, regulators, consumers and the environment are without precedent.

Summary of Australia's significant Development milestones

Australia has addressed many of the challenges required for PI to be accepted as a phytosanitary treatment in both domestic and international markets. Key development milestones have included the establishment of food standards allowing for the irradiation of food, establishment of the first Steritech facility in Brisbane, and development of domestic and international trade protocols. Nevertheless, Australia has taken over 20 years to reach a position where PI can now be considered a viable alternative to other phytosanitary treatments.

Figure 1. Summary of important development milestones

1999	Food Standards Australia New Zealand established Standard 1.5.3 Irradiation of Food
2002	Steritech opens the first ever whole pallet irradiator purpose built or fresh produce treatment
2004	Irradiation Protocol established for Australian mangoes to New Zealand
2005	First international shipment of irradiated produce: Australian Mangoes to New Zealand
2011	Australia domestic interstate protocol ICA-55 established
2015	USDA approval of Steritech Narangba site and pilot pathway for mangoes and lychee
2015-20	Multiple new irradiation trade protocols established with Asia-pacific trading partners
2020	Steritech opens first ever whole pallet X-Ray facility purpose built for PI
2021	Food Standards Australia New Zealand generically approve all fresh produce under Standard 1.5.3
2021	ICA-55 becomes Australia's first generic end-point-treatment for domestic fresh produce movement

DOMESTIC AND INTERNATIONAL TRADE

The Australian horticultural industry has conducted trade phytosanitary irradiation for over 17 years but has experienced significant growth and diversification of this trade over the past six years. This has been largely due to the development of food standards, new trade protocols and the establishment of a second Australian treatment facility.

Domestic trade

Until recently there has been limited use of irradiation for inter-state trade following the adoption of the Interstate Certification Assurance 55 and less than 100t of irradiated fresh produce per annum was moved between states; mostly Queensland fresh produce treated for fruit fly and shipped to Tasmania, South Australia and Western Australia. However, in 2021/22 domestic treatment volumes surpassed 1000t and is on track to exceed 3000t in 2022/23. Steritech).

Growth in domestic trade saw the types of crops accessing phytosanitary irradiation triple within 24 months. Some of the larger volume crops traded domestically include mangoes, tomatoes, summerfruit and citrus to Tasmania; citrus, summerfruit, tropical fruit and Asian vegetable lines to South Australia, and mangoes, baby broccoli and cherries to Western Australia.

Baby broccoli is an example of the use of irradiation for sealed, ice-packed vegetables and other items that cannot be fumigated effectively. The growth in use domestically has been primarily due to the FSANZ approval of Standard 1.5.3 for all fresh produce in 2021, access to the new Melbourne irradiation facility, and permission in Western Australia for use of 400 Gy as a treatment for Serpentine Leaf Miner after an outbreak in NSW and Victoria in 2020. Other factors have included the commercial and technical benefits proven through international trade, and indirectly, short term failure of some alternate pathways to maintain product quality or effective biosecurity outcomes.

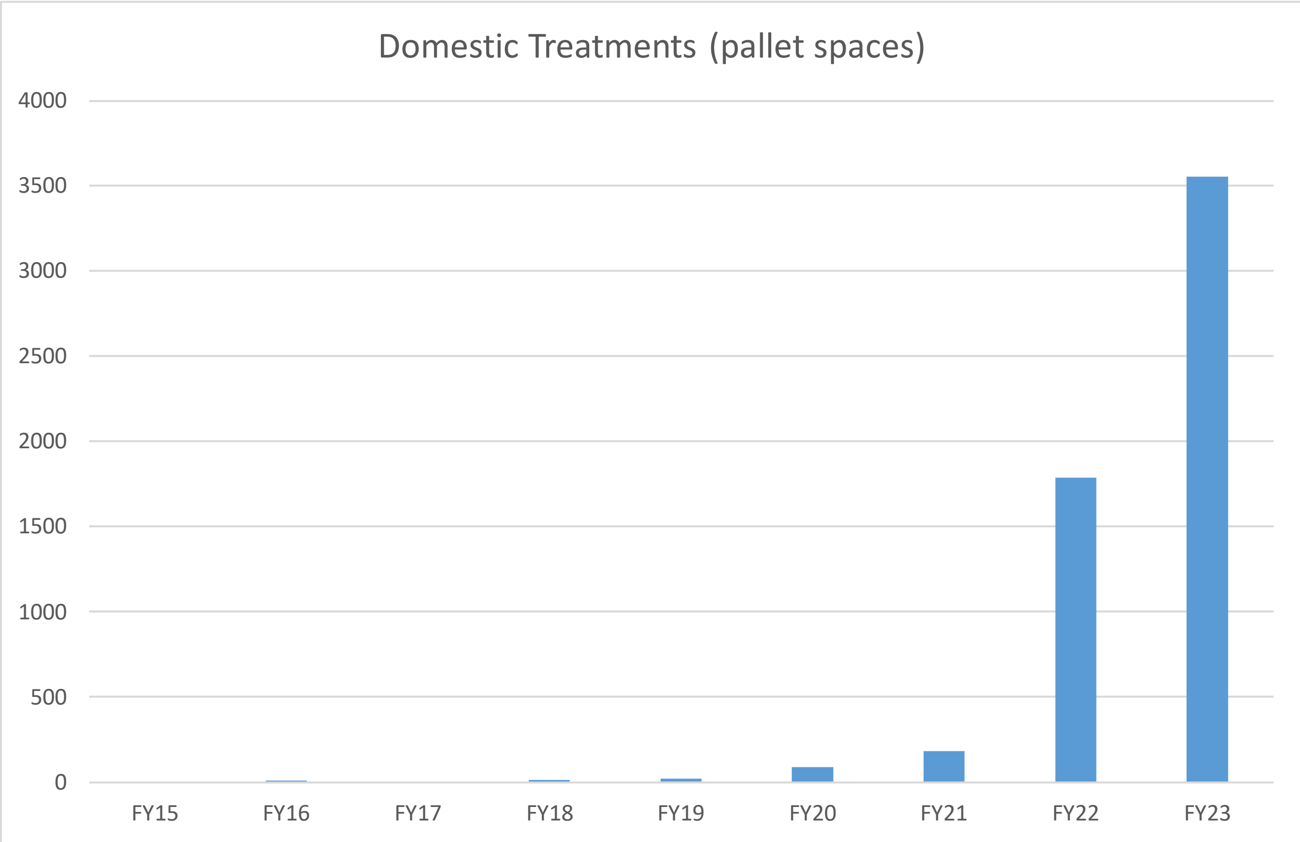


Figure 2: Total domestic treatments by pallet space of horticulture fresh produce (Data provided by Steritech Pty. Ltd.)

Significant growth in the use of irradiation is expected to continue as more supply chains become familiar with the broad benefits of the treatment option. In the past three years, the domestic market has gone from accounting for less than 1% of total phytosanitary irradiation produce treatment in Australia to now over 30%.

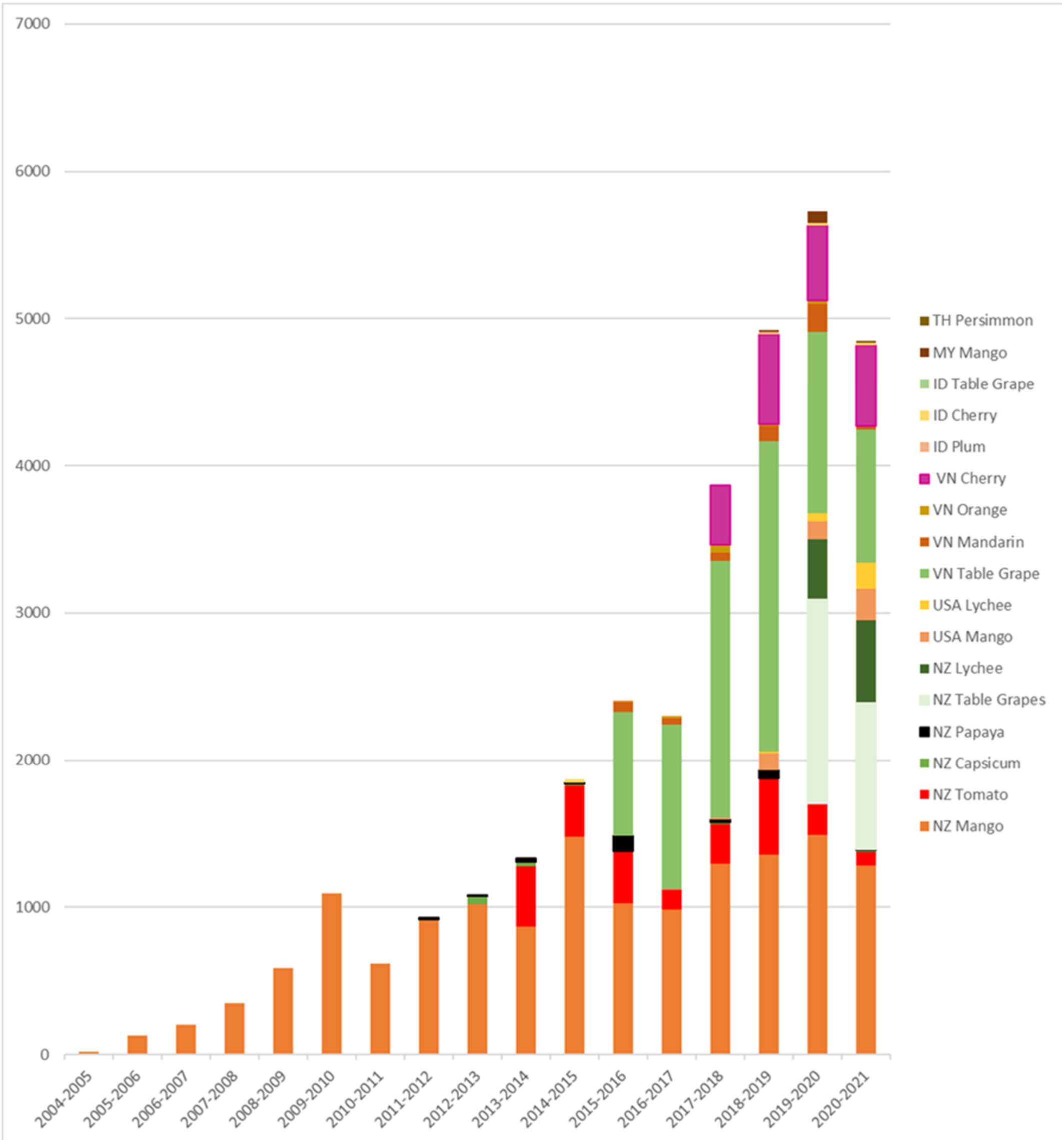
International trade

Exports

Australian exports of irradiated fresh produce to New Zealand have steadily expanded since the 2004-05 season, both in terms of volume and type of product. In recent years, export markets in the USA, Vietnam, Indonesia, Malaysia and Thailand have been developed with Vietnam a particularly successful new market. Volumes are low in several markets, however gaining market access offers the potential for future growth.

In the last three growing seasons, Australian irradiated exports have grown, averaging over 5000 pallets of fresh produce. In 2021/22, Australian businesses treated nearly 9000 pallets of produce with phytosanitary irradiation despite major disruption and cost increases to air freight during the Covid19 pandemic.

Exported crops included mango, table grape, lychee, tomato, capsicum, papaya, mandarin, orange, cherry, plum, melon and persimmon to six countries (New Zealand, Vietnam, USA, Indonesia, Malaysia and Thailand).



ID: Indonesia; NZ: MY: Malaysia; New Zealand; USA: United States; TH: Thailand; VN: Vietnam

Figure 3: Export volumes by crop and market (Data provided by Steritech Pty. Ltd.)

Growth in export volumes is largely tied to new or improved market access outcomes that have added phytosanitary irradiation as a treatment option. Growth has been mostly consistent for the past seven years as new irradiation pathways are added. Isolated events such as the temporary loss of air-freight due to the Covid 19 pandemic in 2021, and poor seasonal conditions during the summer of 2023, have resulted in temporary falls in the volume of pallets being treated.

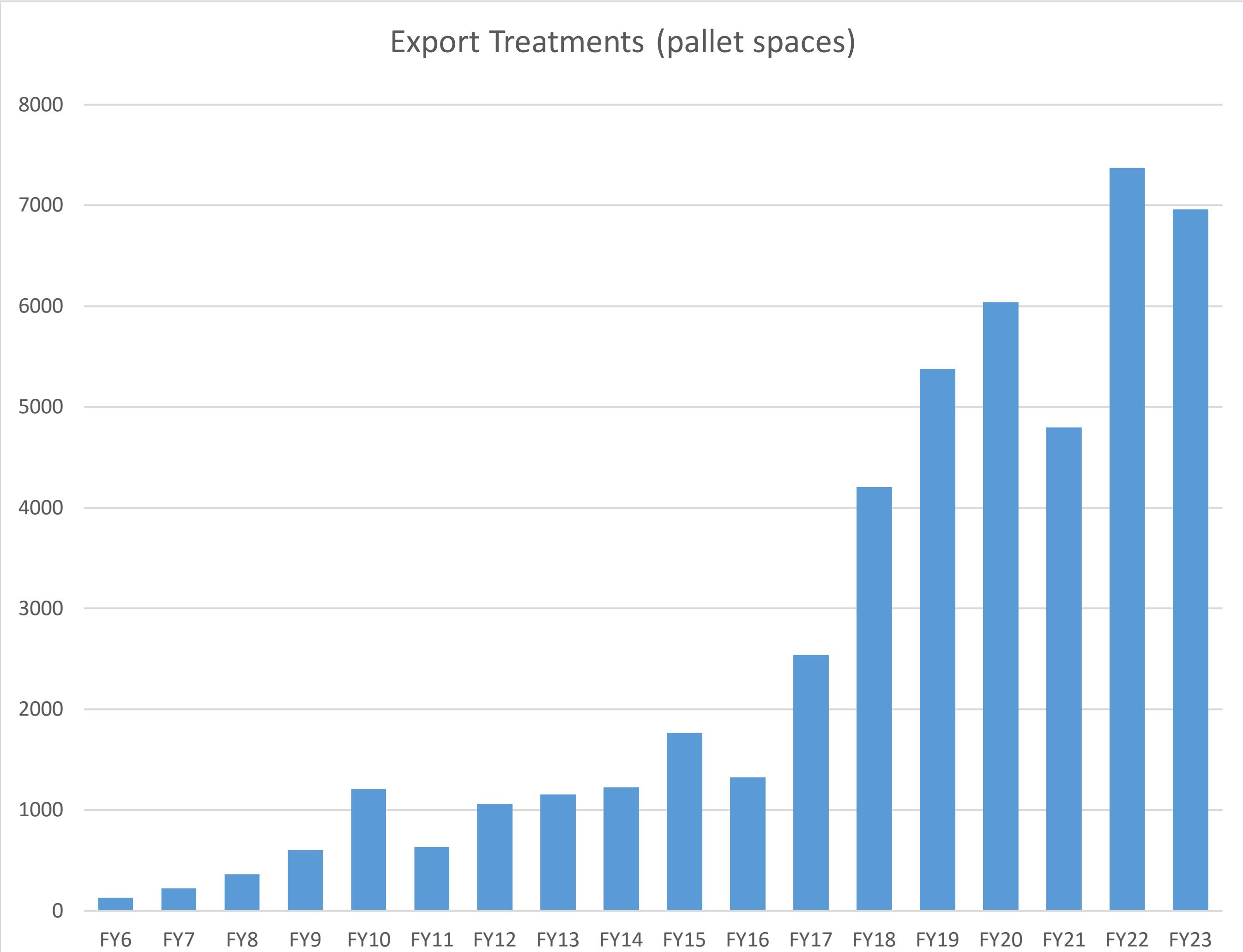


Figure 4: Total export treatments by pallet space of horticulture fresh produce (Data provided by Steritech Pty. Ltd.)

Imports

In the period 2015-2021, irradiated consignments totaling 1100t have been imported; 1067t from Vietnam and 35t from Thailand, with over 500t being mangoes, over 300t being lychees, and 200t being longan. There have also been low volumes of mango from India, Pakistan, Mexico and etrog from Israel. These low import volumes can in part be attributed to the unique ability for Australia to meet year-round fresh produce demand.

Although imports are low, it is important to recognise the value of two-way trade as a step toward harmonising global or regional regulations and providing reciprocal trade arrangements. These outcomes will ensure more productive bilateral trade relationships with our trading partners and deliver improved biosecurity outcomes for Australia.

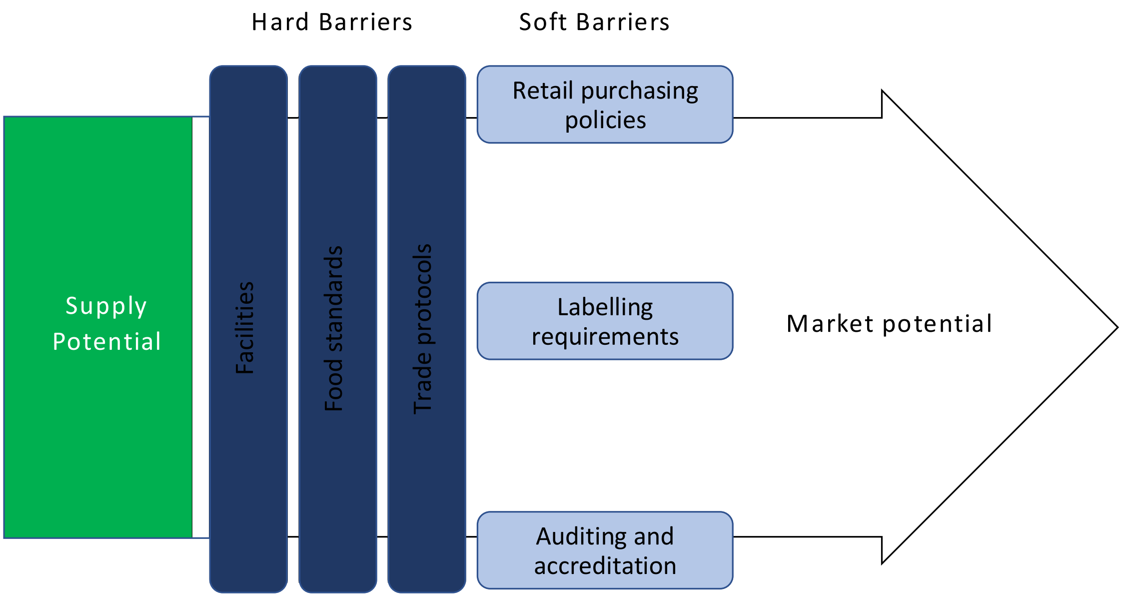
Other bilateral activities continue to support two-way trade. Organisations such as the Australian Horticultural Exporters and Importers Association (AHEIA) and Steritech Australia participate in two-way trade development projects to assist countries such as Vietnam to use irradiation pathways that supply Australia with mangoes.

CATEGORISING AND UNDERSTANDING BARRIERS

Over the past two decades, Australia has made significant progress in identifying and addressing many barriers to the commercial use of phytosanitary irradiation. As the first country to achieve international trade, there was no existing road map or formula to identify and overcome barriers. The experiences over these first two decades of development provide insights that help refine Australia's ongoing efforts, particularly in gaining market access overseas.

The barriers to phytosanitary irradiation development can be largely divided into two categories. This categorization helps develop a clearer understanding for prioritization which in turn avoids disruption and delays. The classification also highlights common barriers that can be more efficiently address across multiple crops and or markets.

Hard barriers are the first and most significant of the two categories. Unless all hard barriers are overcome, PI cannot be used commercially. Soft barriers make up the second group. These are the barriers that can throttle, delay or restrict trade even if there are no regulatory or technical barriers, but do not ever prevent it entirely. The hard barriers act like dam walls that prevent the flow of water, while soft barriers act as obstructions that slow the flow.



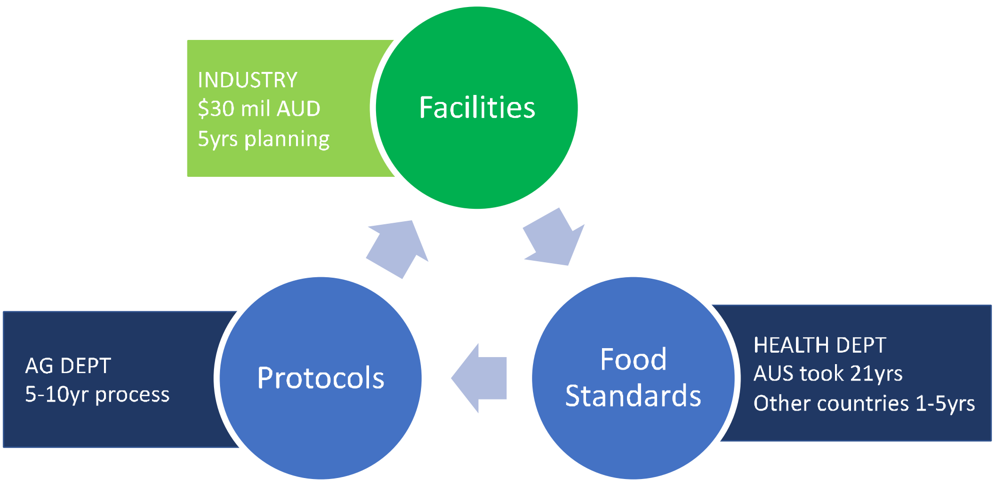
While the combination and significance of the soft barriers vary between each supply chain, the hard barriers are consistent in every case. A clear and full understanding of the hard and soft barriers enables an effective, multi-faceted strategy to realise commercially significant progress for industry.

Hard Barriers

There are only three hard barriers to the use of PI.

1. Food irradiation standards in the destination market
2. Trade protocols listing phytosanitary irradiation as a treatment option
3. Treatment facilities to service commercial trade.

In the simplest sense, if there no food standard to permit irradiation of fresh produce, then there can be no trade protocols, and without trade protocols there is no business plan for development of treatment facilities. Overcoming



ralia has a food standard that permits irradiation, a generic ICA-55 pathway and two purpose built treatment facilities.

While all three hard barriers have been addressed domestically, many export supply chains are still unable to utilize irradiation due to a lack of food standards and or trade protocols, specific to the market and crop.

Establishing food standards and protocols are two separate, technical tasks, each taking significant time and financial investment. They are regulated by different government organizations with different areas of focus and responsibility. If not pursued concurrently, the timeline to realizing commercial benefits places support from critical stakeholders at risk.

Food irradiation has been deemed safe and important by numerous scientific organizations around the world. Food irradiation standards now exist in over 60 different countries. Food standards in the remaining markets can be expedited by recognizing the research and risk assessments of other countries, rather than repeating them.

Similarly, existing trade protocols recognize the generic efficacy of irradiation which avoids the standard process of developing and reviewing efficacy data for each insect and crop. This in turn is streamlining the process to add irradiation to existing pathways and establishing new protocols.

Many countries around the world remain in a state of development paralysis due the investment and time required to over-come all three hard barriers. Communication and coordination across all stakeholder groups remains critical to achieving new markets.

While Australia’s horticultural industry has world-leading access to irradiation treatment facilities, food standards and domestic trade protocols, the same situation cannot be found for our international export markets. Hard barriers continue to be a major concern, with PI at various stages of development. Most of Australia’s export markets can be classified into one of four groups relating to their stage of development (Kingham and Roberts 2022):

1. Markets with no food irradiation standard and no irradiation trade protocol (e.g., Japan, South Korea)

2. Markets with a food irradiation standard but no irradiation trade protocols (e.g., China, Philippines, Singapore)

3. Markets with a food irradiation standard that already export irradiated (e.g., India, Pakistan)

4. Markets with a food irradiation standard and irradiation trade protocols s (e.g., Vietnam, Thailand, Indonesia, Malaysia)

Different approaches are required to address trade development opportunities in each group for irradiated fresh produce, however the level of difficulty in achieving market access for new commodities is highest for group 1 and lowest for group 4. Group 1 are clearly some of our most important trading partners, however significant barriers must be overcome in the medium to long term (5-10 years) before trade is likely to occur. At the opposite end, Group 4 provide a much easier path to seek grow the volume and variety of commodities treated with PI.

Soft Barriers

In most cases, soft barriers restrict, rather than block trade in Australia. They are often the result of subjective policies implemented by businesses who do not consider PI as an acceptable phytosanitary treatment. Nevertheless, attitudes toward PI continue to improve in response to increasing success in the marketplace and ongoing efforts by government and industry to promote the strengths and benefits of PI.

Consumer Marketing and Acceptance Concerns

Sales and marketing of goods treated with PI was once viewed as a risk by many businesses in Australia. In 2023, many of these businesses now use PI on a routine basis. The growth in volume and diversity of trade has done much to disprove the long-term concern about consumer resistance.

Although consumer marketing is a task best managed by industry marketing experts and their businesses, allowing consumer marketing to potentially disrupt domestic biosecurity and trade should be avoided and addressed when necessary.

Examples of existing trade have increasingly helped to turn the tide on negative opinion. While producers, marketers and buyers of fresh produce are focused on business-to-business related activities, there is an important opportunity to provide examples of successful consumer marketing that focus on the product quality, biosecurity and sustainability benefits associated with PI.

Retail Buying Policies and Irradiation.

There are few businesses in Australia that maintain an active policy against the use of irradiation. Unfortunately, this minority includes Australia’s two largest supermarkets chains who established policies preventing suppliers from using the treatment in the early 2000’s out of concern for consumer acceptance.

Since then, the issue has stagnated with no clarity from either retailer on how the policy can be reviewed or reversed. While many growers and supply chains have gone on to realize the benefits of the treatment, they are forced to use less desirable and effective chemicals and fumigants. While unintended, this policy has greater implications for effective biosecurity and sustainability as well as safety and food quality.

Labelling Requirements of Irradiated Food

Most countries adopt or adapt the Codex Standard for Irradiated Foods (CAC, 2003) which requires irradiated food to be labelled. FSANZ Standard 1.5.3 requires labelling of the treatment to enable consumer choice (FSANZ, 2021). While there is labelling requirements for phytosanitary irradiation, there are no equivalent labelling requirements for alternate treatments such as methyl bromide and dimethoate.

The additional labelling requirements on irradiated products do add significant operational cost and complexity which creates a genuine challenge for industry. The cost and complexity of these labelling requirements impact all segments of the supply chain, from grower through to retailer.

The lack of labelling requirements for other treatments has created an unintended outcome that has slowed the uptake of a new and sustainable technology.

Importantly there are now numerous wholesale and retail businesses in Australia that have adopted novel instore approaches to signage, rather than employ more costly piece-based labelling. These approaches show the way forward for the retail sector under the current food standard.

However, in the longer-term, consideration should be given to remove the requirement for labelling of fresh products treated with PI, primarily as an incentive to move toward more sustainable treatment technologies, but also to reduce any unnecessary cost to consumers, supply and retail chains.

Post-Harvest Research

Research conducted by post-harvest experts such as Golding et.al (2022) in Australia and others internationally, continue to provide more detailed and thorough findings. The independence and expert nature of this research has helped validate the treatment and build trust throughout the wider Australian industry.

Informal trials have also been conducted by Steritech with industry leading businesses to assess and confirm the post-treatment quality for fresh produce, with a view to building long term trust in the treatment. The domestic ICA-55 pathway has also proven a low-cost, low risk way to gain real-world commercial feedback from wholesalers and retailers on the commercial viability and quality outturn of different varieties of fresh produce treated with phytosanitary irradiation.

While irradiation is broadly considered to have little or no impact on shelf life and quality of fresh produce, commodities including avocados and select varieties of citrus have suffered skin blemishing at high treatment doses. Ongoing research is required to better understand, manage and ultimately prevent such impacts on quality.

Importantly, research needs to be carefully planned and analysed if outcomes of commercial significance are to be delivered to industry. In particular, pre- and post-harvest management conditions should be recorded along with non-destructive quality and maturity measures prior to any treatment. This will help to differentiate any potential quality issues resulting from pre- and post-harvest management as opposed to the treatment itself.

Operational Development and Change

Across Australia's horticultural industry, many growers face difficulties associated with having a single crop per season and/or being remote from a phytosanitary treatment facility. Access to a phytosanitary treatment facility can therefore dictate the available supply chain for many commodities across Australia, whether they be focused on domestic or export markets.

As an example, to switch from on farm spray and inspection procedures under ICA 21 (Agriculture Victoria, 2022b) to using end point treatments (methyl bromide & phytosanitary Irradiation) meant that growers needed to plan additional transport to access the treatment and make bookings for the treatment. At the same time, switching to an off-farm end point treatment has removed significant on farm compliance and cost.

These challenges continue to be addressed through 'how to' and FAQ information on the treatment and its net benefits, which is being produced by state and Commonwealth governments as well as private industry. Private industry is also working to simplify freight through routine consolidated services to Adelaide and to engage with regulators to continually improve existing pathways for operation efficiency without compromising biosecurity outcomes. Based on these ongoing efforts, phytosanitary irradiation continues to see new businesses and supply chains adopt the treatment in Australia.

Cost Perceptions

Products and services commonly face comparison based on price. To some, comparing biosecurity solutions, particularly end-point-treatments can be like comparing apples and oranges. When compared with fumigation or cold disinfestation, the base cost for PI is often considered to be equal or higher cost. However, for many growers and supply chains, distance to a PI treatment facility in Melbourne or Brisbane can add significant cost.

Nevertheless, there are other costs that should be considered beyond the base treatment and freight costs. With other phytosanitary treatments, there is the possibility of treatment recalls and impacts to quality and shelf life that may impact returns.

For high value crops like Australian cherries and grapes being shipped to Vietnam, or Australian lychees to the USA and New Zealand, accessing air freight is a major point of differentiation for Australian producers competing against sea freight. The Australia product is often worth more than $10,000 per pallet. Using PI allows the cold chain to be maintained, benefitting product quality and shelf life.

There is also a higher risk that a temporary loss of market access may occur if there are multiple detections of live insects using alternative phytosanitary pathways, this can have industry wide economic impacts.

CONCLUSIONS

Phytosanitary Irradiation is one of only a few end-point treatments available to the Australian horticultural industry that helps manage biosecurity and build secure trade. When compared with alternate end-point treatments or systems approaches, phytosanitary irradiation is considered a more reliable, enduring, and sustainable end-point treatment.

Over the past five years, Australian trade facilitated by phytosanitary irradiation has experienced significant growth in both volume and diversity. Today, phytosanitary irradiation is used to regularly treat over 60 different horticultural crops, destined for six export markets and multiple domestic markets. The growth in trade now necessitates a more focused and strategic approach to address commercial barriers to adoption.

While concerns around consumer acceptance have been a notable distraction to domestic development efforts in Australia, the growing trade volumes in each crop and market have continuously disproven consumer resistance. Domestically, we understand that we must attend to the last few soft barriers that exist and establish a strategy to overcome them. We now have many examples of success, and these case studies should be used to promote the benefits of phytosanitary irradiation to industry and retail businesses who do not understand the benefits of PI.

In the simplest form, Australia has some the world's best access to treatment facilities, however distance to treatment facilities can be restrictive. To overcome this restriction, significant increases in trade volumes are required before new facilities can become viable.

For export markets, trade is dependent on the presence of food irradiation standards and trade protocols. Not all of our major trading partners have established the required food standards that allow fresh produce treated with PI to be sold. Without the pre-requisite food standards, no trade protocols can be negotiated. Consequently, hard barriers continue to be a major concern for export markets. Most of Australia's export markets can be classified into one of four groups relating to their stage of development:

1. Markets with no food irradiation standard and no irradiation trade protocol (e.g., Japan, South Korea)
2. Markets with a food irradiation standard but no irradiation trade protocols (e.g., China, Philippines, Singapore)
3. Markets with a food irradiation standard that already export irradiated (e.g., India, Pakistan)
4. Markets with a food irradiation standard and irradiation trade protocols s (e.g., Vietnam, Thailand, Indonesia)

Different approaches are required to address trade development opportunities in each group for irradiated fresh produce, however the level of difficulty in achieving market access for new commodities is highest for group 1 and lowest for group 4.

RECOMMENDATIONS

The following actions are recommended as options to address barriers to domestic and export market access for fresh produce treated with PI.

Domestic market access

Improve awareness for effective inclusion of irradiation in Australia's domestic market access and export strategies.

- Generate audience specific messaging focused on the benefits of PI.
- Develop reference materials to support online and third-party distribution.
- Promote stakeholder collaboration promoting a united national, multi commodity, multi market focus.
- Increase investment for irradiation R&D, balanced against the ongoing investment in other end point treatments.
- Host periodic Australian irradiation events and increase Australia's participation in international events.

Strengthening Australia's Domestic Biosecurity

- Continue with existing state and Commonwealth efforts to evaluate the benefits and viability of moving irradiation from ICA, into a new parallel system that harmonises with the commonwealth auditing and certification process.
- Summarise the toolbox of biosecurity solutions Australian industry has, including the benefits and limitations of each to highlight the strategic importance of PI to trade and biosecurity.

Future Proofing Biosecurity and Market Access

- Develop a sustainability paper on the benefits and future potential of irradiation in comparison to other existing solutions.
- Host an industry workshop to complete an export trade SWOT analysis, identifying where irradiation is a strategic preparedness tool.

International market access

Food Standard Development

- Summarise food standard development progress around the world based on available information.
- Establish a list of regional food standard organisations, experts and stake holders.
- Form a core group of Australian stakeholders to pursue food standard development.
- Establish a multi-faceted strategy to engage trading partners and relevant regional authorities to identify and support food standard development.

Export Market Access Development

- Complete a multi-market, multi-commodity review of the Australia's existing use of irradiation, current market access development priorities and a vision of future trade and biosecurity needs, to identify common goals and priorities.
- Facilitate two-way and multilateral capacity building events and activities to strengthen relationships and identify opportunities to expedite market access priorities.
- Identify opportunities to enhance existing generic data sets to include non-insect pests and integrate Australia's existing efforts with ones in the wider international community.

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