AUSTRALIAN PROCESSING TOMATO

Grower.

RESEARCH & REPORTING ANNUAL JOURNAL VOLUME 46, 2025

SOIL DISEASE RESEARCH

IMPLICATIONS FOR MANAGEMENT AND FUTURE RESEARCH

APTRC CULTIVAR TRIALS

ANNUAL INDUSTRY SURVEY

PUBLISHED BY THE AUSTRALIAN PROCESSING TOMATO RESEARCH COUNCIL INC. ISSN 1322-8617

Intro

The APTRC is once again pleased present this publication as a record of the industry's research and development program and major events.

We also thank all the businesses and agencies that support these activities.

This issue's cover:
'Mark Sargeant OptiAg keeping oversight on trial planting at Yalca with GoFarm planting crew.'

With thanks

Special thanks to our contributors for this issue and the dedicated team of people who work on the magazine and reporting each year.

Contributors include:

Charles Hart
Andrew Ferrier
Mark Cashin
Matthew Stewart
Susie Murphy White
Kate Armstrong
Mark and Sarah Sargeant
Tania Zhang
Alexandre Fournier-Level
Hanyue Feng
Jiajing Cao
Jason Risteski
Paul W.J Taylor
Sigfredo Fuentes
Alexis Pang
Niloofar Vaghefi

Editor:
Matthew Stewart

Design:
Kylie Norton Design

Notice to Contributors for future editions:
Authors wishing to contribute articles to the next 'Australian Processing Tomato Grower' should submit copy to IDM, Matthew Stewart at APTRC Inc., aptrc.idm@outlook.com

Contents

Chairmans report 2025

Charles Hart
Chair, Australian Processing Tomato Research Council Inc.

The past season gave the industry something it hasn't had for a few years, a relatively straightforward season in the field. After several seasons shaped by storms, flooding and unpredictable harvesting conditions, growers finally experienced a period that was largely free of major disruptions. This stability translated into strong, consistent crops across most regions, and it showed in both the tonnage and the quality delivered. It wasn't a perfect year, but it was a reminder of what Australian production looks like under reasonable conditions.

One notable item picked up in the annual industry survey this season was the increased confidence in a broader range of cultivars from multiple seed companies. Growers are moving toward cultivars with improved genetics and disease resistance packages, and the APTRC trial program continues to play a practical role in supporting those decisions. The trial data coming out of the early and mid-season sites, combined with screening work, is giving growers and processors more confidence when assessing performance and risk. It also positions us better in terms of seed security, which remains a significant pressure point due to current biosecurity settings and international supply constraints.

Processor requirements continued to evolve. SPC and Kagome are still dealing with the effects of high inventories and market compression, with global producers processing significantly more than anticipated. The reduced Australian processor forecast for this coming season highlights the ongoing imbalance between global supply and domestic market opportunity.

The extension activities delivered under the TM20000 project played an important role again this year. Field days, the annual Forum and region-based events remained well attended and relevant. The quality of discussions between growers, agronomists and processors were able to compare approaches, challenge assumptions and keep refining the fundamentals. The Portugal–Spain study tour in August also added perspective on how other countries are adjusting to cost pressures, climate variability and global processor and customer expectations.

Biosecurity developments added another layer of complexity to the year. The decision to stand down the national ToBRFV response means the sector is now operating in a long-term management phase rather than eradication. This shift requires ongoing adjustments in offshore and local seed testing and the APTRC will continue to work with growers, processors and State and National Authorities to ensure expectations are clear and workable. Other emerging pests remain on the radar, though none have impacted processing tomatoes at this stage.

The agronomic performance last season was welcome, but the surrounding commercial landscape remains complex. The role of the APTRC remains to undertake appropriate research to allow us to support sound and profitable on farm decision-making, maintain the industry's co-operative culture and help advocate for our Australian products.

I want to acknowledge the great job done by the growers and processors during these more challenging times and the continued supporting role that our IDM, Matt Stewart continues to deliver. I'd also like to again thank the voluntary time the committee members give as they help to keep the APTRC focused on contributing in a meaningful and sustainable way.

Charles Hart
Chair, APTRC Inc.

Commitee members

Our dedicated committe members:
L-R Nick Raleigh, James Weeks , Chris Taylor
Andrew Ferrier, David Chirnside, Matt Stewart
Stuart McColl, Charles Hart

Field report Kagome

Mark Cashin
Field Logistics Manager, Kagome

Kagome successfully concluded its 2025 tomato harvest, delivering 172,210 payable tonnes — equivalent to 93 percent of the targeted 185,820 tonnes. The harvest covered 1,736 hectares, with 1,196 hectares in Victoria and 541 hectares in New South Wales, cultivated across five growing entities. Average yields reached 99.2 tonnes per hectare, supported by a Brix level of 5.25, ensuring premium quality for processing.

A total of 21 tomato varieties were grown, underscoring the industry's commitment to varietal diversity and resilience. The long-standing H3402 cultivar remained dominant, accounting for nearly 40 percent of the planted area, followed by H1015 at just under 20 percent and UG16112 at slightly more than 8 percent. This varietal mix reflects a strategic approach to meeting diverse end-product requirements while adapting to varying soil types and seasonal conditions.

Harvest operations commenced on 28 January and concluded on 13 April, spanning a record 76 consecutive days of uninterrupted factory production. This milestone underscores Kagome's robust logistics and planning capabilities, enabling seamless operations without disruption from adverse weather events.

Seasonal conditions were notably more favourable than in recent years. Echuca recorded approximately 190 mm of rainfall from the beginning of planting through to the end of harvest, a marked improvement compared with 307 mm in the 2023/24 season and the exceptionally high 454 mm recorded during the challenging 2022/23 season. The more moderate rainfall contributed to a stable harvest schedule and consistent product quality, reinforcing the benefits of improved seasonal predictability.

Looking ahead to 2026, Kagome faces an increasingly challenging market environment. A global surplus of processed tomato products is exerting downward pressure on pricing and intensifying competition around quality and value. These dynamics will result in a reduced planted area for the 2025/26 season, as the company seeks to avoid excess inventory.

In response, Kagome remains focused on innovation and sustainability. Priorities include diversification through new product development, utilisation of waste streams, enhanced processing efficiencies, and strategic planning to safeguard competitiveness. These initiatives reflect the company's determination to secure its future in an increasingly complex tomato processing landscape.

Mark Cashin
Field Logistics Manager, Kagome

Field report SPC

Andrew Ferrier
Field Manager, SPC

With the wild weather events of the previous seasons behind us, the Australian Processing Tomato Industry entered the 2024-25 season full of hope for more favourable growing conditions and a strong market recovery.

With the fallout still being felt from the weather induced low production year that was the 2023 season, which led to market losses in 2024 and subsequent high inventory levels in SPC warehouses, 2025 became a year of consolidation as SPC reduced their requirement significantly from years past. Just 30,000 tonnes, a 40% reduction in contracted volumes from the previous year, were sought by SPC.

With industry icon Bruce Weeks retiring from the industry after 40+ years, SPC were left with 3 contracted growers. A total of 288Ha was planted with UG16112 taking over the mantle as the most planted variety (41%) with H1015 (36%) and H3402 (22%) making up the balance.

Planting began at the beginning of September in the Boort region and early October at Rochester and Corop with early blocks getting away steadily. The Spring weather was much more stable than previous seasons, devoid of the extreme events experienced in previous years. Planting continued largely uninterrupted wrapping up in early November. Plant growth throughout Spring was steady but with notable size variation within many blocks. Several rain events between mid-November and early December, totalling around 90mm in the Rochester area, set back growth in some fields while signs of root disease began to emerge in other areas which would ultimately affect those fields' yields. That was to be the last of the rain, however, as paddocks began to recover to the point where growers were confident of achieving contracted tonnes when earlier, that looked anything but possible. By the end of December paddocks really began to fire with the best fields setting up incredibly well.

Harvest began at Corop on the 5th of February with Rochester and Boort starting 2 and 5 days later respectively with the first paddocks yielding as predicted but as the harvest rolled on, it became clear that all yield expectations would be exceeded. With warm to hot conditions throughout the harvest period and only 2 minor rain events that stopped harvesting at Rochester for a combined total of 1 day, no processing days were lost. Issues with manufacturing caused several disruptions with an unplanned 3-day stoppage over the long weekend in March creating a significant issue with over-ripe fruit, to the point where a portion of the Boort area had to be abandoned as we fell behind the quickly ripening, high yielding crop. Another 2-day breakdown at the end of March also caused headaches as growers were desperately trying to complete the harvest of crops that were now well past their prime. Despite the setbacks, growers were able to complete the harvest on the 9th of April. Paddock yields varied, ranging from a low of 68T/Ha up to an impressive 192T/Ha with areas within blocks exceeding the magical 200T/Ha mark!

38,801 nett tonnes were processed through the SPC facility in 2025, 129% of the contracted volume, the highest on record for SPC growers. Average yield across the 284.4 harvested hectares was 136.5T/Ha at 5.53°brix average, both also SPC records. UG16112 accounted for 46% of the intake, H1015 33%, and H3402 21%. Quality for the most part was very good.

Ongoing high cost of living pressures and an abundance of cheaper imported product on the supermarket shelves continue to place enormous pressure on Australian processors. As SPC continues to consolidate their position in the marketplace, a further reduction in contracted tonnes for 2025 is unavoidable. After a year of record yields, it is hoped that another good year in the field can be matched by a strong year of sales and SPC and the Australian Processing Tomato industry as a whole can return to a position of strength and profitability.

Andrew Ferrier
Field Manager, SPC

Hort Innovation update

Susie Murphy White
Industry Development and Innovation Manager

In FY24, the horticulture industry's gross value production (GVP) was valued at $17 billion, producing 6.9 million tonnes of fruit, vegetables, and nuts. It's now the third-largest agricultural industry by value, behind grains and red meat. But to maintain this momentum, productivity must be front and centre - not just in terms of how much we grow, but how we grow it.

The Factors Driving Horticulture Productivity report, released this year, found that adoption of productivity enhancing innovation in the horticulture industry could generate up to an additional $1 billion annually in value added, reaching $22 billion in 2040.

The report outlines four key areas for action - building capability in production cost analysis, automating data collection, harnessing AI-driven insights, and embracing mechanisation and automation at scale. These are practical pathways to help every grower, no matter the size of their business, farm smarter and more profitably.

One productivity related project we look after is the TM20000 project, funded by Hort Innovation. It is the cornerstone initiative for the Australian processing tomato sector. Supported by a voluntary R&D levy, government contributions, and APTRC in-kind support, it delivers targeted research, development, and capacity-building solutions to enhance profitability and sustainability for processing tomato businesses.

This year, the project is in its final year, with planning underway for the next phase. It is fully funded until August 2026, aligning with the Strategic Investment Plan. Regular field day events and an annual forum facilitate direct engagement with growers, ensuring the project remains responsive to industry needs. The project has delivered annual trials to evaluate new cultivars, quarterly newsletters, field days, industry forums, international study tours, an annual magazine, and a comprehensive annual industry survey on production and consumption. The project has fostered collaboration between growers and processors, creating a cohesive industry capable of adapting to change and driving innovation.

The objective for the next industry development project after consultation earlier in the year is set to focus on the following.

Increase productivity per hectare sustainably

Research and adopt advanced agronomic practices, including optimised crop rotations and precision farming techniques.

Integrate sustainable resource management strategies for soil health, water efficiency, disease management, weed management and reduced environmental impact.

Accelerate innovation and technology adoption

Investigate AgTech, AI, and autonomous solutions to improve operational efficiency and data-driven decision-making.

Facilitate technology and trial demonstrations through field days and forums to drive industry-wide adoption.

Strengthen industry capability and collaboration

Build capacity through training, knowledge-sharing platforms, and partnerships with global tomato research networks.

Foster collaboration between growers and processors to align RD&E outcomes with market needs.

In September, I had the opportunity to visit several growers in Northern Victoria after the APTRC committee meeting. These in-person discussions provided valuable insights into current industry practices and challenges. I appreciated the chance to engage directly with growers and deepen my understanding of the sector. I look forward to future visits, particularly during the cropping season, to further strengthen industry relationships and support ongoing development.

The delivery of this industry development project continues to excel and steer the industry in the right direction. It is pleasing to see that the processing tomato industry is resilient and robust.

Susie Murphy White Industry Development and Innovation Manager

Contact and Further Information

For further details or to discuss the project, contact:

Susie Murphy White
(Industry Development and Innovation Manager)
Susie.Murphy-White@horticulture.com.au

Mark Spees
(Industry Services and Delivery Manager)
Mark.Spees@horticulture.com.au

More information and project outcomes are available on the **Hort Innovation website**

Hort Innovation

The voluntary processing tomato R&D levy was established for investment through the processing tomato collective industry fund (CIF), now known as the Hort Innovation Processing Tomato Fund.

Profit & Loss

Australian Processing Tomato Research Council Inc
For the year ended 30 June 2025

	RESEARCH	HORT INNOVATION
Trading Income		
Levies	211,001	-
Total Trading Income	**211,001**	**-**
Cost of Sales		
Grower Levies - Hort Innovation	123,481	146,631
Total Cost of Sales	**123,481**	**146,631**
Gross Profit	**87,520**	**(146,631)**
Other Income		
Interest Received	326	42
Profit on Sale of Plant & Equipment	14,300	-
Total Other Income	**14,626**	**42**
Operating Expenses		
Accounting	313	-
Audit	1,800	-
Bank Charges	125	-
Biosecurity	1,500	-
Consultant Fees	1,688	-
Depreciation	13,888	-
Donation - Hort Innovation	20,313	(20,313)
Fringe Benefits Tax	3,168	-
Internal Event	4,005	-
Meeting Expenses	646	-
Memberships & Subscriptions	2,161	-
Projects - Melbourne University Hot Water Treatment	49,591	-
Projects - Melbourne University PhD Hanyue	10,000	-
Study Tour (USA) - Reimbursements	525	-
Training	4,000	-
Travel Expenses	2,320	-
Total Operating Expenses	**116,044**	**(20,313)**
Net Profit	**(13,898)**	**(126,276)**

TM20000 Processing tomato industry development and extension

Matthew Stewart, Industry Development Manager, APTRC

INTRODUCTION

The overall objective of this project is to deliver effective research, development, and capacity building solutions to the Australian processing tomato industry, with the goal of improving profitability and sustainability.

The opportunities for this project encompass to following:

1. Increasing the reach of the processing tomato industry R&D program by engaging stakeholders in the R&D process, including on-farm trials.

2. Effectively communicating R&D outcomes and applicable industry information to Australian processing tomato businesses and assisting with adoption of relevant R&D.

3. Being actively involved with the relevant stakeholders, including seed suppliers into Australia, to facilitate the importation process.

4. Collecting industry benchmark data and statistics to track changes, help identify gaps and direct industry development efforts.

5. Identifying, and securing where possible, other funding sources (including through cross-industry projects) to support R&D and extension aimed at industry development.

The target audience for these activities is primarily the processing tomato growers and farm managers. However, the project is also very active in engaging advisors and professional industry stakeholders, due to their extension roles in industry.

TM20000 ACTIVITIES AND OUTCOMES

Annual APTRC Forum

The highlight of the annual extension program is the APTRC Forum, which was successfully held on Friday, May 16, 2025, at the Rich River Golf Club in Moama. The forum attracted 53 delegates, while the follow-on dinner was attended by 37 industry members and partners.

Throughout the day, 9 speakers presented on a variety of topics across three sessions; including crop rotations, cultivar trials, soil disease, seed treatment, water, processing and employment. The speakers were complimented by a keynote from David Lamb of the Food Agility CRC and an end of forum panel. Feedback from participants indicated that the new format set a new standard for the quality and value of the annual event.

The evening dinner provided an additional opportunity for growers, processors, suppliers, industry experts, and university academics to further discuss and consolidate the day's learnings.

Field Days

During the 2024/25 season, both scheduled crop inspection field days were successfully held.

On Wednesday morning, 11 December 2024, an irrigation flushing, and chlorination demo was held at Graeme and Michelle Lawrence's Leaghur property, attended by 14 industry members plus Agriculture Victoria and Netafim staff, ahead of the Boort & Boga Tour. The training topics discussed can be found here. Drip-System-Maintenance-and-Monitoring.pdf

On the afternoon of December 11th, the Boort & Boga crop inspection day saw active participation from 45 individuals, focusing on seeded vs transplant crops, cultivars, growing practices and problem areas. This event was followed by an evening dinner for 37 members at the Mystic Park Hotel.

On Friday January 17th, the Netafim-sponsored Rochester Tour attracted 58 members. The tour incorporated a visit to Gilleston Fresh Produce, a local fresh market tomato grower's property as well as a drone spraying demonstration at Kennedy Agricultural and finished with a cultivar trial visit at Campaspe Ag in Rochester. Following the tour, an Industry Dinner at Rich River Club, Moama welcomed 94 members, which included partners and children.

A comprehensive record of these discussions is available in the December 2024 and March 2025 editions of Tomato Topics under the Information for Industry tab.

Processing Tomato Cultivar Evaluation

Operating across five commercial sites this season, the APTRC cultivar evaluation program included two early-season and four mid-season machine-harvest trials, supported by three screening sites co-located with mid-season locations. In total, 15 early-season and 18 mid-season cultivars were assessed, with screening plots used to identify lines suitable for next year's replicated trials through visual evaluation by Ann Morrison and Bill Ashcroft.

Early-season yields varied significantly across sites, but identified some new cultivars that outperformed the standard. Mid-season trials showed more weather-related variation, yet Rochester delivered strong, consistent yields, again with some cultivars outperforming the industry standard. Several cultivars achieved higher Brix or improved colour, particularly the Very High Lycopene lines. The direct-seeded mid-season trial yielded higher than industry averages, with cultivars performing similarly across quality traits.

These results continue to build the industry's multi-year cultivar performance database and highlight the need for ongoing access to diverse genetics. With seed timing still affecting trial structure—particularly for screening entries—collaboration with seed companies and host growers remains vital to ensuring a strong pipeline of suitable cultivars for future seasons.

Industry Publications

The longstanding industry newsletter, "Tomato Topics," has been a vital component of the APTRC's capacity-building initiatives. Current issues are accessible on the APTRC website. Additionally, past editions of the "Processing Tomato Grower" Magazine, which provide detailed accounts of APTRC's seasonal work, are available online.

The APTRC's online R&D database was revised this season to modernise its functionality as it continues to provide value as a comprehensive and searchable platform for industry researchers, growers, and service providers. This resource enables a thorough review of past findings, thereby enhancing the value of previous R&D efforts.

Annual Industry Statistics

The data compiled for the annual report is a crucial industry resource, vital for monitoring, evaluation, and project planning in line with local and global trends. This information is published as an independent document, available on our website, and prominently highlighted in the annual Processing Tomato Grower magazine. Additional details can be found in the related article within the magazine.

Assessment of Emerging Crop Threats and Industry Communication

Ongoing engagement with Plant Health Australia and other relevant biosecurity authorities aims to deepen our understanding of the challenges related to seed imports and to explore effective solutions. Collaboration with processors, growers, and Hort Innovation is essential to our collective efforts in managing risks and improving national seed security.

As a signatory to the Emergency Plant Pest Response Deed, the APTRC remains closely involved in national arrangements for managing Tomato Brown Rugose Fruit Virus (ToBRFV). After detections across South Australia, Victoria and NSW, the National Management Group determined in mid-2025 that eradication was no longer technically feasible and formally stood down the National Response Plan in September. Efforts have now shifted to long-term management, including strengthened seed-testing requirements, revised interstate movement controls and support for growers implementing strict on-farm hygiene.

South Australia has declared state-wide area freedom, while Victoria and NSW maintain movement controls for fruit from affected properties.

Governments, industry and the APTRC continue working together to limit spread, protect markets and provide clear guidance for growers.

The processing tomato industry also continues to engage with other plant industry groups through PHA member meetings to monitor for recently established pests such as Tomato Potato Psyllid, Fall Army Worm, and Serpentine Leaf Miner, while staying updated on the latest management recommendations for Silverleaf White Fly and Tomato Yellow Leaf Curl Virus.

The APTRC is also keeping an eye on Guava Root Knot Nematode and maintaining links with organisations undertaking surveillance for potential incursions of Brown Marmorated Stink Bug. To date, none of these new threats have been identified in the processing tomato industry.

Promoting Awareness of the Australian Processing Tomato Industry Locally and Internationally

In my capacity of Australian IDM, I have continued the voluntary role of president of the Research Commission for the World Processing Tomato Research Council (WPTC). This role involves directing the WPTC research group focus and helps to strengthen connections globally for the betterment of global and local industry.

The IDM role is a crucial liaison for the processing tomato industry, centralising information, coordinating efforts, and promoting innovation. Locally, this involves active participation in key industry networks such as the Horticultural Industry Network (HIN), the Austral-Asia Pacific Extension Network (APEN), and Plant Health Australia (PHA). APTRC staff also actively collaborate with researchers from Australian universities, particularly The University of Melbourne and Deakin University.

Additionally, the APTRC maintains strong connections with departmental institutions, including state Departments of Primary Industries (DPIs) and Biosecurity Australia.

Projects Extended During TM20000 and Funded by APTRC or External Sources

Although much of the RD&E in the processing tomato industry is directly funded through APTRC committee projects, disseminating information from these initiatives is crucial for industry development and forms a significant part of TM20000 activities. This dissemination is supported by the Hort Innovation TM20000: Processing Tomato Industry Development and Extension Project.

Extension activities include sharing results from various projects, such as ongoing research at the University of Melbourne and Agriculture Victoria.

Portugal and Spain Study Tour

In August 2025, under the management of the APTRC IDM and with the support of several global industry connections from Portugal and Spain, 11 industry members—including growers, processors, and agronomists from Australia —participated in a study tour.

This week-long tour fostered global and local industry connections, highlighted global system management practices across two different countries, particularly in regard to different soil types, water quality scenarios and different growing methodologies. The Portugal site visits leveraged Kagome's processing and grower connections in the main growing regions and the Spain trip was arranged from associations gained from attending the world congress and via the Research Commission role. The IDM role and TM20000 project has been instrumental in helping extend the learnings from this trip.

Acknowledgments

The APTRC sincerely thanks processing tomato growers and processors for their unwavering support. Special appreciation goes to Mark and Sarah Sargeant of OptiAg for their excellent trial work and Kagome, for their assistance with the trial programs. Genuine thanks again go to the dedicated APTRC committee members who consistently step forward to undertake the diverse duties essential for project success.

We also gratefully acknowledge the support of Hort Innovation and look forward to continued collaboration in delivering effective and relevant projects in the future.

Matthew Stewart Industry Development Manager, APTRC

Annual Industry Survey 2025

Matthew Stewart, Industry Development Manager, APTRC

CONTENTS

1 EXECUTIVE SUMMARY

The annual industry survey provides a year-on-year comparison, detailing industry performance in the current year compared with the previous one.

The data also tells the 'story' of Australian production and international trade over a longer period of time, supporting analysis of where the industry is headed, for example in terms of grower numbers, production, and location.

The 2024/25 season was favourable in terms of yield, total delivered tonnes and product quality. The favourable growing season and dry harvest period meant several growers delivered over contract fruit and achieved record average yields.

During the 2024/2025 season, eight growers produced 211,011 tonnes of processing tomatoes, almost exactly what was produced in 2023/24 (211,350 MT), however for the first time, the crop was processed by only two Australian processing companies.

Some 2,040 hectares were planted in total, with sub-surface drip irrigation used for 1,936 ha, and pivot irrigation used for 104 ha.

The use of transplants was slightly higher than the previous year at 87% of the total area under production, with direct-seeded tomatoes making up the remaining 13%.

In 2024/25, the Australian processing tomato industry achieved an average yield of 104.4 tonnes per hectare and 99% of the planted area was harvested.

The typical inverse relationship between yield and solids means there is often a drop in average solids when yields are higher. This season however, both high average yields and high soluble solids, which averaged 5.4%, were achieved. This is likely due to favourable and balanced weather conditions and modern cultivar selections supporting skilled farming enterprises.

On the international scene, imports and exports are reviewed and discussed in the context of the **previous calendar year** (2024), not the abovementioned processing season (2024/25).

The importation of processed products into Australia increased sharply in the 2024 calendar year, a confirmation that the current world oversupply issue is flowing into our local market spaces and applying extra pressure to processors and growers.

As predicted, with a favourable season of production to support it, the exports of Australian processed tomatoes increased significantly, more than doubling in 2024 Vs 2023. To put this into context however, the levels are just returning to pre-covid levels and don't represent any significant new trend toward higher export market access.

By the numbers, Australian domestic consumption increased significantly in 2024 a record level of 28 kgs per capita. The increase in domestic consumption was supplied by improved local production and increased imports. With a total domestic demand of over 700,000 tonnes of tomatoes and a current domestic production closer to 200,000 tonnes, there is significant scope for higher local production within Australia if only the local markets and governments would do more to support our industry.

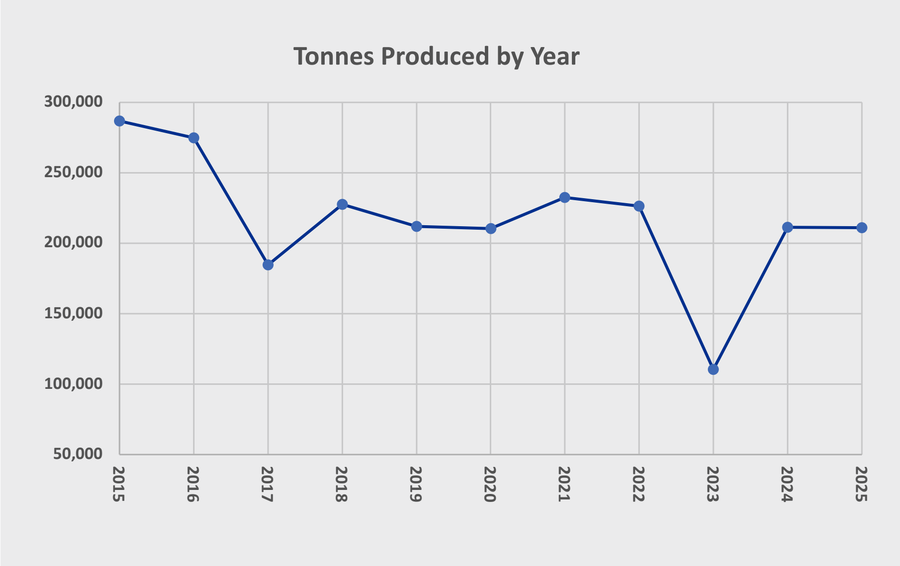
Image: Planting time at Campaspe Ag, Rochester Victoria

2 INDUSTRY SIZE

2.1 Volume

2.1.1 Paid tomato volumes delivered (tonnes) (APTRC)

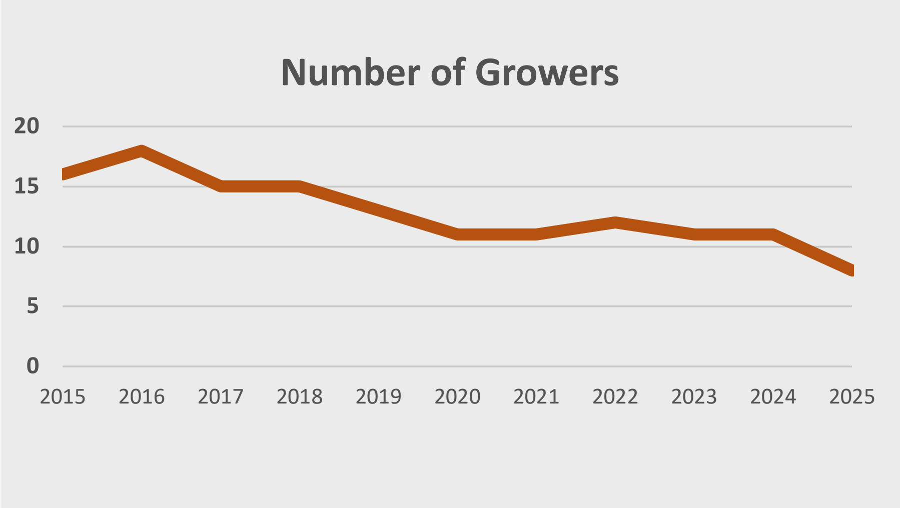
Growers produced 211,011 tonnes of processing tomatoes during the 2024/25 season, with the bulk of demand coming from Kagome and a smaller quantity processed through SPC. There were no organic tomatoes processed this season.



2.2 Producers

2.2.1 Number of growers (APTRC)

There were 8 specialist businesses producing for the 2024/25 processing tomato season, with the majority grown across Northern Victoria, and a lesser amount grown in Southern NSW.

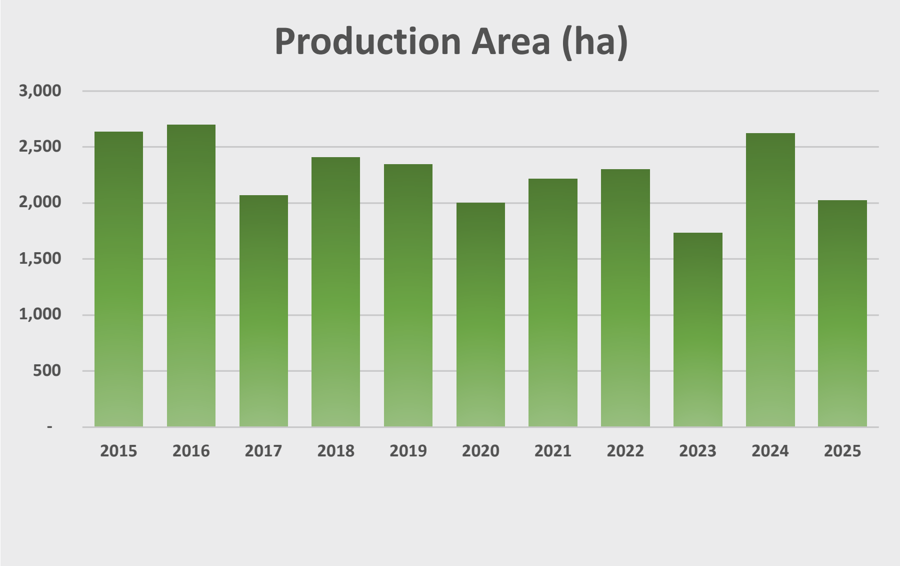


2.3 Producers

This season, Kagome took 82% of the total crop and SPC 18%, which is typical of these two processors.

3 THE CROP

3.1 Area and management



3.1.1 Planted production area (ha) (APTRC)

Production area dropped to 2,040 hectares (99% harvested), yet total tonnes equalled last season's output from 2,741 hectares. This was achieved through markedly higher yields, reflecting a return to typical Australian field conditions in the absence of severe storm or flooding impacts.

Season	Transplanted	Seeded
2010/11	79%	21%
2011/12	81%	19%
2012/13	72%	28%
2013/14	59%	41%
2014/15	68%	32%
2015/16	69%	31%
2016/17	86%	14%
2017/18	88%	12%
2018/19	91%	9%
2019/20	86%	14%
2020/21	90%	10%
2021/22	85%	15%
2022/23	94%	6%
2023/24	85%	15%
2024/25	87%	13%

3.1.2 Proportions of transplants Vs seed by area grown (APTRC)

This season, the crop was mainly grown under sub-surface drip irrigation, however Kagome Farms grew an increased area of 104 ha using only centre pivot irrigation (i.e., without drip irrigation). This method has proven useful in the normal rotation for Kagome Farms, where they already grow carrots and garlic crops on sand.

Direct-seeding declined slightly this season as the Boort region, typically a direct-seeding stronghold, shifted more of its production to transplants.

Area and Production by State	VIC	NSW
Area Planted	72.7%	27.3%
Tomato Volume Processed	83.9%	16.1%

3.1.3 Production by State (APTRC)

In the 2024/25 season, the proportion of planted area by state did not align with the proportion of production. This discrepancy was driven by several Victorian SPC growers achieving record average yields, which increased Victoria's share of total production.

3.2 Yield

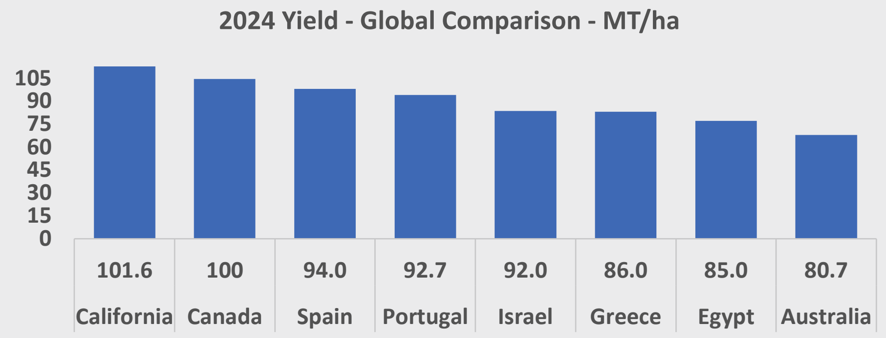
SEASON	AREA (HA) PLANTED	AREA (HA) PROCESSED	AREA % HARVESTED	AVERAGE YIELD MT/HA	MAJOR SEASONAL CHALLENGES
2012/13	1999	1998	100%	96.6	Wet, late harvest
2013/14	2386	2330	98%	93.6	Wet, late harvest
2014/15	2700	2635	98%	106.1	Early crop failure
2015/16	2782	2697	97%	101.9	Poor crop stand, delayed harvest, over-contract fruit
2016/17	2183	2071	95%	89.2	Delayed harvest due to rain
2017/18	2457	2407	98%	94.4	Abandoned due to factory power outage and resulting delay
2018/19	2347	2347	100%	90.3	Extreme bacterial speck, high temperatures
2019/20	2073	2003	97%	105.1	Hot and windy during growing; late harvest rains
2020/21	2215	2215	100%	106.13	Dry start, strong winds mid spring, some hail, mild summer
2021/22	2480	2300	93%	99.1	Delays from staff scarcity and crops abandoned due to wet finish
2022/23	1733	1643	95%	67.9	Excess early rainfall & flooding caused planting delays and losses
2023/24	2741	2620	96%	80.7	Storms caused widespread damage and poor growth due to flooding
2024/25	2040	2021	99%	104.4	Favourable weather and record yields for some growers

3.2.1 Average yield, harvest conditions (MT/ha) (APTRC)

Growers enjoyed a notably favourable season, with steady temperatures, very few extreme weather events, and almost no delays due to rain during harvest. It marked a sharp contrast to the difficulties of recent years, including widespread flooding in 2022/23 and damaging storms in 2023/24.

3.2.2 Average yield (t/ha) (APTRC)

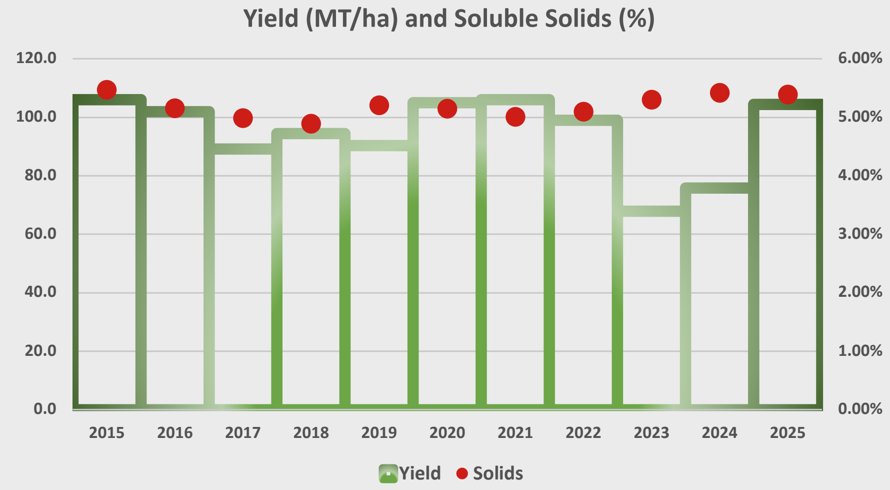
The industry recorded an average yield of 104.4 t/ha in the 2024/25 season — an exceptional result reached by only a small number of countries globally.



3.2.3 2024 average yield (MT/ha), by country (Colvine)

For the most accurate global comparison, international production data is reported one season behind. Accordingly, this report compares Australian performance with the 2023/24 global season. This timing reflects the later availability of Northern Hemisphere data.

3.3 Soluble Solids



3.3.1 Soluble solids (%) and yield (t/ha) (APTRC)

Average soluble solids for the season were 5.4%, which is above the minimum benchmark of 5.0% preferred by processors.

3.4 Cultivar

3.4.1 Cultivar by proportion of total area

When comparing the 2023/24 and 2024/25 seasons, the cultivars supplying the majority of production remained broadly consistent; however, the industry's appetite for commercially testing new genetics increased markedly. With 22 cultivars recorded, this is likely the most diverse range of tomatoes ever grown in Australia.

The well-supported APTRC cultivar improvement trial program is accelerating the introduction of modern, optimised processing-tomato genetics into commercial systems. The impact is now evident, with commercial plantings becoming increasingly diverse across the industry.

This diversification enhances resilience by reducing seed-supply risks—such as biosecurity threats, shortages, or production stoppages—while also keeping innovation for yield and brix improvement firmly at the forefront of the Australian processing tomato sector.

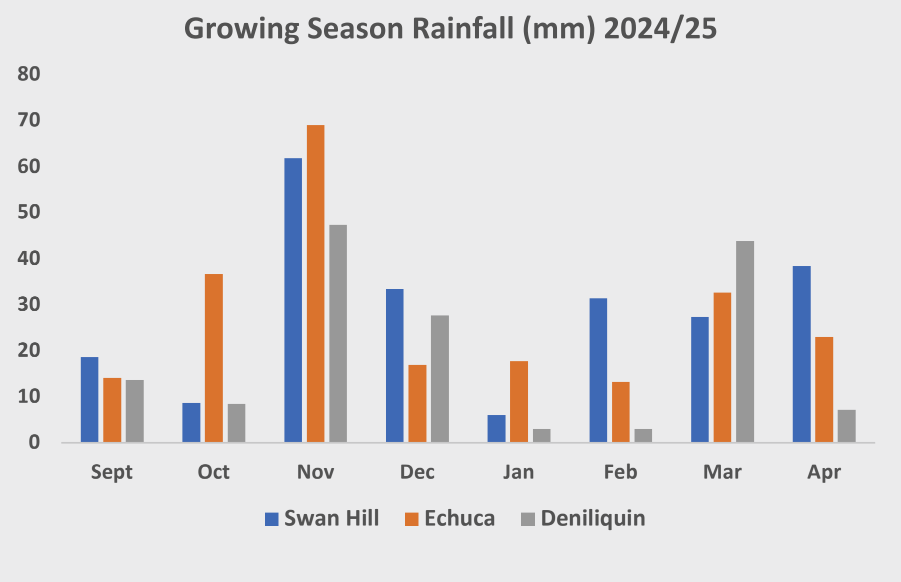
CULTIVARS	Percentage of Total Area Grown	
	2024/25	2023/24
H3402	33.2%	38.3%
H1015	22.3%	22.7%
UG16112	11.8%	6.8%
SVTM9000	7.9%	2.5%
H1311	5.1%	6.6%
H1014	4.5%	0.0%
H1301	4.2%	2.2%
UGMIX	2.8%	6.9%
SVTM9025	2.7%	0.0%
SVTM9023	1.8%	2.6%
SVTM9024	1.4%	0.5%
HM58811	0.65%	0%
H1281	0.37%	0%
SVTM9018	0.21%	0%
H1657	0.17%	0%
SVTM9300	0.16%	0%
Eventus	0.15%	0%
UG6617	0.15%	0%
H1884	0.14%	0%
HM58841	0.10%	0%
UG29814	0.10%	0%
SVTM9037	0.08%	0%

4 THE SEASON

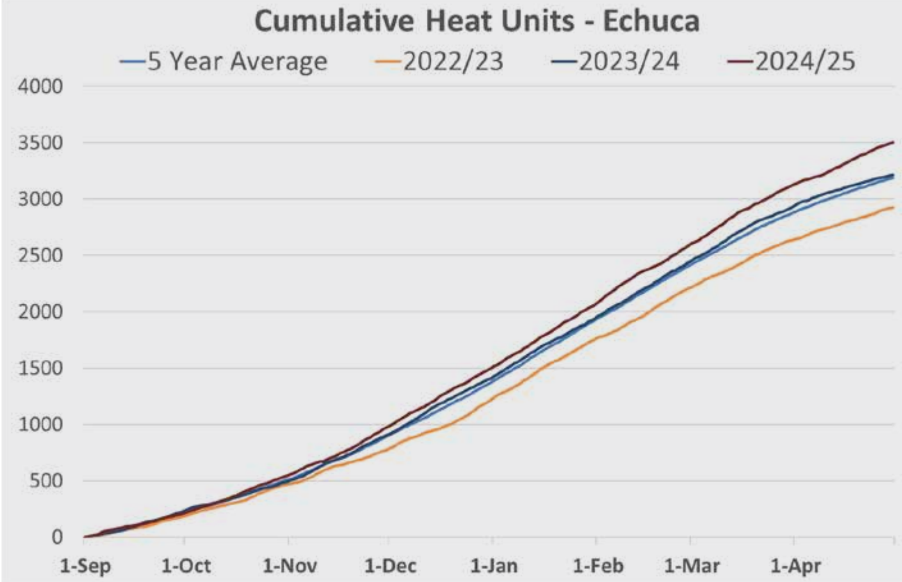
4.1 Rainfall

4.1.1 Rainfall across the major growing regions (mm) (BOM)

For most regions, rainfall was light on for planting during late September and through October. The November rain caused some operational delays but were not detrimental. For the majority of the harvest period, during January through to April, rainfall totals were moderate to low and manageable.



4.2 Heat Units

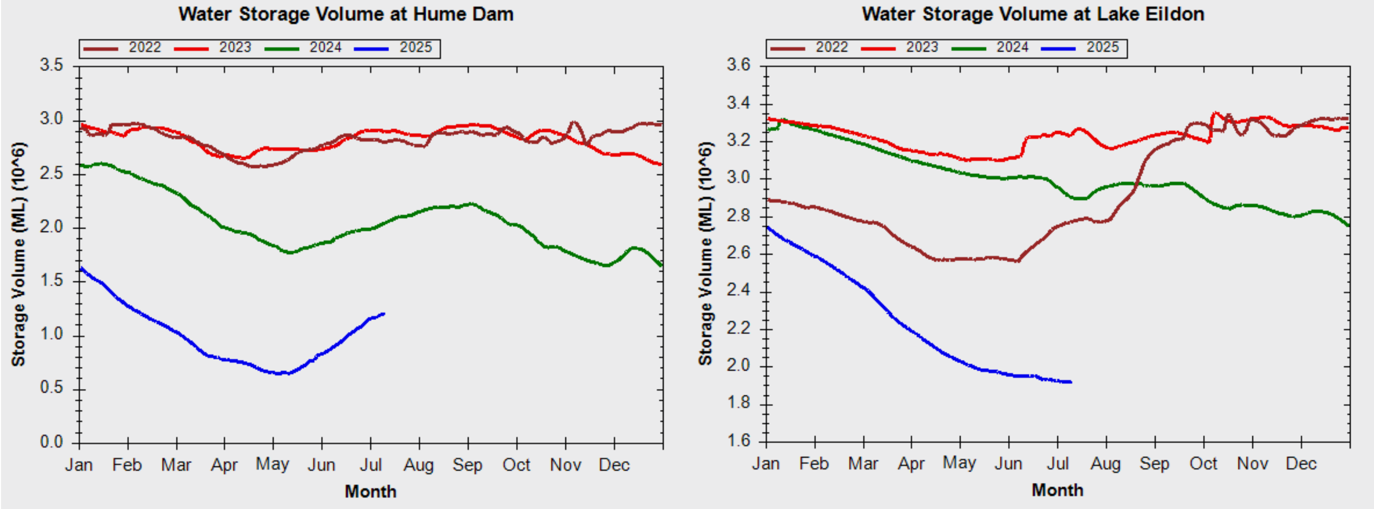


4.2.1 Heat units – Echuca (BOM)

The heat units recorded during the major crop growth period demonstrate that the season was warmer than the 5-year average and this likely contributed in some part to the increased average yields across industry.

Although this graph uses data from Echuca, it's a central point for industry and can be generally considered indicative of what was experienced by growers in surrounding regions.

4.3 Water Storages

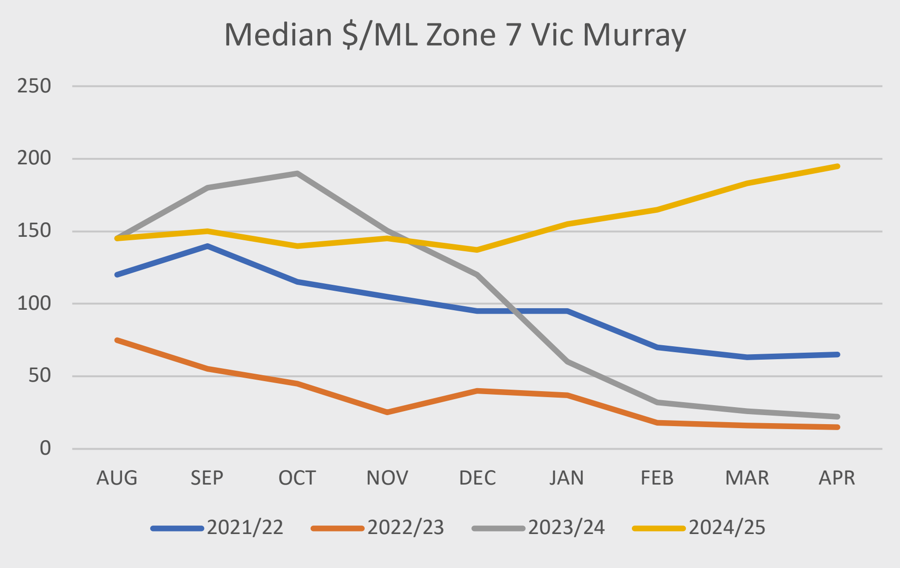


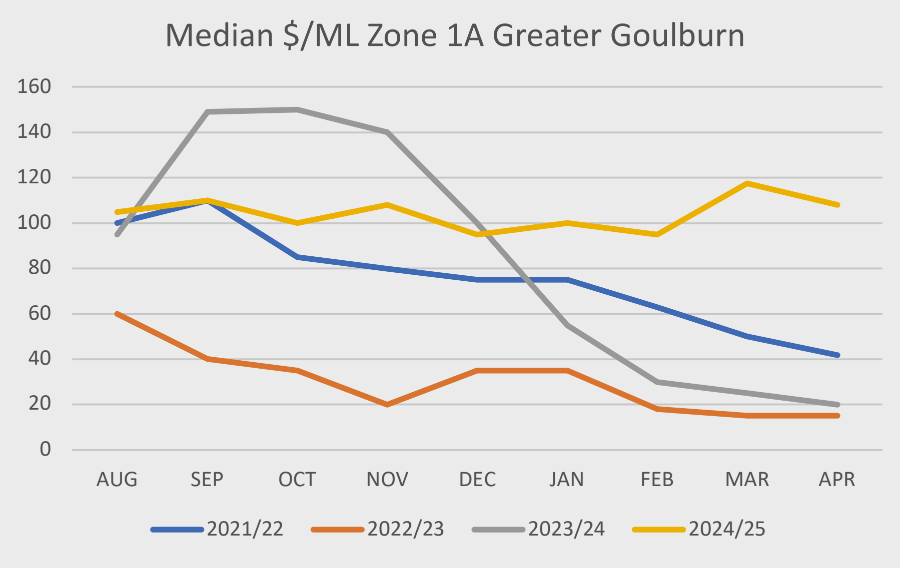
4.3.1 Storage Volume, Lake Eildon and Hume Dam (GMW)

The water storage level in Hume and Eildon dropped off significantly during the growing season and without re-charge in the next 6 months, the storage levels will remain suppressed and consequently allocations for the 2024/25 season are set to be greatly diminished.

4.4 Water Price

4.4.1 The price of water during 2024/25 began on par with the previous year, however continued to increase as the season progressed and storages were diminished through summer cropping usage and no recharge. The price could continue to rise further still into the 2025/26 season if the lack of significant rainfall continues across the catchments.





4.4.1 Zone 1A and Zone 7 median water price ($/ML) (Registry)

5 TRADE

5.1 Imports

Product	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Dried/powder	26,875	34,506	37,934	37,660	34,880	28,017	29,143	34,263	26,638	28,767
Whole/pcs <1.14L	45,222	40,965	43,354	42,683	41,799	51,121	36,356	45,488	38,479	47,055
Whole/pcs >1.14L	28,088	22,997	24,002	24,275	22,369	21,129	21,316	24,029	18,908	23,420
Paste/puree <1.14L	153,210	102,733	107,923	109,578	110,328	159,447	137,971	125,751	147,343	183,182
Paste/puree >1.14L	102,866	130,171	140,532	144,906	133,524	143,118	140,502	187,046	203,539	197,038
Juice	75	83	38	75	50	30	17	47	27	19
Sauce/ketchup	39,276	38,462	45,705	45,946	47,050	48,375	45,788	51,585	58,092	71,376
Total Tomato	395,612	369,917	399,488	405,123	389,999	451,236	411,093	468,210	493,026	550,857

5.1.1 Imports of Tomato Products (equivalent raw tonnes) (ABARES)

The volume of imports rose sharply during 2024 in all categories except for Juice and Paste/puree>1.14L.

This year again set a new record for import volumes—the highest since the industry began tracking data in 2010—extending a consistent year-on-year upward trend.

The largest sources of these imports, sorted by category were as follows (where the major importer supplied less than 90% of the total, the next most significant supplier/s are also included).

- **Dried/powder** – Turkey 50%, China 18%, New Zealand 12%
- **Whole/pcs <1.14L** – Italy 97%
- **Whole/pcs >1.14L** – Italy 95%
- **Paste/puree<1.14L** – Italy 72%, China 22%, Chile 2%
- **Paste/puree>1.14L** – USA 41%, China 39%, Italy 11%
- **Juice** – USA 58%, Mexico 19%, UK 8%
- **Sauce/ketchup** – Italy 43%, New Zealand 18%, Spain 12%

At 62% of total volume (last year 60%), Italy remains the dominant source of imported processed tomato products into Australia. The next largest suppliers were China and USA, supplying 14% and 8% respectively into Australia.

Product	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Dried/powder	5.98	5.33	5.61	5.77	5.69	6.22	5.42	6.05	7.23	7.81
Whole/pcs <1.14L	1.17	1.22	1.10	1.17	1.26	1.39	3.02	1.58	2.11	1.74
Whole/pcs >1.14L	0.99	0.92	0.89	0.97	1.00	1.00	2.05	1.24	1.78	1.81
Paste/puree<1.14L	1.36	1.34	1.27	1.27	1.40	1.56	1.54	1.75	2.30	2.94
Paste/puree>1.14L	1.27	1.14	1.08	1.15	1.24	1.31	1.20	1.47	3.73	4.47
Juice	1.54	0.88	2.37	1.79	1.87	3.09	3.31	2.85	3.47	4.62
Sauce/ketchup	1.71	1.73	1.75	1.78	1.91	2.19	2.15	2.22	2.72	2.78
Total Tomato	1.31	1.31	1.26	1.32	1.42	1.54	2.11	1.70	2.67	2.80

5.1.2 Average import prices ($/kg), in 2024 monetary values (ABARES)

5.2 Correlation between Imports and Price

The overall price of imports in 2024 only rose marginally across categories but actually decreased for Whole/pcs<1.14 L—the category that typically represents canned tomatoes. Lower import prices, coupled with the significant increase in import volume for this product category explains the competitive pressures facing Australia's domestic processing sector in the canned tomato market.

Across the past decade, price–volume correlations show mixed behaviours:

- Juice displays a strong negative correlation, indicating that as prices rise, import volumes decline.
- Sauce/ketchup and Paste/purée show moderate positive correlations, meaning import volumes have risen alongside increasing prices.

Broadly, correlations vary considerably across imported products—ranging from moderately positive to moderately negative—and often differ by package size within a category. This pattern suggests that price is not the dominant driver of import volumes for most product types, with Juice being the main exception.

Where positive correlations appear between rising import prices and rising import volumes, it is unlikely that higher import prices are causing increased imports. Instead, it is more likely that domestic prices are rising even faster, making imported product relatively more attractive despite its own gradual price increases.

As a result, local buyers may be purchasing more imported product even as import prices trend upward.

5.3 Exports

Product	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Whole/pieces	746	461	133	62	139	623	273	417	513	484
Paste/puree	43,747	104,518	21,852	16,402	11,695	32,766	38,323	22,032	9,085	3,725
Sauce/ketchup	8,196	4,039	8,799	11,636	13,227	14,788	17,986	13,660	5,661	18,504
Juice	131	57	50	80	106	52	47	118	112	167
Total Tomato	**52,819**	**109,075**	**30,834**	**28,180**	**25,167**	**48,228**	**56,629**	**36,227**	**15,371**	**22,880**

5.3.1 Exports of tomato products (ABARES) (equivalent raw tonnes)

Overall export volumes increased slightly this season, though exports continue to represent only a very small share of Australia's total tomato production. While exports of Paste/purée declined significantly, this was offset by a substantial increase in the sauce /ketchup category.

The largest export markets, sorted by category and then by country were as follows:

Whole/pieces – Thailand 61%, New Zealand 8%, Papua New Guinea 8%

Paste/puree – New Zealand 44%, Thailand 24%, Japan 10%

Sauce/ketchup – New Zealand 33%, Japan 28%, China 11%

Juice – Hong Kong 26%, South Korea 20%, New Zealand 11%

At 33% of all products (2023 was 22%), New Zealand was the major export destination for Australian processed tomato produce, with Japan close behind at 25% and China at 10% of total exports.

Product	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Whole/pieces	4.97	6.18	8.05	5.73	3.14	2.03	3.54	3.75	3.17	3.23
Paste/puree	1.55	1.20	1.43	1.70	2.16	2.71	2.53	2.55	2.93	3.47
Sauce/ketchup	3.13	3.30	2.35	2.4	2.44	2.81	2.41	2.33	2.99	2.88
Juice	1.55	1.94	1.37	2.08	1.26	1.28	1.19	1.23	1.60	1.22
Total Tomato	**2.27**	**1.52**	**2.02**	**2.20**	**2.38**	**2.73**	**2.47**	**2.44**	**2.96**	**2.90**

5.3.2 Average export prices ($/kg) (ABARES), in 2024 monetary values

The real price of exports decreased slightly in 2024, which is disappointing for the Australian processing industry. However, for the Paste/puree category at least, the price had a noticeable increase.

- The data suggests a moderate negative correlation between average export price and volume exported, meaning that as price goes up, volume exported goes down.
- This applies to all product categories, except for Juice, which consistently appears to have no correlation to export price whatsoever.

Over the past decade, the relationship between Australia's export volumes and the USD exchange rate has steadily weakened. Exchange rates no longer explain much of the movement in export activity; instead, other forces are shaping outcomes.

Chief among these is the much lower pricing offered by competitor countries, which affects Australia's ability to compete far more than fluctuations in currency values.

5.4 Market Demand

Calendar Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	5 yr	10 yr
Dom. Demand	629,620	534,691	553,336	604,579	576,793	613,485	587,025	658,422	588,276	**751,743**	639,790	609,797
Imports	395,613	368,918	399,488	405,123	389,999	451,236	411,093	468,210	493,026	**550,857**	474,885	433,356
Net Australian	234,007	165,773	153,848	199,456	186,794	162,249	175,933	190,212	95,250	**200,885**	164,906	176,441
Imported %	63%	69%	72%	67%	68%	74%	70%	71%	84%	**73%**	74%	71%
Local %	37%	31%	28%	33%	32%	26%	30%	29%	16%	**27%**	26%	29%
Per capita (kgs)	**26**	**22**	**22**	**24**	**22**	**24**	**23**	**25**	**22**	**28**	**24**	**24**

5.4.1 Apparent domestic market demand (ABARES) (equivalent raw tonnes)

Table 5.4.1 represents the Australian market demand for processed tomato products and shows how this demand is being supplied, from local or imported products.

For individual years, combining data can produce non-matched results; ABARES data is based on a calendar year, rather than a seasonal year, and this survey is unable to account for year-end stocks. However, these factors should tend to be mitigated when viewed over time, such as through the 5-year or 10-year averages.

Considering this data, the following may be noted:

Imports: Imports increased in the 2024 calendar year and were significantly higher than the 10-year average.

Net Australian: The net Australian figure equates to tomatoes processed, less exports and in 2024 calendar year has returned to more normal levels, due to a more significant value of delivered tonnes in 2024.

Domestic Demand: Although the figures imply a strong rise in domestic consumption in 2024, it's unlikely demand surged that dramatically in a single year. Instead, the elevated number more likely reflects a combination of higher imports and strong domestic production that has replenished stocks, with some potential overstocking from cheap imports.

Imported %: Levels of imported product have now re-balanced to the more expected ratio's of 73% Imported Vs 27% Local. Ideally, we would like to see imports decrease, as more Australian markets support local grown and processed product.

Local %: The percentage of local product sold in the Australian market increased to more traditional levels that we've seen over the past 5-year average.

Per Capita kgs: Per-capita consumption rose to 28 kg of raw-tomato equivalent, but this spike is unlikely to reflect Australians genuinely eating that much more tomato product in 2024. It is more plausibly a re-stocking anomaly rather than a true demand shift and is not expected to be sustained. For meaningful insight into consumer behaviour, the 5-year and 10-year averages remain the more reliable indicators of underlying consumption trends.

6 GLOBAL INDUSTRY
6.1 Production

In 2024, recorded global production totalled 44,416 million tonnes, compared to 38,449 million tonnes for the previous year; a considerable increase of 15.5%. This is mainly due to the significant increase in China's production, on top of a large crop in the USA.

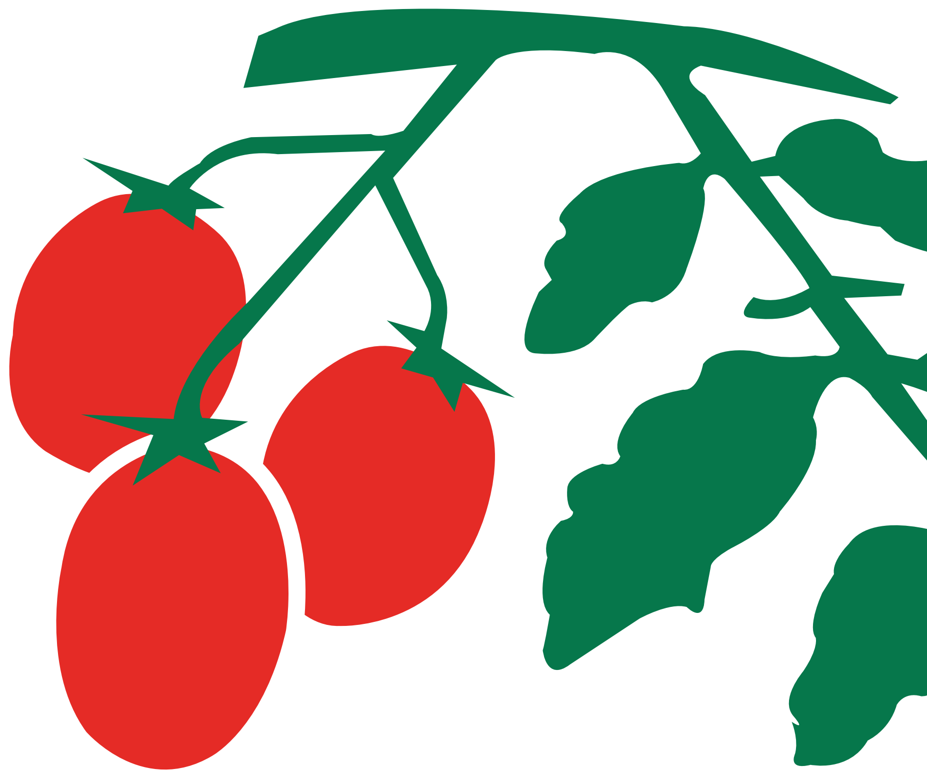
In 2024, Australia contributed 0.5% of global production and moved its ranking up to 20th for industry volume.

Country	Season	2023	2024	2025 Prelim	% Change 2024-25E	Ranking 2024	% Total 2024
China	Jul-Dec	8000	10450	4900	-53,1%	1	22.8%
USA	Jul-Dec	12031	9999	10650	6,5%	2	21.8%
Italy	Jul-Dec	5404	5272	5700	8,1%	3	11.5%
Spain	Jul-Dec	2600	3080	2400	-22,1%	4	6.7%
Turkey	Jul-Dec	2700	2700	2200	-18,5%	5	5.9%
Brazil	Jul-Dec	1571	1650	1420	-13,9%	6	3.6%
Portugal	Jul-Dec	1500	1500	1300	-13,3%	7	3.3%
Iran	Jul-Dec	2000	1400	1800	28,6%	8	3.1%
Algeria	Jul-Dec	1350	1300	1300	0%	9	2.8%
Chile	Jan-Jun	1150	1300	1340	3,1%	10	2.8%
Tunisia	Jul-Dec	826	1000	935	-6,5%	11	2.2%
Russia	Jul-Dec	660	670	650	-3,0%	12	1.5%
Argentina	Jan-Jun	586	630	620	-1,6%	13	1.4%
Egypt	Jul-Dec	600	624	780	25,0%	14	1.4%
Ukraine	Jul-Dec	500	550	500	-9,1%	15	1.2%
Greece	Jul-Dec	390	510	510	0%	16	1.1%
Canada	Jul-Dec	520	493	575	16,6%	17	1.1%
Poland	Jul-Dec	250	400	400	0%	18	0.9%
Dominican Republic	Jul-Dec	227	227	227	0%	19	0.5%
Australia	**Jan-Jun**	**110**	**211**	**211**	**0%**	**20**	0.5%
Israel	Jul-Dec	197	184	180	-2,2%	21	0.4%
France	Jul-Dec	160	168	175	4,2%	22	0.4%
India	Jan-Jun	162	162	162	0%	23	0.4%
Peru	Jan-Jun	150	150	160	6,7%	24	0.3%
South Africa	Jan-Jun	160	140	160	14,3%	25	0.3%
Hungary	Jul-Dec	110	120	97	-19,2%	26	0.3%
Morocco	Jul-Dec	100	100	100	0%	27	0.2%
Senegal	Jan-Jun	73	73	73	0%	28	0.2%
Bulgaria	Jul-Dec	37	60	40	-33,3%	29	0.1%
Syria	Jul-Dec	40	40	40	0%	30	0.1%
Mexico	Jan-Jun	40	40	40	0%	31	0.1%
Thailand	Jul-Dec	40	40	40	0%	32	0.1%
New Zealand	Jan-Jun	25	39	37	-5,1%	33	0.1%
Japan	Jul-Dec	26	26	25	-3,8%	34	0.1%
Czech Republic	Jul-Dec	25	25	25	0%	35	0.1%
Slovakia	Jul-Dec	20	20	20	0%	36	0.0%
Venezuela	Jul-Dec	24	14	14	0%	37	0.0%
Malta	Jul-Dec	6	7	7	0%	38	0.0%
Total		**44370**	**45849**	**40288**	**-12,1%**		**100.0%**

6.1.1 World Production by Country ('000 tonnes) (Colvine)

6.2 Outlook

Looking ahead to the 2025/26 season, Australia's forecast has been reduced to 166,000 MT to be processed this year by two processors. The significant reduction in contracted tonnes is a direct result of global oversupply and excess product being imported into Australia, putting extreme pressure on local processors and loyal Australian brands to maintain market share.



7 References

ABARES. (n.d.). Australian Bureau of Agricultural and Resource Economics and Sciences.

APTRC. (n.d.). *Previous Survey Data*. Australian Processing Tomato Research Council.

https://aptrc.asn.au/info-for-industry

BOM. (n.d.). *Climate Summary Archive*. Bureau of Meterology.

http://www.bom.gov.au/climate/current/statement_archives.shtml

Colvine, S. (n.d.). World Processing Tomato Research Council.

GMW. (2024-25). *Storage Levels*. Goulburn Murray Water.

https://www.g-mwater.com.au/water-resources/catchments/storage-levels

Registry. (n.d.). *Allocation Trading History*. Victorian Water Registry.

https://www.waterregister.vic.gov.au/water-trading/allocation-trading

**n.d. denotes where 'no date' could be found for publishing.*

The industry recorded an average yield of 104.4 t/ha in the 2024/25 season — an exceptional result reached by only a small number of countries globally.

APTRC Cultivar Trials 2024/25

Mark and Sarah Sargeant
OptiAg

INTRODUCTION

The APTRC cultivar evaluation trial program exists to help the Australian tomato industry identify new cultivars that might be suitable for growing and processing.

Reasons for evaluating new cultivars include assessing traits that are more desirable for growers (yield, brix and field holding capacity), quality factors for processing (pH, colour, brix) and to meet specifications of new or existing product lines (i.e., lycopene).

The main goal is to identify cultivars which perform equally or better than current industry standards in terms of yield, fruit quality and fruit holding. However, making sure Australia has cultivars with the most current disease resistance genetics is also important. In addition to assessing varietal performance, the trials also provide valuable insight into the suitability of alternative cultivars, ensuring the industry has viable backup options should seed supply of current commercial standards become constrained in future seasons.

There were a total of five trial sites within the APTRC cultivar evaluation trial program for the 2024/25 season, with two early-season sites and four mid-season sites (three transplant trials and one direct seeded trial).

The early-season sites were located at Lake Boga and Boort, while the mid-season sites were located at Rochester, Katunga and Thyra (NSW) (Figure 1). A total of 15 early season cultivars and 18 mid-season cultivars were included in the machine harvest trials.

There were also three screening trial sites, which were co-located with the mid-season commercial harvest trials. Due to delays in seed availability, the early-season screening cultivars were planted at the mid-season screening trial sites.

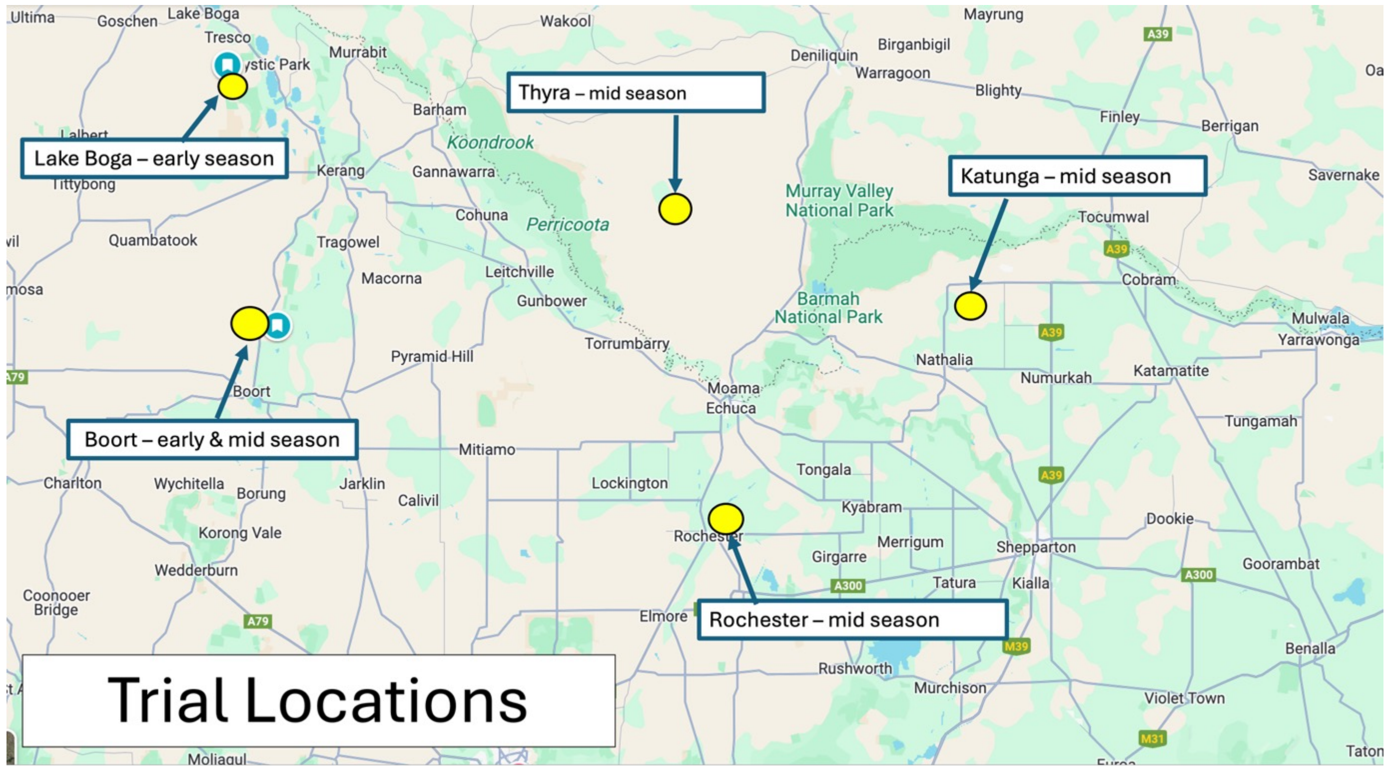


Figure 1. Location of early and mid-season cultivar trials in 2024/25

METHODS

Site Selection

Trial sites were selected prior to planting and desirable criteria for selection included consistent soil types throughout the valve and suitable row lengths. Best efforts were made to ensure that the trials were located between spray runs to avoid any wheeled traffic causing fruit and canopy damage in the inter-row near harvest time.

Trial Design

The commercial harvest trials were setup as a randomized complete block design, with five replicates per trial for the transplant trials, and four replicates for the direct seeded trial. Plot lengths varied slightly between trial sites due to valve length or other constraints and ranged from 55-70 m and were single bed width (1.52 cm). The trial site locations and planting and harvest details are presented in Table 1.

Site	Planting type	Planting/seeding density	Planting date	Harvest date	Days from planting to harvest
Early-season					
Lake Boga	Transplant	18,400	9-Oct	17-Feb	131
Boort	Transplant	18,400	15-Oct	18-Feb	126
Mid-season					
Thyra	Transplant	18,400	9-Nov	27-Mar	138
Katunga	Transplant	18,400	1-Nov	31-Mar	150
Rochester	Transplant	18,400	23-Oct	26-Mar	154
Boort	Direct seeded	75,000	15-Oct	20-Mar	156

Table 1. Site details for all six trial sites

Screening Observation Trials

The screening trials were laid out as small, hand planted, non-replicated plots. The plots were 8 m long, and 1 bed wide. A commercial standard of H 1015 was included in the early-season screening trials, and H 3402 was included as the standard for the mid-season screening trial. A list of the cultivars included in the screening trials are listed in Table 2.

Early-season	Mid-season
H 1015 (standard)	H 3402 (standard)
HM 7103	HM 8268
N 4528 (528) – cherry	N 279
N 507	SVTM 9038
N 6438 (254)	-

Table 2. Cultivars assessed in the early and mid-season screening trials

Planting of Replicated Machine Harvest Trials

Four of the five transplant cultivar trials used traditional carousel transplanters, which ranged from 4-6 rows wide and at Thyra, the 5 row, automated robotic Ferrari transplanter was used. In all cases, members of the planting crew walked behind the transplanter and filled any missing plants with the industry standard.

Harvesting & Sampling

Two days prior to commercial harvest, 20 ripe fruits from each plot were sampled and sent to the Kagome laboratory for quality analysis. The analysis conducted on the fruit included pH, Brix and colour assessments. The methodology for sampling was to walk the length of the plot (avoiding 5 m at each end) and hand pick ripe undamaged fruit from a range of locations within the plants.

Commercial harvest was conducted on the plots with either a Johnson or Guaresi harvester. Bin trailers with load cells were used to weigh the tomatoes as they were harvested from each plot.

Screening Trial Assessment

The aim of screening trials is to determine if cultivars warrant inclusion in the machine harvest trials in the following season. The screening trials were visually assessed by Bill Ashcroft and Ann Morrison and were scored on a combination of factors including, vine structure, leaf coverage over fruit, and shape, colour and number of fruit.

Statistical Analysis

The statistical analysis was conducted using Agricultural Research Manager (ARM 2025 – Gylling Data Management) software. An ANOVA (Analysis of Variance) was used to test the significance of the treatment effects to the 95% confidence level. Mean separations were conducted using LSD (Least Significant Difference) values.

Where required, the data were transformed to ensure the normality of the residuals. In simple terms, this means that when the raw data for a particular assessment did not meet the assumptions required for an ANOVA analysis, such as skewed data, a mathematical adjustment was applied to make comparisons between varieties statistically appropriate. This process does not alter the actual results; it simply improves the accuracy of the analysis. To ensure the ease of reading, the untransformed data are presented, while mean separations are based on the transformed data.

RESULTS EARLY SEASON TRIALS

Yield

The yield at Lake Boga ranged from 91-153 T/ha (Figure 2.), while yields at the Boort site ranged from 115-206 T/ha.

At the Lake Boga site, none of the cultivars yielded significantly higher than the standard; H 1015. However, at the Boort site, the SVTM 9032 yielded 206 T/ha, which was significantly higher than H 1015, which yielded 172 T/ha. Boort and Lake Boga sites were harvested at 126 and 131 days after planting respectively, which is longer than ideal for some of these cultivars and needs consideration when reviewing performance.

Brix

The Brix values ranged between 4.8 and 6.1 for cultivars at the Lake Boga site, and between 4.2 and 5.9 at the Boort site (Figure 2). Generally, a higher brix value is better, with 4.9 often used as a threshold.

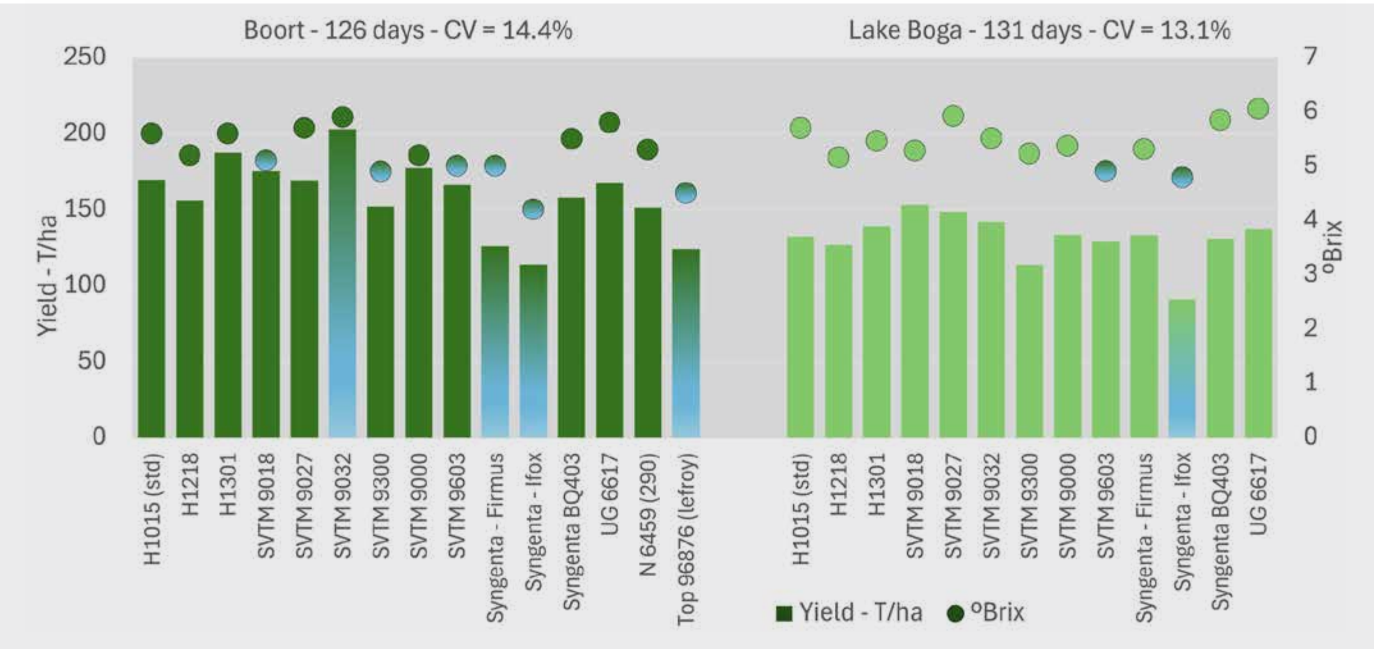


Figure 2. Yield and Brix values at the Lake Boga and Boort early season sites. Yield (columns) and Brix (circles) that differ statistically from the H1015 standard cultivar within each trial are coloured differently.

Cultivar	Boort	Lake Boga
H 1015 (std)	4.51 b-e	4.56 a
H 1281	4.56 a-d	4.52 ab
H 1301	4.58 ab	4.50 ab
SVTM 9018	4.46 e	4.40 d
SVTM 9027	4.48 cde	4.45 bcd
SVTM 9032	4.45 e	4.42 cd
SVTM 9300	4.63 a	4.57 a
SVTM 9000	4.48 cde	4.46 bcd
SVTM 9603	4.54 a-e	4.47 bcd
Syngenta Firmus	4.54 a-e	4.46 bcd
Syngenta Ifox	4.62 a	4.51 ab
Syngenta BQ403	4.49 cde	4.42 cd
UG 6617	4.48 de	4.48 bc
N 6459 (290)	4.56 a-d	-
Top 96876	4.57 abc	-
F Prob (p=0.05)	0.002	<0.001
LSD	0.092	0.074

Table 3. pH at Boort and Lake Boga early season sites. (Mean values with similar letters are statistically similar).

pH

The pH values did not vary much between cultivars or sites (Table 3). At the Boort site, the pH values for the cultivars ranged from 4.45-4.63, while at the Lake Boga site, the pH ranged from 4.40-4.57. Lower pH values are desirable for processors, with a pH value of 4.5 often used as a guide.

Cultivar	Boort	Lake Boga
H 1015 (std)	2.29 b	2.23
H 1281	2.23 bc	2.21
H 1301	2.20 bc	2.22
SVTM 9018	2.19 bc	2.17
SVTM 9027	2.13 c	2.18
SVTM 9032	2.22 bc	2.19
SVTM 9300	2.22 bc	2.25
SVTM 9000	2.22 bc	2.32
SVTM 9603	2.24 bc	2.25
Syngenta Firmus	2.26 bc	2.31
Syngenta Ifox	2.17 bc	2.20
Syngenta BQ403	2.18 bc	2.25
UG 6617	2.19 bc	2.23
N 6459 (290)	2.21 bc	-
Top 96876	2.46 a	-
F Prob (p=0.05)	0.043	0.326
LSD	0.151	NS

Table 4. a/b colour of ripe fruit at Boort and Lake Boga sites. (Mean values with similar letters are statistically similar).

Colour

The a/b colour values are a complex measure of colour conducted on processed fruit in the laboratory and provides a correlation of the colour of a finished produce. A higher a/b colour value is more desirable for finished products, with a value higher than 2.0 being desirable.

With the sampling process within the trials targeting ripe fruit, the a/b colour of the cultivars in these trials will tend to be higher than a commercially grown field where there may be orange and green fruit at harvest. However, this still represents colour differences between ripe fruit of the different cultivars and is a good guide for which cultivars are providing the best colour for final products.

The a/b colour from the Boort site ranged from 2.13 (SVTM 9027) to 2.46 (TOP 96876). At the Lake Boga site, the a/b colour ranged from a 2.17 (SVTM 9018) to 2.32 (SVTM 9000).

RESULTS MID-SEASON TRANSPLANT TRIALS

The mid-season trials contained a larger number of cultivars, although it's worth noting, not every mid-season site contained all of the available cultivars. The mid-season trials were more impacted by stormy weather at harvest, with the Thyra and Katunga sites both receiving heavy rainfall prior to harvest causing delays. There was a large amount of variation in the data at the Thyra site, that is represented by the large Coefficient in Variation (CV) value in the yield data (32%). Due to the large CV, this data is presented, but not discussed as caution needs to be exercised in interpreting the data.

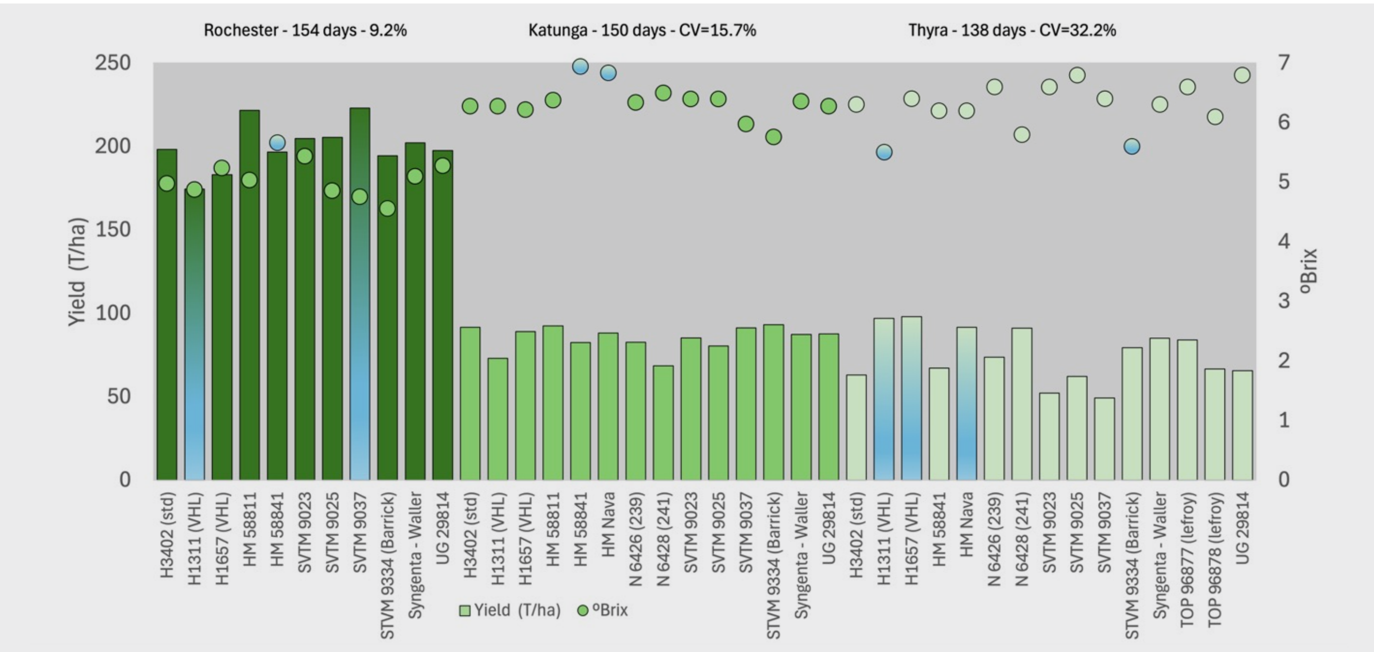


Figure 3. Yield and Brix values at Rochester, Katunga and Thyra mid-season sites. Yield (columns) and Brix (circles) that differ statistically from the H 3402 standard cultivar within each trial are coloured differently.

Yield

The highest yields were achieved at the Rochester site, where yields ranged from 175 to 223 T/ha (Figure 3). Here, SVTM 9037 yielded 223 T/ha, which was significantly higher than the standard H 3402, at 198 T/ha. This site also had the lowest site variation, with a CV of 9.2%. The very high lycopene (VHL) cultivars H 1311 and H 1657 yielded 174 and 183 T/ha respectively, with the latter statistically similar yield to the H 3402 standard. The fruit of all cultivars hung on well given the late harvest of this site.

At the Katunga site, there were no statistical difference between the yields of the cultivars, with yields ranging from 68 to 93 T/ha (Figure 2). The standard H 3402 produced a yield of 91 T/ha.

Brix

The Brix values at the Rochester site ranged from 4.56 for SVTM 9334 up to 5.66 for HM 58811 (Figure 2). The brix of 5.66 for HM 58811 was statistically higher than the 4.98 of H 3402. All of the other cultivars had a statistically similar brix value to H 3402. At the Katunga site, the Brix values ranged from a low of 5.76 for SVTM 9334, up to 6.94 for HM 58811. At the Katunga site, there were two cultivars that achieved a statistically higher Brix than the H 3402 standard, which were HM Nava that had a brix of 6.84 and HM 58811 with a value of 6.94.

Cultivar	Rochester	Katunga	Thyra
H 3402	4.75 abc	4.65 bc	4.8 ab
H 1311 (VHL)	4.80 ab	4.77 ab	4.8 abc
H 1657 (VHL)	4.83 a	4.77 ab	4.6 ef
HM 58811	4.66 cde	4.59 bc	4.6 de
HM Nava	-	4.60 bc	4.6 efg
N 6426 (239)	-	4.59 bc	4.6 cde
N 6328 (241)	-	4.70 bc	4.7 b-e
SVTM 9023	4.61 def	4.71 bc	4.7 cde
SVTM 9025	4.52 f	4.54 c	4.5 g
SVTM 9037	4.59 ef	4.62 bc	4.7 b-e
SVTM 9334 (Barrick)	4.70 bcd	4.75 b	4.8 abc
Syngenta – Waller	4.70 bcd	4.97 a	4.8 abc
Top 96877	-	-	4.5 fg
Top 96878	-	-	4.6 def
UG 29814	4.62	4.61 bc	4.7 a-d
HM 58841	-	4.59 bc	-
F Prob (p=0.05)	<0.001	0.011	<0.001
LSD	0.105	0.2	0.11

Table 5. pH at the Rochester, Katunga and Thyra mid-season trial sites. (Mean values with similar letters are statistically similar).

pH

The pH of the ripe fruit at Rochester, Katunga and Thyra trial sites were generally within the same ranges (Table 5). At the Rochester site, the pH ranged from 4.52 to 4.83, while at Katunga they ranged from a low of 4.53 up to 4.97. The same cultivar produced the lowest pH at the three sites, which was SVTM 9025, which was statistically lower than the H 3402 standard at the Rochester and Thyra sites.

Cultivar	Rochester	Katunga	Thyra
H 3402	2.04 c	2.15 cd	2.22 bc
H 1311 (VHL)	2.29 ab	2.32 b	2.48 a
H 1657 (VHL)	2.42 a	2.50 a	2.33 ab
HM 58811	2.08 c	2.15 cd	-
HM Nava	-	2.24 bcd	2.11 c
N6426 (239)	-	2.28 bc	2.25 bc
N6328 (241)	-	2.24 bcd	2.21 bc
SVTM 9023	2.15 bc	2.11 d	2.24 bc
SVTM 9025	2.07 bc	2.17 bcd	2.17 bc
SVTM 9037	2.03 c	2.11 d	2.13 c
SVTM 9334 (Barrick)	2.14 bc	2.22 bcd	2.17 bc
Syngenta – Waller	2.12 bc	2.20 bcd	2.18 bc
Top 96877	-	-	2.18 bc
Top 96878	-	-	2.11 c
UG 29814	2.15 bc	2.16 cd	2.19 bc
HM 58841	2.16 bc	2.21 bcd	2.18 bc
F Prob (p=0.05)	0.002	<0.001	0.014
LSD	0.173	0.152	0.173

Table 6. a/b colour of ripe fruit at the Rochester, Katunga and Thyra mid-season trial sites. (Mean values with similar letters are statistically similar).

Colour

The a/b colour the VHL varieties at each site were generally higher than the other cultivars. At the Rochester site, the H 1311 (VHL) and H 1657 (VHL) cultivars had an a/b colour of 2.29 and 2.42 respectively, which were statistically higher than the 2.04 achieved by H 3402.

There were some variations in a/b values of non VHL cultivars across all trials, however all non-VHL cultivars had similar a/b values as H 3402.

RESULTS MID-SEASON DIRECT SEEDED TRIAL

Yield

The direct seeded trial yielded between 148 and 202 T/ha (Figure 4). The lowest yielding cultivar was SVTM 9025, which yielded significantly lower than all other cultivars include in the trial, while all other cultivars yielded similarly to each other.

Brix

The brix values were all statistically similar between cultivars and ranged from 4.8 to 5.3.

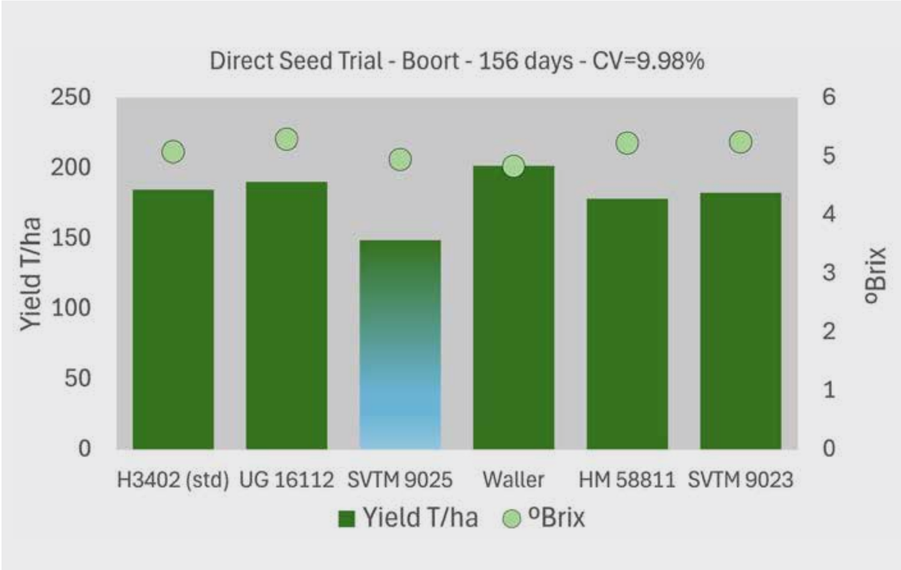


Figure 4. Yield and brix values for cultivars included in the direct seeded trial at Boort

Colour

All cultivars had statistically similar a/b colour values to each other (Table 7), which ranged between 2.10 and 2.25.

pH

All cultivars had a statistically similar pH, which ranged between 4.46 and 4.76 within the trial (Table 7).

Cultivar	pH	a/b colour
H 3402	4.49	2.15
UG 16112	4.76	2.13
SVTM 9025	4.46	2.17
Syngenta – Waller	4.56	2.13
HM 58811	4.46	2.25
SVTM 9023	4.54	2.1
F Prob (p=0.05)	0.529	0.518
LSD	NS	NS

Table 7. pH and a/b colour of ripe fruit at the Boort direct seeded mid-season trial.

Acknowledgments

I would like to thank the all the farm managers that hosted the cultivar trials, and the workers who patiently planted the many different cultivars. Thank you to Hamish Lanyon for sharing the data from the direct seeding trial that he setup and established and is included in this report. A special thankyou to Bill Ashcroft for assistance with assessing the screening trials, and also to Ann Morrison for helping guide us through our first season of conducting processing tomato cultivar trials.

TomH20 - The Effect of Hot Water Treatment on Seed Germination and Vigour

Tania Zhang, Alexandre Fournier-Level, School of BioSciences, The University of Melbourne

Contact: tania.zhang@unimelb.edu.

INTRODUCTION

Hot water treatment (HWT) of tomato seed for the processing tomato industry has been widely adopted in Australia based on recommendation from agricultural research extension projects across the USA and Canada.

Hot water treatment was shown to lower microbial infection (Ivey & Miller, 2005). However, the consequence of the treatment on germination quality and seedling vigour, especially after an extended period of storage, is unknown. Understanding the broader consequence is critical to the Australian processing tomato industry, where seed retention time can be longer and the need for microbial control on seed may differ to that required by other countries.

The Australian Processing Tomato Research Council (APTRC) approached the University of Melbourne to address this knowledge gap. The following activity plan will detail how the issue of understanding the potential effect of hot water treatment on seed germination and early vigour will be addressed.

To investigate the response of seed germination and early vigour across a range of genetic backgrounds, the following six cultivars were selected for this study:

- H1015
- H3402
- HM58811
- SVTM9023
- UG16112
- UG29814

This includes the current industry standards for early and mid-season cultivars, H1015 and H3402 respectively.

METHODS AND MATERIALS:

In September of 2024, we received ~1000 seeds of each cultivar from Matthew Stewart of the APTRC. For each cultivar, seeds originated from the same batch. This reduces variability in each cultivar, but might have introduced batch effects. Seeds were first assessed for homogeneity, presence of empty seeds and mould. This was done through two tests - a germinability test and a tetrazolium test.

For the germinability test, 3 replicates of 20-25 seeds from each cultivar were sown on a petri dish containing a solution of water with 0.8% agar. These dishes were placed in a growth chamber set to a light / dark cycle as follows: 22°C 12hr light / 18°C 12hr dark. Seeds were considered germinated if at least 5 mm of the leaf shoot or root tip was visible (Fig.1 left). By day 7, all cultivars had an average germination rate above 90%, with the exception of UG29814, which took 10 days to reach >90%. This informed our decision to run the main germination experiment for 10 days.

Seeds were also assessed for quality using a tetrazolium test. (Miller, 2010). Three replicates of 20-25 seeds from each cultivar were nicked with a razor blade, then soaked in a solution of 0.1% tetrazolium salt for 24 hours with continuous agitation. The tetrazolium solution stains for cellular respiration, turning living seeds red (Fig.1 right). This was cross checked with seeds that had been heat killed, which remained white even after staining. All cultivars had an average of at least 90% living seeds. Given these results, all six cultivars passed our benchmarks for viability and quality and were cleared to proceed to the main germination and seedling vigour experiments.

In October, seeds of each cultivar were divided into 4 sets of 250 seeds, with one set for the control (no treatment) and 3 sets to be independently tested to ensure full repeatability. Seeds from the 3 test sets were placed in nylon mesh bags and immersed into 50°C sterile double distilled H_20 water for 25 min. The hot water treatment was also applied independently but simultaneously, with each set in a different hot water bath. The nylon mesh bags were hung up overnight at room temperature to allow seeds to dry.

Following the hot water treatment (HWT), each set of 250 seeds were divided into 5 batches of 50 seeds, to test the effect of storage time between HWT and sowing for the germination and seeding vigour experiments. One batch from each set (1 control, 3 HWT) was sown at 0, 2, 6, 12 and 43 weeks post-treatment, representing 5 time points (T0-T4). T0 was planted 24 hours after HWT, representing no storage time between treatment and sowing. The remainder of the seeds, including the control seeds, were stored at 15 degrees in a dark growth chamber at 50% humidity until they were sown (Fig.2).

Fig.1 Left: The germinability test, showing a plate with 95% germination.
Right: seeds after the tetrazolium test, where a red colour indicates a living seed.

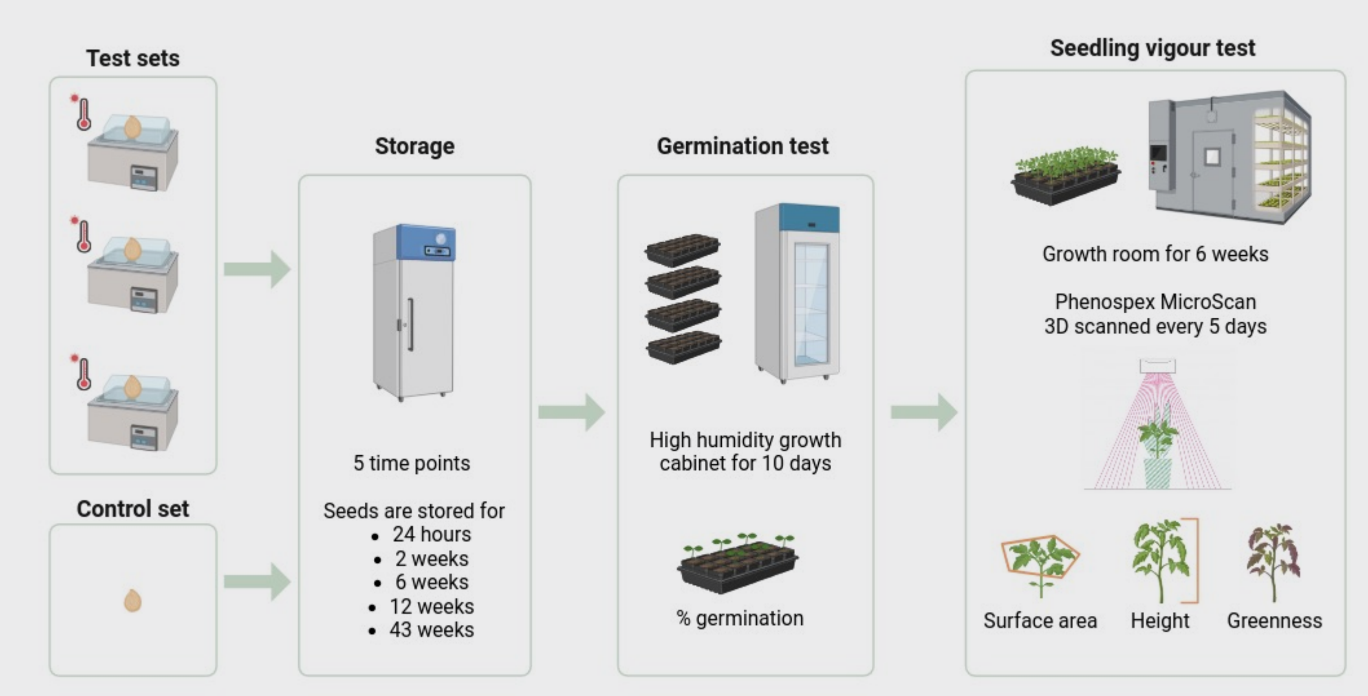


Fig.2 Overall experimental design.

GERMINATION TEST:

For each time point, 1 control set and 3 test sets for each cultivar were sown in 4.2 cm x 4.2 cm x 7.5 cm cells on separate 42-cell trays filled with a seedling raising mix (Plugger seed mix with sand, from Australian Growing Solutions). In 5 mm deep holes, one seed was sown per cell and the tray was covered in a light layer of vermiculite to aid in moisture retention. Trays were placed in a tall, solid bottom drip tray and watered-in with 2 L of 1 dS/m EC fertiliser solution, consisting of a 1:1 mix of Campbells Diamond Special T and Campbells NitroCal. Water was sprayed on the inside of clear propagation domes, which were then placed on top of the trays and sealed to the bottom tray with tape to maintain high humidity (Fig.3 left).

Trays were then placed in growth chambers at 22°C and 70% humidity for 60 hours (days 0,1 and 2) in the dark. On the morning of day 3, lights were switched on and chambers switched to a day/night cycle set to 22°C 12hr light / 18°C 12hr dark. Without removing the propagation lids, germination percentage was scored on days 3, 6 and 10, based on the emergence of cotyledons.

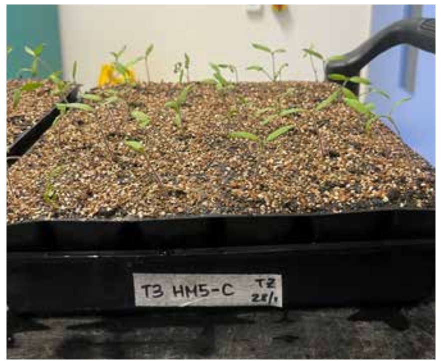


Fig.3 Left: A tray on day 0, sealed in with a propagation dome.
Right: A tray on day 10, after tomato seedlings had emerged.

Statistical analysis were carried out using R 4.1.2 (R Core Team, 2021), and the *lme4* (Bates, Mächler, Bolker & Walker, 2015).

RESULTS & DISCUSSION:

Across all timepoints, no germination was observed on day 3. This is expected, as the 60 hour dark incubation period does not typically trigger germination. At 6 days post sowing, three cultivars (HM58811, UG16112, UG29814) had consistently lower germination rates but by day 10, we saw >80% germination for all cultivars.

When we consider all cultivars together, at every storage time point, a linear regression model showed no significant effect of HWT on germination percentage on day 6 or day 10 (Table.1, Bates, 2015). Even after 43 weeks of storage time, germination rates of HWT showed no significant difference compared to non-treated control seeds.

To test the effect of different genotypes on germination rate, we compared 3 models across each day where measurements were obtained. Model 1 (null) was a linear regression model considering only treatment as the explanatory variable, Model 2 was a linear-mixed model with treatment and genotype as additive explanatory variables, and Model 3, a linear-mixed model with interaction between genotype and treatment. Model 2 with only treatment was significantly better than the null model based on AIC, BIC and deviance, but not significantly different from model 3. This suggests that the additive model best explains the data and variation in germination rates is primarily determined by cultivar.

However, when looking at individual cultivars, HWT marginally decreased germination percentage in both UG16112 and UG29814 cultivars at the 0 and 2 week timepoints (Table.2). This effect was more notable in UG1 than UG2. By the 6 week timepoint (T2), this effect was no longer observed in either cultivar. The other 4 cultivars showed no difference between the control and HWT trays at any time point.

Note that germination was only scored up to day 10, so we cannot say if total germination percentage was lowered in UG16112 and UG29814 or if the HWT merely slowed germination in these cultivars.

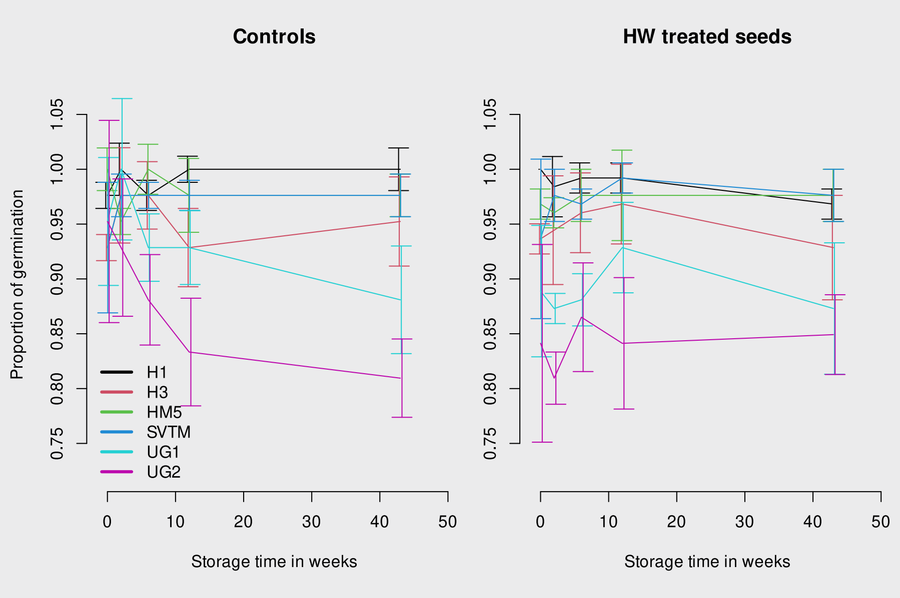


Fig.4 Proportion of germination over storage time in weeks.

Day 10 average germination %			
Timepoint	Control	With HWT	Significance
T0	95.63	92.85	-
T1	97.22	92.46	-
T2	95.63	94.04	-
T3	94.05	94.98	-
T4	93.13	92.86	-

Table.1 Average germination percentage on day 10 of the experiment, across the 5 timepoints. For statistical significance, - indicates a non-significant result, * indicates a significant result with $p<0.05$ and ** indicates a significant result with $p<0.01$.

Day 10 average germination %				
Timepoint	Genotype	Control	With HWT	Significance
T0	UG16112	95.20	88.87	*
T0	UG29814	95.20	84.13	**
T1	UG16112	100.00	87.13	*
T1	UG29814	92.90	80.97	**
T2	UG16112	92.90	88.1	-
T2	UG29814	88.10	86.53	-
T3	UG16112	92.90	92.87	-
T3	UG29814	83.30	84.13	-
T4	UG16112	88.10	87.33	-
T4	UG29814	82.53	84.93	-

Table.2 Average germination percentage on day 10 when comparing the two UG cultivars only. For statistical significance, - indicates a non-significant result, * indicates a significant result with $p<0.05$ and ** indicates a significant result with $p<0.01$.

CONCLUSION:

Overall, hot water treatment did not affect germination rates, though cultivars responded differently. In our experiment, cultivars UG16112 and UG29814 showed a slight reduction in germination rate but this effect disappeared within 2 to 6 weeks of storage post-HWT. No cultivars showed any increase in germination rates following HWT.

Growers may want to individually test their cultivars for negative effects if this is of particular concern, but across the industry, hot water treatment is not expected to have any negative or positive impacts on seedling germination.

Increased storage time negatively impacted treated and non-treated seed equally. As long as seeds are properly dried following HWT and no mold is introduced to the seed stock, there are no long-term impacts of HWT on seed germination.

SEEDLING VIGOUR TEST:

For each time point, following the conclusion of the germination test on day 10, propagation lids were removed and open trays were moved to a walk-in growth room at the UoM glasshouse complex. These larger growth rooms had conditions set to 18°C 12hr dark / 24°C 12hr light with 400μmol/m2/s light. To minimise interference and light competition, planting density in each tray was halved by removing plants in alternating cells, resulting in a checkerboard arrangement of plants in each tray (Fig.5).

To avoid any potential effects of uneven water distribution from sprinkler systems, all trays were bottom watered every Monday and Wednesday, and drained after soil reached water saturation. During this process, trays were also rotated and shifted along the workbenches, to control for any edge or positional effects within the growth room.

Every Friday, trays were watered in with 2 L of a 1 dS/m EC fertiliser solution instead, and this solution was not drained. The fertiliser solution consisted of:

- 2 ml/L of Campbell's Diamond Special T (from 250 g/L stock solution)
- 2 ml/L of Campbell's NitroCal (from 250 g/L stock solution)
- 6 ml/L of RichGro Organic Phosphorus booster (from 25 g/L stock solution)

New stock solutions were made for each timepoint and stored in the dark to prevent degradation. Before watering, the solution was also checked with an EC probe to ensure that it fell within ±0.1 dS/m. This watering and fertilising routine was maintained for the duration of the seedling vigour experiment.

For 6 weeks, trays were scanned every 4-5 days using a Phenospex microscan, equipped with a PlantEye F500 3D multispectral scanner (Phenospex, Heerlen, the Netherlands). The Phenospex creates 3D models of plants by illuminating the plants with a flashing light and capturing reflected wavelengths as it moves across the tray (Fig.6). This method of trait measurement can capture data with much greater speed and accuracy compared to manual measurements. The scanner can also estimate certain traits like biomass over time without killing the plant, unlike traditional methods of measuring biomass. The trays were scanned on slow settings to maximise resolution.

Fig.5 Left: Tomato seedlings after density reduction, in a checkerboard pattern.
Right: The walk in growth room where our experiment was conducted, with T0 on the left bench, T1 on the right bench and the Phenospex in the centre of the room.

Each scan recorded 14 discrete traits, including seedling height, leaf surface area, normalized difference vegetation index (NDVI, an index comparing reflected red light and near infrared light) and estimated biomass. This allowed comparison of growth indicators and photosynthetic efficiency over time between the control and hot water treated trays.

Statistical analyses were carried out using R 4.1.2 (R Core Team, 2021), the lme4 (Bates, Mächler, Bolker & Walker, 2015) and the FactoMineR (Le, Josse & Husson, 2008) packages.

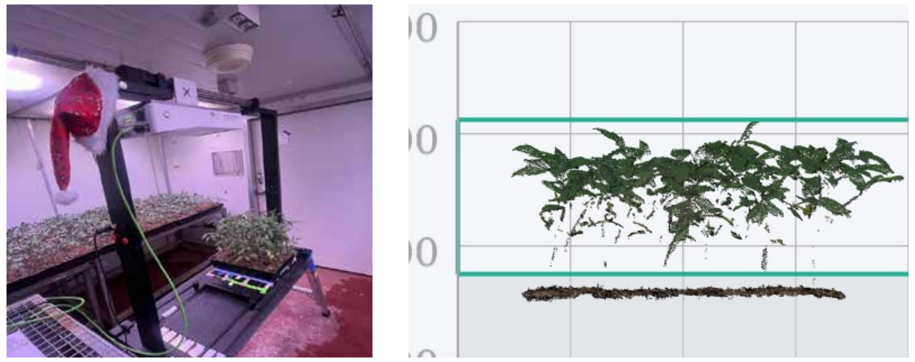


Fig.6 Left: A tray of tomato seedlings being scanned by the PlantEye of the Phenospex.
Right: A 3D model of a tray constructed by the PlantEye.

RESULTS & DISCUSSION:

We generated a large set of plant traits measurement over the duration of the experiment. We used Principal Component Analysis (PCA) to reduce dimensionality in the dataset and identify the most important traits to consider in our analysis.

Highly correlated traits were excluded from the PCA analysis. For example, projected leaf surface area, which had a correlation coefficient of r=0.99 with leaf surface area, was excluded.

Principal Components 1 and 2 explained 72% and 18% of the variation in the data, respectively. Top contributing traits to PC1, in decreasing order, were average NDVI, leaf surface area (mm²), digital biomass (mm3), average hue degree and height (mm). Top contributing traits to PC2 were average NPCI (a measure of chlorophyll content) and average greenness.

Following this, we chose leaf surface area, digital biomass and height as our main indicators of plant growth and seed vigour. Out of the four multispectral traits (NDVI, hue, NPCI and greenness), we chose NDVI as our main indicator as it is highly correlated with photosynthetic rates and is commonly used to quantify plant health (Gamon et al., 1995).

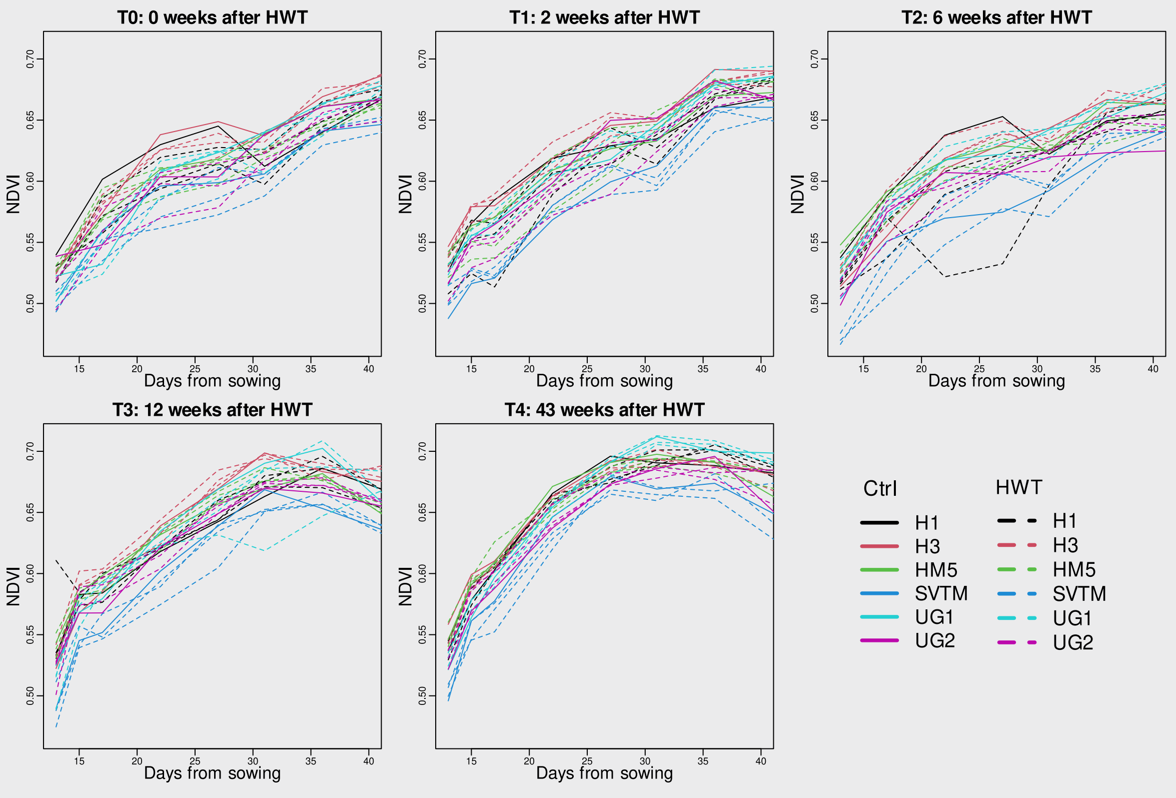


Fig.7 NDVI over time for each storage timepoint.

NDVI ranges from -1 to 1, with positive values representing healthier plants. No significant effect of HWT on NDVI was observed at any of our 5 timepoints, indicating that HWT does not lead to healthier or less healthy seedlings, compared to non-treated seeds.

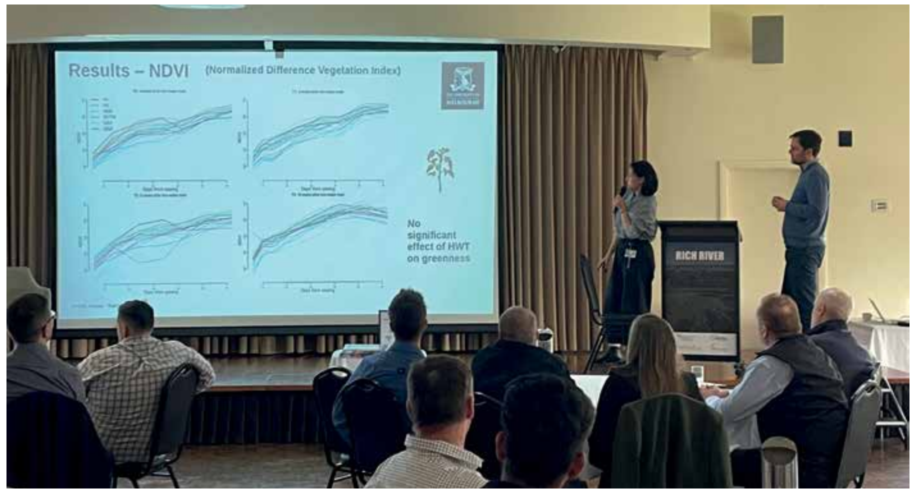


Image: Tania and Alex presenting at the Annual APTRC Forum

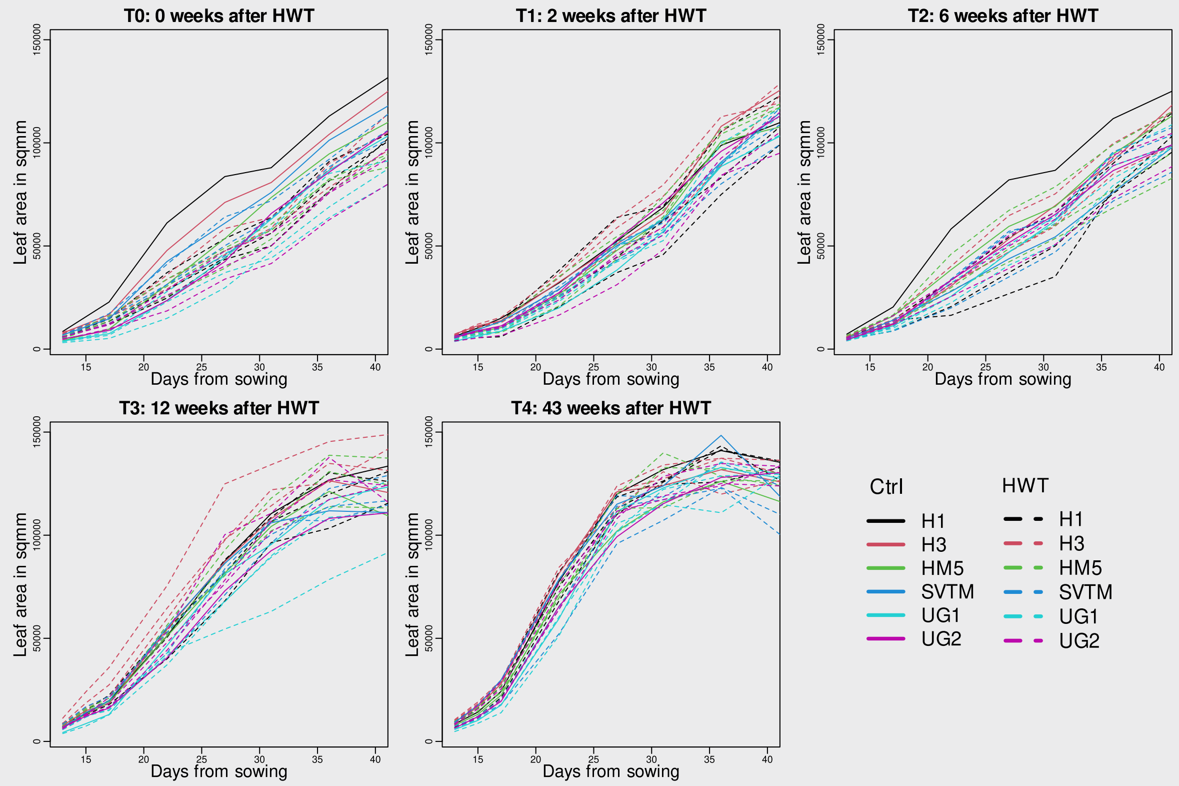


Fig.8. Leaf area in mm² over time for each storage timepoint.

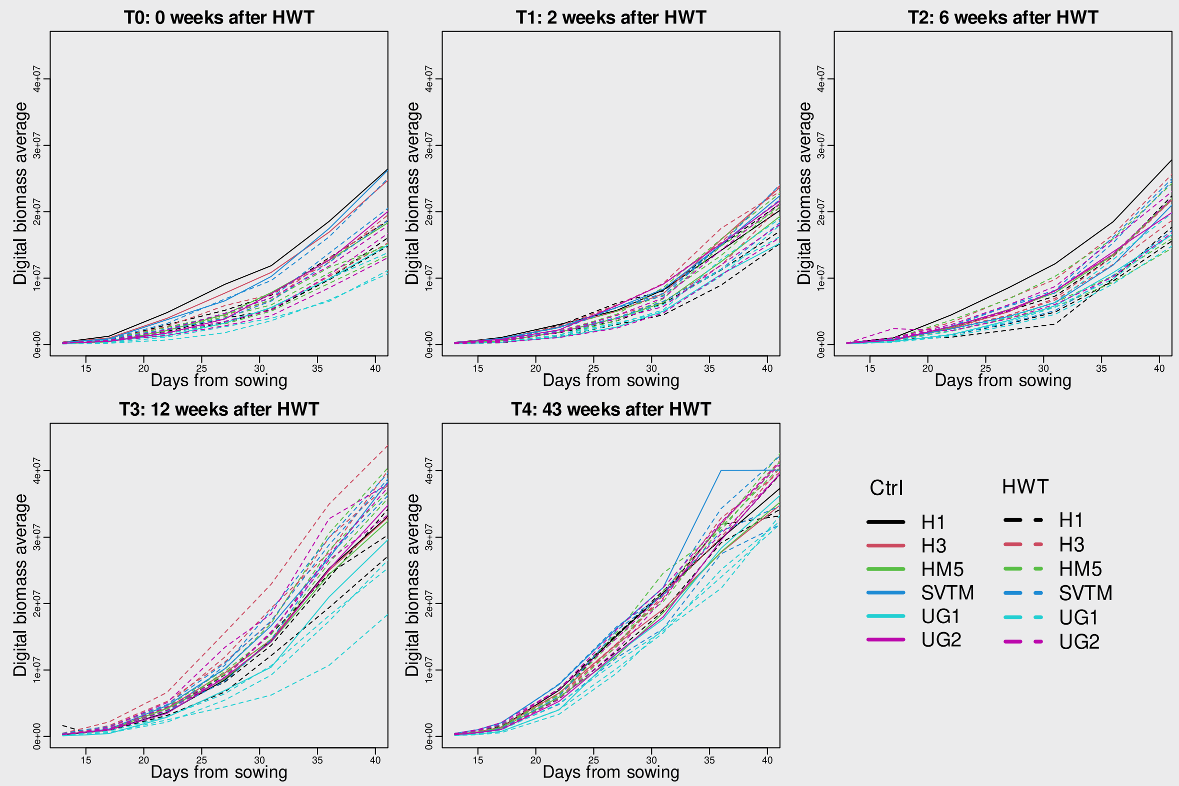


Fig.9. Digital biomass in mm³ over time for each storage timepoint.

Leaf surface area and biomass are key drivers of seedling vigour. Higher leaf surface area allows for more light capture and increased photosynthesis, leading to better growth. Higher biomass represents a larger and better established plant.

At T0, HWT resulted in decreased leaf surface area and biomass in all cultivars in the later stages of seedling growth (Fig.8, Fig.9). This result suggests that plants grow less vigorously when sown immediately (within 24hrs) of HWT. This may lead to decreased tomato yield or worse survival rates when transplanted into fields, though this was not tested in this study.

HWT did not have a significant effect on leaf area or biomass at any other storage timepoint. This indicates that storing seeds after HWT can reverse this negative initial effect of the treatment. We did not test any storage time points between 24hrs and 2 weeks, so further testing would be required to determine the exact length of storage time required to reverse this effect. Long term storage of up to 43 weeks also resulted in no decreases in leaf area or biomass.

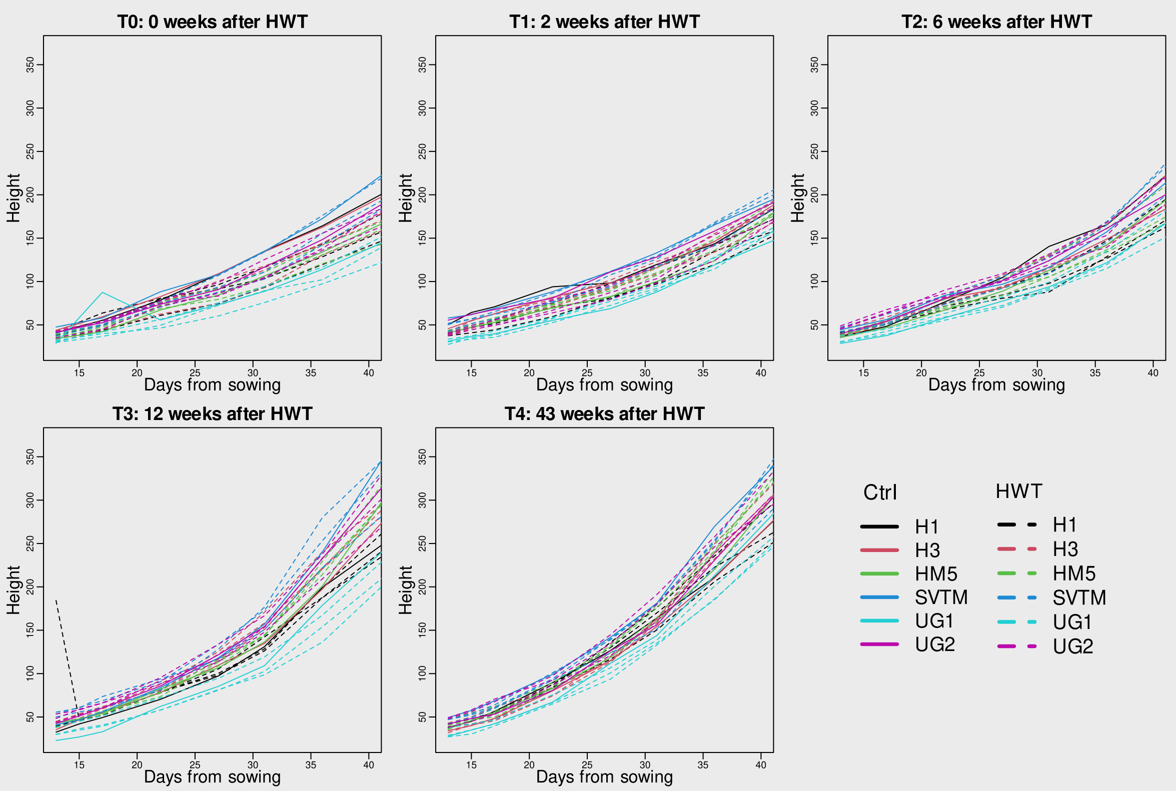


Fig.10. Plant height over time for each storage timepoint.

Another key indicator of plant health and vigour is height. At 17 days post sowing T0, HWT decreased average plant height by 10 mm (p=0.026) However, this effect was not observed in T0 plants on any other day of the experiment, and also not observed at any other storage timepoint. This suggests that HWT seeds grow slower initially when sown immediately (within 24hrs) of treatment, though plants eventually reach similar heights compared to non-treated seeds. Storing seeds also reverses this negative effect.

Notably, no differences in any trait were seen in T4 across the whole 6 week growing period. Long term storage did not have significant effects on early seedling vigour.

Although the HWT had no effect after a long period of storage, we saw plants reach their peak leaf surface area and average NDVI earlier in time points T3 and T4 compared to other timepoints. Plants also reached a greater average height by 42 days post sowing. Typically, seedling vigour is expected to decline as storage time increases, which made the previous result unexpected.

One possible explanation for this is the duration of the seedling vigour test, T0, T1 and T2 coincided in the growth room. Trays from each time point were grown on separate workbenches, hence not directly competing for light. However, the presence of more plants in the room may have shielded peripheral light or reduced airflow within the room, resulting in slower early growth. Since trays in T3 and T4 did not overlap with another timepoint, these potential additional factors were absent.

Alternatively, since the germination rate by day 10 was lower in T3 and T4, thinning each tray to exactly 21 plants when transitioning to the seedling vigour experiment may have inadvertently selected for stronger germinants, leading to better growth.

CONCLUSION:

HWT resulted in a minor reduction in biomass and leaf surface area of plants at T0, our HWT+24hr time point, but no change compared to non-treated seeds by T1, our HWT+2week time point. Based on our results, a storage time of at least 2-14 days following HWT can prevent any negative impacts of HWT on early seedling vigour.

All major traits describing seedling vigour remained unaffected by HWT over storage time. Based on our findings, storing seeds for prolonged periods up to 43 weeks following HWT will not have any positive or negative effects on seedling vigour.

The unexpected increase in seedling vigour at later timepoints indicates that these traits are highly sensitive and many other factors influence early seedling growth, and warrant future research to optimise early growth conditions.

For seed lines without any prior seed treatments, and if microbial contaminants are likely to be present, hot water treatment may play an important role in reducing risks of seed-borne pathogens.

This study showed no significant impacts on early growth or seedling vigour, either negative or positive by performing HWT on tomato seeds. Therefore, HWT of tomato seeds in Australia seems only necessary if a risk of seed borne microbial pathogens is present. Any justification for HWT for improved germination rates or enhanced vigour is also purely subjective and not based on findings from this scientific study.

ACKNOWLEDGEMENTS:

This project was funded by the Australian Processing Tomato Research Council. I would like to thank Matthew Stewart of the APTRC for coordinating the project and Steven Elefteriadis, Glasshouse Complex Manager at UoM for his ongoing assistance in the glasshouse facilities.

REFERENCES:

Gamon, J., Field, C., Goulden, M., Griffin, K., Hartley, A., Joel, G., Penuelas, J., & Valentini, R. (1995). Relationships Between NDVI, Canopy Structure, and Photosynthesis in Three Californian Vegetation Types. *Ecological Applications*, *5*, 28–41. https://doi.org/10.2307/1942049

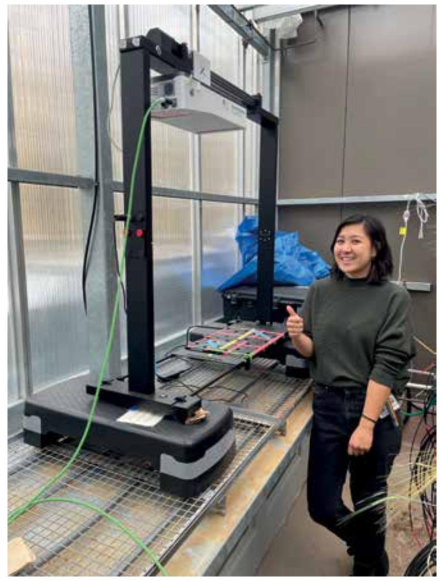
Ivey, M., & Miller, S. (2005). Evaluation of hot water seed treatment for the control of bacterial leaf spot and bacterial canker on fresh market and processing tomatoes. *Acta Horticulturae*, *695*, 197–204. https://www.actahort.org/books/695/695_22.htm

Miller, A. Logan., Subcommittee, A. of O. S. A. T., & Technologists, S. of C. S. (2010). Tetrazolium testing handbook. In *Tetrazolium testing handbook*. AOSA & SCST.

Douglas Bates, Martin Maechler, Ben Bolker, Steve Walker (2015). Fitting Linear Mixed-Effects Models Using lme4. Journal of Statistical Software, 67(1), 1-48. doi:10.18637/jss.v067.i01.

Sebastien Le, Julie Josse, Francois Husson (2008). FactoMineR: An R Package for Multivariate Analysis. Journal of Statistical Software, 25(1), 1-18. 10.18637/jss.v025.i01

R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.r-project.org/



Top: Tania Zhang
Below: Matt Stewart and Alexandre Fournier-Level

Soilborne Tomato Diseases: Key Findings & Next Steps

Key findings on diversity and pathogenicity of soilborne diseases of processing tomato and implications for management and future research

Key findings on diversity and pathogenicity of soilborne diseases of processing tomato and implications for management and future research

Hanyue Feng, Jiajing Cao, Jason Risteski, Paul W. J. Taylor, Sigfredo Fuentes, Alexis Pang, and Niloofar Vaghefi

School of Agriculture, Food and Ecosystem Sciences, Faculty of Science, the University of Melbourne, Parkville 3010, Victoria, Australia

Contact: vaghefin@unimelb.edu.au

1. INTRODUCTION

Fusarium oxysporum and several *Pythium* species have been identified as major soilborne pathogens contributing to root disease and yield decline of processing tomatoes in Australia (Callaghan, 2020; Callaghan et al., 2022; Feng et al., 2022). *Fusarium oxysporum* is associated with tomato wilt and root rot and can severely reduce plant vigour and productivity; and *Pythium* species are known to cause pre-mature damping-off of tomato seedlings as well as root rot, particularly in cool and humid conditions (Callaghan et al., 2022; Ma et al. 2023).

Fusarium oxysporum is a genetically diverse species complex (FOSC) comprising multiple *formae speciales* (f. sp.), each presumed to have adapted to infect specific host species (Edel-Hermann and Lecomte, 2019). In tomatoes, two *formae speciales* are of particular relevance: *F. oxysporum* f. sp. *lycopersici* (FOL), which causes Fusarium wilt, and *F. oxysporum* f. sp. *radicis-lycopersici* (FORL), responsible for Fusarium collar and root rot. FORL has not been reported in Australia, whereas FOL has been reported on tomato in Queensland (Ramsey et al., 1992). FOL includes different physiological races differentiated by their ability to infect tomato cultivars carrying specific resistance, or immunity (*I*), genes. Globally, three FOL races have been described, with race 3 first reported in Queensland (Ramsey et al., 1992; Swett et al., 2023).

Characterisation of *F. oxysporum* isolates requires both species-level identification and assessment of race-specific pathogenicity because these do not always correlate (Lievens et al., 2009). While conserved core genome markers, *i.e.*, housekeeping genes, can reliably identify species, differentiation of *formae speciales* and races has relied on either glasshouse pathogenicity assays against a differential set of tomato cultivars or characterisation of pathogenicity-related genes (Achari et al., 2021). These pathogenicity-related genes include secreted in xylem (*SIX*) and polygalacturonase (*PG*) genes, which are involved in host infection and can trigger resistance responses in specific tomato cultivars (Jangir et al., 2021; Mahmood et al., 2021). Characterising these genes in *Fusarium oxysporum* has been reported to provide insights into pathogen virulence, host specificity, and race structure, which are critical for cultivar selection.

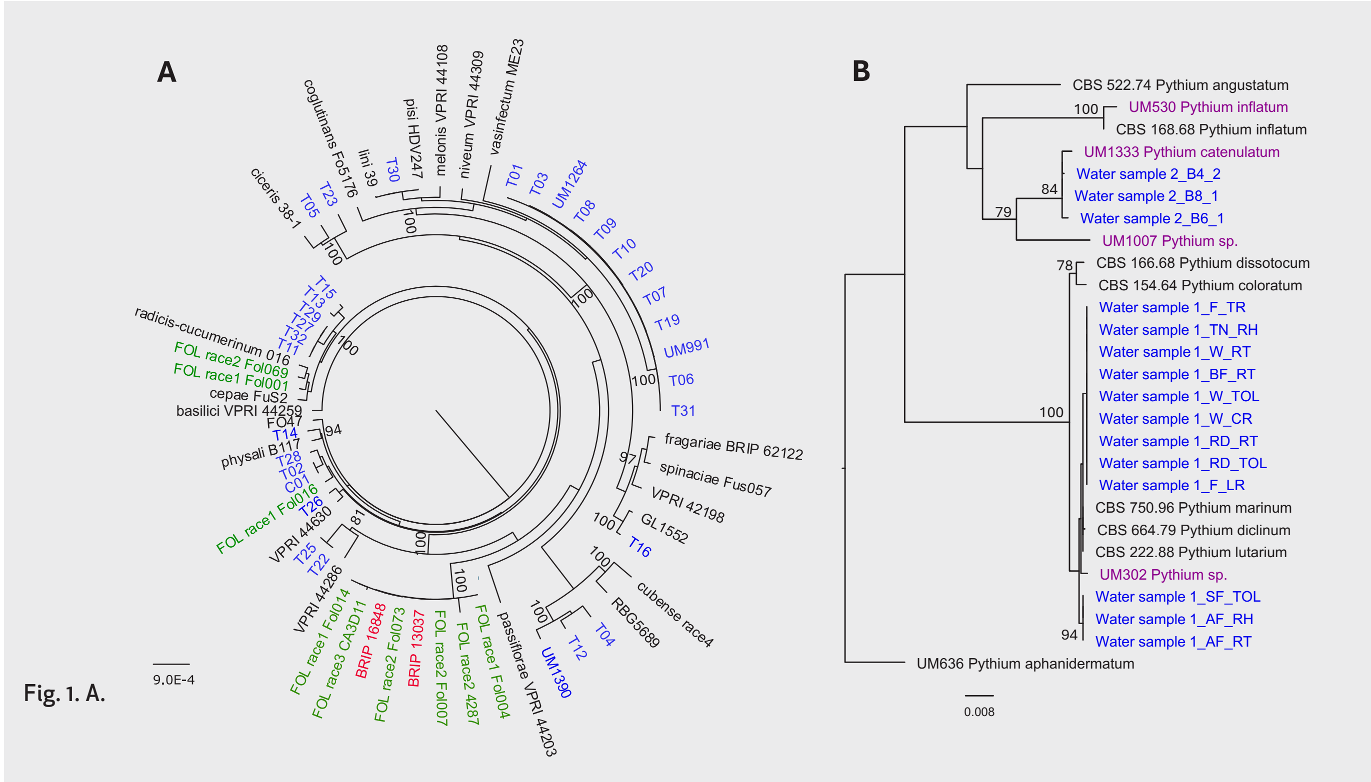
The second group of soilborne tomato pathogens, *Pythium* species, are soilborne and waterborne. Infections typically occur during the early developmental stages of plants (Callaghan et al., 2022). In the presence of free water, zoospores are chemotactically attracted to germinating seeds or roots of tomato, where they penetrate host tissue, block the flow of water and nutrients, and result in root decay and ultimately plant mortality in severe infections (Adhikari et al., 2024). Given the motility of zoospores in water, previous studies have highlighted the epidemiological importance of water as a dissemination pathway for *Pythium* species (Redekar et al., 2019).

Recent research projects conducted at the University of Melbourne have focused on understanding the taxonomy and diversity of *F. oxysporum* and *Pythium* species in Australian processing tomato fields, as well as investigation of pathogenicity, early detection and quantification of *F. oxysporum* isolates in infested soil and infected processing tomato plants (Callaghan et al., 2022; Feng et al., 2022, 2023, 2024; Risteski et al., 2024). This article summarises the key findings and implications for disease management and future research. By linking pathogen characterisation with disease management considerations, these studies aimed to provide evidence-based guidance for growers for sustainable production in the Australian Processing Tomato Industry.

2. SUMMARY OF FINDINGS

Fusarium oxysporum and several _Pythium_ species were associated with diseased tomato plants and irrigation water in processing tomato fields

Field surveys were conducted over several years to collect symptomatic plant material from commercial processing tomato crops exhibiting yellowing, stunting, and overall poor growth. Irrigation water samples from two locations were also included. Isolation from root, collar and lower stems were conducted on plant samples while healthy tomato seedlings were used to bait waterborne pathogens from water samples. *Fusarium oxysporum* was consistently isolated from symptomatic tissue with vascular and root decay, along with the occasional presence of *Pythium* spp. Both pathogens were also present in one water sample, while the second water sample only carried *Pythium*. The persistence of both pathogens in affected fields and irrigation water highlights their capacity to survive across growing seasons and potentially contribute to the yield decline of processing tomatoes.



Molecular analyses using multi-gene phylogenetic approaches as well as whole genome sequencing confirmed that all *Fusarium* isolates obtained from symptomatic processing tomatoes belonged to the *F. oxysporum* species complex (FOSC), with high genetic diversity that showed their diverse genetic backgrounds (Fig. 1.A). More specifically, this analysis showed the distinct genetic background of the *F. oxysporum* isolates from processing tomato in NSW and Vic (blue in Fig. 1.A) compared to those associated with fresh tomato production in Qld (red in Fig. 1.A).

Fig. 1. A. Genome-wide phylogeny of *Fusarium oxysporum*. Isolates from processing tomato in NSW and Vic are shown in blue while Qld *F. oxysporum* f. sp. *lycopersici* (FOL) isolates from fresh tomato production are indicated in red. FOL isolates from overseas are shown in green. Isolates from other *formae speciales* or those without an assigned *forma specialis* are in black. **B.** Five-gene phylogeny of *Pythium dissotocum/diclinum* species complex based on concatenated alignment of the internal transcribed spacers of the ribosomal DNA (ITS), Cytochrome c oxidase subunit I (*Cox1*) and subunit II (*Cox2*), beta tubulin (*tub2*), and mitochondrial 40S ribosomal protein S10 (*rps10*) genes. Isolates from irrigation water samples are shown in blue while isolates from processing tomato plants in NSW and Vic are shown in purple.

Further characterisation of pathogenicity-related loci, including several *PG* gene markers indicated that several isolates were genetically similar to FOL race 3 from overseas, while results from *SIX* genes showed divergence from known races (Feng et al., 2023, 2024). The discrepancies amongst the tested marker systems indicate that partial pathogenicity genes developed based on overseas isolates may not resolve *F. oxysporum formae speciales* or FOL races in the Australian pathogen populations.

The two water samples were found to harbour different *Pythium* species (Fig. 1.B). One water sample included *P. catenulatum*, which was also previously isolated from processing tomato plants in Australia (Callaghan et al., 2022) while the other sample harboured potentially two *Pythium* species within the taxonomically unresolved *dissotocum/diclinum* complex.

All tested _Fusarium oxysporum_ isolates caused disease on all tested processing tomato cultivars, irrespective of isolate genetic background

To assess pathogenicity and host responses, several replicated glasshouse bioassays were established using representative *F. oxysporum* isolates. Disease severity, plant growth, physiological parameters and symptom expression were monitored under controlled conditions to evaluate the virulence spectrum across isolates. Results confirmed that all tested *F. oxysporum* isolates induced wilt or caused significant root growth reduction in processing tomato plants, regardless of their phylogenetic placements or race classification (Feng et al., 2023).

Image, opposite page: Niloofar Vaghefi and Hanyue Feng in the greenhouse.

SOILBORNE TOMATO DISEASES

Fig. 2

Pathogenicity of *Pythium dissotocum/ diclinum* on tomato and potential interaction with *Fusarium oxysporum*

One replicated glasshouse bioassay was recently completed which indicated an isolate obtained from irrigation water and identified within the *Pythium dissotocum/ diclinum* complex caused yellow and brown discolouration of older leaves (Fig. 2) and significantly reduced root growth in processing tomato at 1.5% inoculum level. A potential synergistic effect of *Fusarium* and *Pythium* was detected with 20% mortality rate in plants co-inoculated with both pathogens; however, this is based on one experiment only, and results need to be repeated. The *F. oxysporum* isolate used in the experiment had been isolated from irrigation water, indicating the role of irrigation in spread of pathogenic *F. oxysporum* isolates.

Fig. 2. Visual comparison of **A.** an asymptomatic, non-inoculated tomato plant with **B.** *Fusarium oxysporum* inoculated plant showing chlorosis, **C.** *Pythium dissococum/diclinum* inoculated plant showing chlorosis and necrosis, and **D.** a plant co-inoculated with both *Fusarium* and *Pythium*.

Pathogen detection in the soil and infected plants

Beyond pathogen characterisation, Hanyue Feng's PhD project focused on developing novel tools for early disease detection and quantification to support integrated disease management. An e-nose coupled with machine learning successfully differentiated between healthy and infected plants based on the production of volatile compounds, demonstrating the potential for non-destructive, early-stage diagnosis of *F. oxysporum* infection (Feng et al., 2022).

Quantification of *Fusarium* inoculum proved to be more challenging as several published quantitative real-time PCR (qPCR) assays developed overseas failed to detect the Australian *Fusarium* isolates. Therefore, a modified qPCR assay was designed specifically for an aggressive Australian *Fusarium* isolate, which further enabled precise detection and quantification of *F. oxysporum* in both plant tissue and soil samples. This further highlights the distinct genetic background of the local *Fusarium* population compared with those reported internationally and reinforces the need for region-specific diagnostic tools and continued molecular surveillance to capture the unique diversity of Australian *F. oxysporum* populations and ensure the accuracy of detection systems.

Contribution of non-host crops to *Fusarium* carryover between growing seasons

The optimised qPCR assay was used to quantify pathogen inoculum levels both *in planta* and in soil samples, which enabled the evaluation of pathogen dynamics is processing tomato and several other crops commonly grown in rotation with tomato, including barley, canola, faba bean and wheat. *Fusarium oxysporum* was able to asymptomatically infect all tested rotation crops, indicating that all crops contributed to survival of *F. oxysporum* in processing tomato fields.

However, different crops carried variable amounts of inoculum. Soil cropped to tomato carried the highest levels of *F. oxysporum* inoculum, as expected. All rotation crop soils had significantly less *Fusarium* DNA detected compared to soil previously cropped with processing tomato. However, soils cropped with canola and faba bean contained lower amounts of *Fusarium* DNA compared to soils cropped with barley and wheat, indicating that canola and faba bean may be a better rotation option for fields with high *Fusarium* levels in previous seasons.

3. CONCLUSION

This research has advanced our understanding of soilborne pathogens contributing to yield decline in Australian processing tomatoes. The genetic distinctiveness of Australian *Fusarium oxysporum* populations and their pathogenicity on imported cultivars highlight the need for screening imported material against local pathogen populations. Reliance on overseas disease resistance ratings may not be appropriate, and continued monitoring of pathogen diversity and pathogenicity on newly imported cultivars will be essential for effective disease management.

The development of DNA-based diagnostics enables rapid and accurate detection of pathogenic isolates in plant tissue and soil, which could further be used to identify management interventions that reduce inoculum levels in the soil. Once adapted and optimised for field use, these molecular quantification tools could guide cultivar selection, identify high-risk areas, or evaluate the effectiveness of management practices such as crop rotation and soil disinfestation in reducing inoculum. Future work should focus on expanding molecular-based diagnostic tools for rapid, in-field detection and

Key findings on diversity and pathogenicity of soilborne diseases of processing tomato and implications for management and future research

quantification of both *Fusarium* and *Pythium* inoculum in soil, plant tissues and water samples.

The use of sensor-based technologies such as electronic noses, combined with machine learning modelling, represents a promising direction for disease surveillance. Non-destructive detection of early infection through volatile compound production offers the potential for real-time, in-field detection. When used alongside molecular tools, these approaches could potentially form the basis of an integrated early detection system to support precision management.

This work also confirms that irrigation water can harbour pathogenic *Fusarium* and *Pythium* species, identifying it as a potential pathway for pathogen dispersal. The presence of different *Pythium* taxa in different water samples underscores the need for more extensive surveillance of irrigation water sources. However, the presence of a pathogen in water does not necessarily indicate that it contributes to epidemics in the field. Future research should, therefore, incorporate larger numbers of water samples to characterise the diversity of waterborne pathogens, and use population genetics approaches to track pathogen lineages across water, soil, and plant samples. Such approaches would help quantify the extent to which waterborne inoculum contributes to disease development in Australian processing tomato systems.

Acknowledgements

We would like to thank the Australian Processing Tomato Research Council for supporting the projects, and especially Mr Matthew Stewart for his assistance with sampling and for his insightful discussions. The first author is supported by a Melbourne Research Scholarship.

References

Adhikari A, Oli D, Poudel P, Magar P, Pandit S, Pokhrel A, Gurung S, Shrestha J (2024) *Pythium*-induced damping-off disease and its management in tomato (*Solanum lycopersicum* L.): A review. Agricultural Science & Technology, 16(1), 3-17.

Achari SR, Kaur JK, Mann RC, Sawbridge T, Summerell BA, Edwards J (2021) Investigating the effector suite profile of Australian *Fusarium oxysporum* isolates from agricultural and natural ecosystems. Plant Pathology, 70(2), 387-396.

Callaghan SE (2020). Root and collar rot pathogens associated with yield decline of processing tomatoes in Victoria, Australia. PhD thesis. The University of Melbourne.

Callaghan SE, Burgess LW, Ades P, Tesoriero LA, Taylor PWJ (2022) Diversity and pathogenicity of *Pythium* species associated with reduced yields of processing tomatoes (*Solanum lycopersicum*) in Victoria, Australia. Plant Disease, 106(6), 1645-1652.

Edel-Hermann V, Lecomte C (2019) Current Status of *Fusarium oxysporum Formae Speciales* and races. Phytopathology, 109(4), 512-530.

Feng H, Gonzalez Viejo C, Vaghefi N, Taylor PWJ, Tongson E, Fuentes S (2022) Early detection of *Fusarium oxysporum* infection in processing tomatoes (*Solanum lycopersicum*) and pathogen–soil interactions using a low-cost portable electronic nose and machine learning modeling. Sensors, 22(22), 8645.

Feng H, Taylor PWJ, Fuentes S, Pang A, Vaghefi N (2024) Investigating the race structure and alternative hosts of *Fusarium oxysporum*. Australian Processing Tomato Grower, 45, 21-24.

Feng H, Taylor PWJ, Fuentes S, Pang A, Vaghefi N (2023) Identification of *Fusarium oxysporum* isolates associated with yield decline of Australian processing tomatoes. Australian Processing Tomato Grower, 44, 19-23.

Jangir P, Mehra N, Sharma K, Singh N, Rani M, Kapoor R (2021) Secreted in xylem genes: Drivers of host adaptation in *Fusarium oxysporum*. Frontiers in Plant Science, 12, 628611.

Lievens B, Houterman PM, Rep M (2009). Effector gene screening allows unambiguous identification of *Fusarium oxysporum* f. sp. *lycopersici* races and discrimination from other formae speciales. FEMS Microbiology Letters, 300(2), 201-215.

Ma M, Taylor PWJ, Chen D, Vaghefi N, He J.-Z. (2023). Major soilborne pathogens of field processing tomatoes and management strategies. Microorganisms, 11(2), 263.

Mahmood U, Fan Y, Wei S, Niu Y, Li Y, Huang H, Chen Y, Tang Z, Liu L, Qu C, Zhang K, Li J, Lu K (2021) Comprehensive analysis of polygalacturonase genes offers new insights into their origin and functional evolution in land plants. Genomics, 113, 1096-1108.

Ramsey M, O'Brien R, Pegg K (1992) *Fusarium oxysporum* associated with wilt and root rot of tomato in Queensland; races and vegetative compatibility groups. Australian Journal of Experimental Agriculture, 32(5), 651-655.

Redekar NR, Eberhart JL, Parke JL (2019) Diversity of *Phytophthora*, *Pythium*, and *Phytopythium* species in recycled irrigation water in a container nursery. Phytobiomes Journal, 3, 31-45.

Risteski J, Feng H, Tongson E, Taylor PWJ, Vaghefi N (2024) *Pythium* species isolated from irrigation water in a processing tomato field in Australia. Australian Processing Tomato Grower, 45, 25.

Swett CL, Del Castillo Múnera J, Hellman E, Helpio E, Gastelum M, Lopez RE, Johnson H, Oguchi R, Hopkins A, Beaulieu J, Rodriguez F (2023) Monitoring for a new I3 resistance gene-breaking race of *F. oxysporum* f. sp. *lycopersici* (Fusarium wilt) in California processing tomatoes following recent widespread adoption of resistant (F3) cultivars: Challenges with race 3 and 4 differentiation methods. Frontiers in Plant Science, 14, 1088044.

Portugal & Spain report

Matthew Stewart, Industry Development Manager

PORTUGAL–SPAIN PROCESSING TOMATO INDUSTRY STUDY TOUR 2025

In August 2025, an Australian delegation of processing tomato growers, agronomists and industry representatives undertook a structured study tour across Portugal and Spain to examine production systems, processing integration and research frameworks operating in two globally significant tomato regions. The tour focused on varietal development, irrigation and fertigation strategies, disease management, data-driven decision-making and processor–grower integration under increasing climate and regulatory pressure.

The delegation included growers Gerard Kennedy (Kennedy Agricultural), Tim Sawers and Hamish Lanyon (Sawers Farms); processing representatives Darcy Kirchhofer, Adrian Wren and Stuart McColl (Kagome); agronomists Paul Elton (IK Caldwell), Doug Perryman (Perryman Ag) and Matt Nihill (Nutrien); logistics manager Mark Cashin (Kagome); and Matt Stewart representing APTRC as tour organiser.

PORTUGAL - SEMINIS AND HIT FIELD VISITS – TEJO RIVER FLOODPLAIN

The tour commenced in the Tejo River floodplain with field visits hosted by Seminis and HIT/Kagome Portugal, led by Cristina Lima and Alexandre Coelho. Discussions focused on varietal deployment and agronomic adaptation to soilborne disease pressure, particularly the widespread requirement for *Fusarium oxysporum f.sp. lycopersici* Race 3 resistance. This trait has become a baseline requirement in affected production zones.

Seminis hybrids, including SVTM9018, SVTM9034 and SVTM9336, now account for approximately 20% of the Portuguese market. Heinz varieties remain dominant at approximately 50%, with United Genetics cultivar UG16112 planted on roughly 30% of the area.

Planting densities of 30,000–33,000 plants per hectare are standard practice, driven by weed suppression, reduced chemical options and canopy management for sunburn mitigation. Drip irrigation is installed at transplanting and pressurised immediately. Water quality challenges include elevated pH (often above 8.0) and suspended solids, resulting in frequent filtration and emitter blockages. Peroxide flushing and, where required, installation of secondary above-vine drip lines mid-season are used to maintain system integrity.

Digital agronomy tools are widely adopted, with on-board harvester sensors and real-time yield mapping via Bayer FieldView supporting hybrid evaluation across environments. Late blight remains the primary disease constraint in Portugal, while kaolin and sunscreen sprays are routinely used to manage heat and radiation stress.

GROWER VISITS – VILA FRANCA DE XIRA AND CARREGADO

Commercial grower visits near Vila Franca de Xira and Carregado, guided by Sofia Stilwell (HIT/Kagome Portugal), highlighted a high level of mechanisation combined with intensive soil and nutrient management. Guaresi and Barigelli harvesters were observed operating with telemetry and load-cell systems for yield verification and harvest monitoring.

Ferrari automatic transplanters with integrated drip tape installation achieved planting rates of approximately one hectare per hour, while manual carousel crews remained common in smaller or fragmented blocks.

Fertigation programs typically delivered 280–300 kg nitrogen per hectare across the season, applied via bi- or tri-weekly fertigation. Programs were supported by regular leaf tissue testing and frequent adjustment of nutrient formulations. Particular emphasis was placed on potassium and calcium management to optimise colour, firmness and processing performance.

Soils in the region were notable for depth and structure, with mouldboard ploughing used to invert deep, well-aggregated profiles. Despite favourable physical properties, nematodes and southern blight remained ongoing risks, particularly on heavier soil types.

FIT PROCESSING FACILITY

At the FIT processing facility, the delegation followed product flow from receival through pilot and commercial processing. The Portuguese processing model is characterised by close grower–processor integration, with daily data exchange and incentive structures prioritising colour and soluble solids over raw tonnage.

Transport logistics varied between processors, with FIT contracting approximately 89% of cartage, compared with higher levels of grower-owned transport elsewhere. The group observed reverse-osmosis concentration technology and evaluated hot-break versus cold-break paste streams, highlighting processing trade-offs affecting viscosity, flavour profile and yield recovery.

KAGOME AGRICENTER AND HIT PILOT PLANT

The visit to Kagome's Agricenter featured presentations from Take Arai and João Madeira outlining Kagome's integrated research and development framework. Field trials are closely linked to pilot-scale processing, enabling rapid feedback between agronomy, processing efficiency and commercial deployment.

Seminis hybrids account for approximately 20% of the Portugese market.

Planting densities of 30,000–33,000 plants per hectare are standard practice,

HIT/ Kagome export approximately 97% of production to more than 30 countries.

...close grower–processor integration, with daily data exchange and incentive structures prioritise colour and soluble solids over raw tonnage.

Key research themes included nanobubble irrigation to enhance dissolved oxygen availability, biostimulants for abiotic stress tolerance, super-absorbent polymers to improve water-use efficiency, and strigolactone-mediated broomrape management. Breeding priorities were centred on colour, viscosity and peel ability, with mid-brix cultivars positioned to balance factory throughput and grower returns.

At the HIT pilot plant, Artur Noro and Sofia Stilwell guided the delegation through product development facilities, followed by structured tastings led by Marta Nunes and her team. Product differentiation, formulation flexibility and export market requirements were highlighted, with HIT/Kagome exporting approximately 97% of production to more than 30 countries.

VILA FRANCA DE XIRA FIELD PROGRAM AND CROPSCOPE

Field inspections around Vila Franca de Xira included irrigation infrastructure influenced by tidal salinity in the Tejo River. Pumping is restricted to low-salinity windows, requiring precise scheduling. Typical seasonal water use was 4.5–5.0 ML per hectare, applied through pulse irrigation strategies.

Drip tape recovery and recycling are mandatory, with open-field burning prohibited. Crop rotations varied from tomato–wheat systems to extended breaks with brassicas, although economic pressure has resulted in long-term continuous tomato production in some fields.

The Cropscope field demonstration, led by Nuno Santos, showcased satellite-based NDVI analysis integrated with LoRaWAN soil moisture probes to support variable-rate irrigation and improved within-field uniformity.

SPAIN – EXTREMADURA, CTAEX, CICYTEX AND CONESA GROUP

In Spain's Extremadura region, field visits with Seminis and grower Antonio demonstrated production systems operating under sustained high temperatures exceeding 40 °C. Fertigation programs delivered 200–280 kg nitrogen per hectare, with strong emphasis on potassium and calcium during fruit fill. Crop rotations were more frequent than in Portugal, assisting nematode management.

Research visits to CTAEX and CICYTEX, led by Carlos Campillo Torres, highlighted coordinated public–private investment in tomato research, including grafting, nitrogen optimisation, heat mitigation, biological nematode suppression and decision-support systems for harvest forecasting.

The tour concluded with Conesa Group, hosted by Manuel Vázquez, Antonio Bernabé, Anton Cordoba and Luis Garcia. Conesa processes approximately 1.4 million tonnes annually, operates 11 factories globally and exports around 80% of production. Delegates observed large-scale integration of farming, processing, digital monitoring and renewable energy investment.

KEY OBSERVATIONS

Across Portugal and Spain, the dominant theme was system-level integration. Genetic selection, agronomic management, processing requirements and market outcomes are tightly linked, enabling rapid adaptation to climate, regulatory and economic pressures. Many of these challenges closely mirror those faced by the Australian processing tomato industry, reinforcing the value of international benchmarking and targeted technology transfer.

Top Left: Sofia Stilwell conducts in field brix tests
Top Right: Marta Nunes explains products to delegates
Bottom Left: Gerard Kennedy discussing irrigation systems with grower in Spain
Middle: Group photo with Conesa
Right Middle: Stuart McColl and Gerard Kennedy recording notes for the group
Bottom Middle: Equipment inspection on farm in Portugal
Bottom Right: Hamish Lanyon and Carlos Campillo Torres discuss canal irrigation water delivery in Spain


Powdery mildew & mite control on tap!
THIOPRON®
NEW
POWERED BY
XANTHANE
by UPL
EASY-TO-USE ADVANCED LIQUID SULPHUR FORMULATION
• built-in superior adjuvant
• greater coverage & adherence – optimising efficacy
• excellent rainfastness
• easy to store & handle
www.upl-ltd.com/au
® Thiopron is a registered trademark of a UPL group company
Certified Allowed Input
ACO CERT. NO. 11451
UPL
OpenAg™