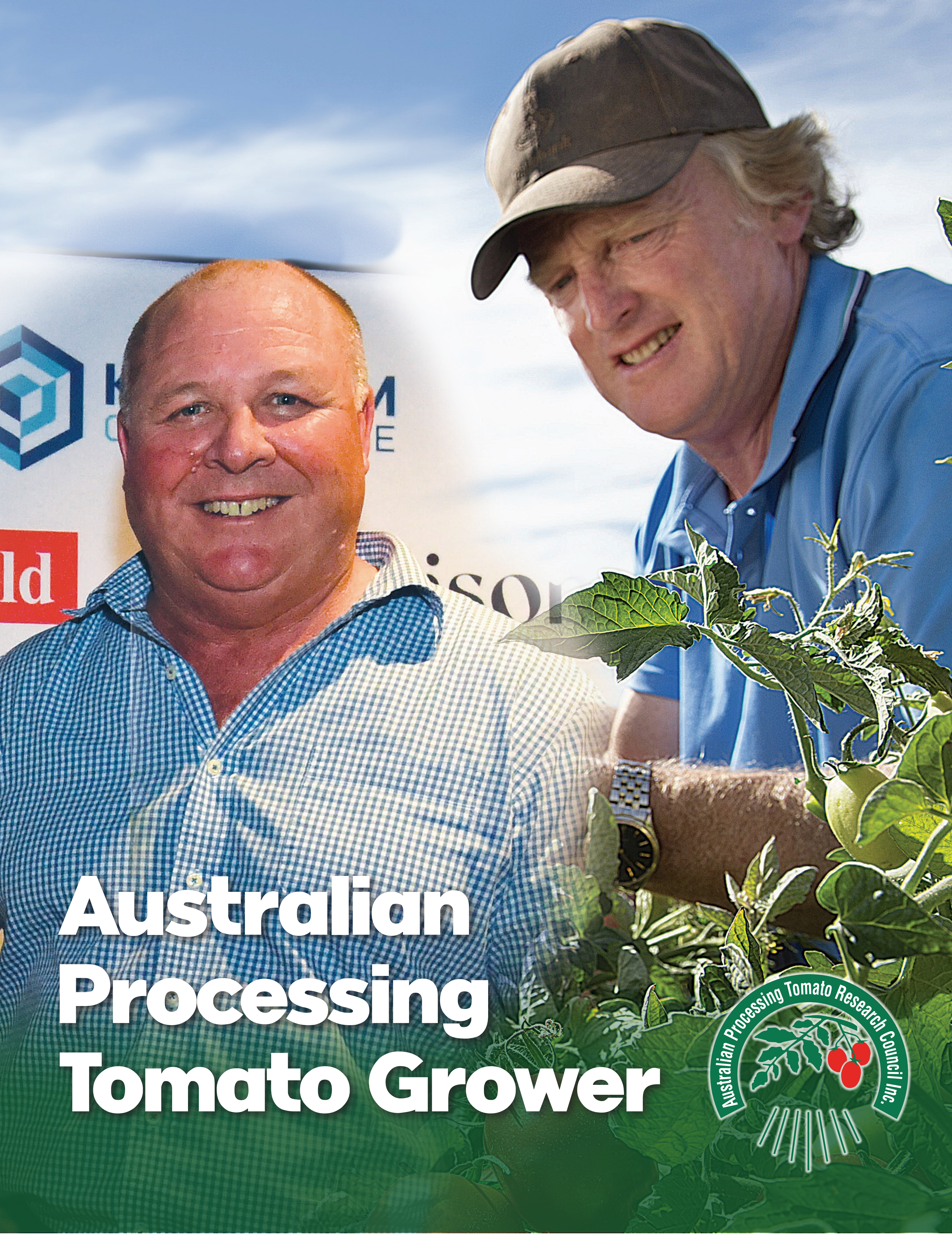

Australian Processing Tomato Grower

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Hort Innovation
Strategic levy investment

PROCESSING TOMATO FUND

Australian Processing Tomato Grower

Volume 45, 2024

INTRODUCTION

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.

Notice to Contributors:
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
NO LATER THAN August 30, 2025.

APTRC COMMITTEE MEMBERS 2024

Left: Charles Hart.
Right: Matthew Stewart.

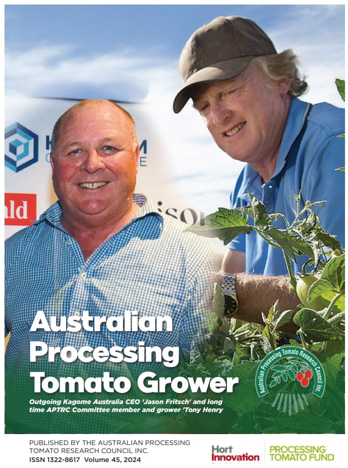
Left: James Weeks.
Middle: David Chirnside.
Right: Nick Raleigh.

Left: Andrew Ferrier.
Middle: Chris Taylor.
Right: Stuart McColl.

PROFIT & LOSS

Australian Processing Tomato Research Council Inc
For the year ended 30 June 2024

	Hort Innovation	Research
Trading Income		
Levies	102,302	204,603
Total Trading income	**102,302**	**204,603**
Cost of Sales		
Grower Levies - Hort Innovation	121,326	102,302
Total Cost of Sales	**121,326**	**102,302**
Gross Profit	**(19.024)**	**102,302**
Other Income		
Donation - Research	20,000	
Interest Received	527	6,334
Total Other income	**20,527**	**6,334**
Operating Expenses		
Accounting -		2,736
Audit -		1,000
Bank Charges -		214
Conferences -		4,998
Depreciation -		6,138
Donation - Development Manager -		50,000
Donation - Hort Innovation -		20,000
Meeting Expenses -		141
Memberships & Subscriptions -		1,500
Motor Vehicle Expenses -		1,268
Projects - ANU - Gasification -		14,979
Projects - Melbourne University PhD Hanyue -		20,000
Study Tour (USA) - Expenses -		77,344
Study Tour (USA) - Reimbursements -		20,313
WorkCover -		760
Total Operating Expenses -		**221,392**
Net Profit	**1,503**	**(112,756)**



Outgoing Kagome Australia CEO 'Jason Fritsch' and long time APTRC Committee member and grower 'Tony Henry'

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APTRC Chairman's Report 2023–24

Charles Hart, Chair, Australian Processing Tomato Research Council Inc.

While this was announced towards the end of 2024, as no doubt most of you are aware, our esteemed colleague, Jason Fritsch has been appointed the CEO of Kagome USA. Jason has played a crucial role in the processing tomato industry in Australia. As a grower and then processor he has been instrumental and responsible for managing and guiding the industry through enormous changes and extreme challenges over the past twenty odd years. These include, but are not limited to, a change in ownership at our largest processing plant, having to manage through the long drought, dealing with the Federal Government on numerous issues including on farm efficiency grants, increasing cooperation between processors and growers in relation to harvesting, driving innovation on farm and at the processing plant and the list goes on. Jason has always acted with infectious positive enthusiasm, integrity, honesty and treated everyone with respect. It is with sadness that we lose a great colleague, but great pride to know that one of our colleagues is taking on a leading role in the processing tomato industry in the USA. I personally would like to thank him and Kelly for their support over the years and as chairman of the APTRC committee I wish to thank them for their dedicated service to the APTRC and the industry as a whole. We look forward to seeing him back in Australia with bigger and better ideas.

I am also very pleased to acknowledge another long-standing industry member in Tony Henry, who was presented with the John Clifford Award at our industry Forum in May in recognition of his service to the grower group. Tony and Rowena's contributions to the tomato industry have been exceptional. Tony leaves the industry, having been an integral part of the APTRC committee for over 28 years, serving as vice president and leader of the grower group for much of that time. Despite his farming commitments, and the distance he had to travel from his farm near Boort, Tony rarely missed a meeting, and always contributed suggestions and ideas. Tony and Ro's Farm stands out for their consistently exceptional tomato yields, achieved through their unending pursuit of innovative solutions to their farming problems – often flowing through to APTRC research programs. To Tony and Rowe, we are very sorry to see you go, but wish you all the very best in your ongoing farming endeavours.

As we reflect on the 2023/24 season, the otherwise calm season was hampered by several weeks of severe weather as we welcomed in the new year. Significant rainfall reduced yields across the industry, with several growers impacted more acutely with localised flooding, hail, and severe winds damaging well established crops.

Thankfully, the harvest period was relatively dry and successful. The 2023/24 season saw growers delivering a total of 211,350 tonnes of processing tomatoes, which came in around 20% lower than the pre-season forecast. Yields were notably suppressed, averaging 80.7 tonnes per hectare, which is much higher than the previous devastating season, but still a long way off our typical industry average of about 100 t/ha.

The APTRC have been delivering above expectations on the activities aligned with the Hort Innovation TM20000 project and we see ever increasing support at our major field days and forum. Driven by our IDM Matt Stewart, the level of engagement by our members and service providers continues to increase.

Following our disappointing 2021/22 season, the APTRC decided the best way to offer support to industry, drive innovation and re-invigorate spirits was to organise a trip to visit our friends in the USA. With assistance from Mike Montna (California Tomato Growers Association) and Zach Bagley (California Tomato Research Institute) Matt planned and executed a study tour through the heart of the Californian growing region. Over 7 days, Mike, Zach and Matt took 17 Australian industry members to processors, farms, machinery dealerships, trial sites and seed breeding facilities. We would like to thank our USA counterparts for supporting our Aussies with their time and local expertise. The reports were overwhelmingly positive from all the attendees. I expect it won't be long before the next tour is planned.

The annual industry survey again provides valuable insights into the local production trends in Australia as well as keeping track of major processing tomato imports and exports. It's not surprising perhaps that after a very low production year in 2021/22, we are seeing a big drop in exports and surge in imports in the 2023 calendar year. On top of this, global production is surging with major increases coming out of China. The market will undoubtedly see pressure from this world over-supply for the coming trading year, however our growers and processors seem steadfast in forecasting above 200,000 tonnes for the coming seasons.

A strong contingency of members attended the World Congress and ISHS Symposium in June 2024, with several of our industry members making notable contributions; including Jason Fritsch of Kagome in the role of WPTC President, Chris Taylor of Kagome on stage for the climate panel discussions, Hanyue Feng from The University of Melbourne presenting her soil disease work in processing tomatoes and Matt Stewart in the role of chair of the WPTC Research Commission, summarising the major findings from the ISHS symposium to the congress attendees.

The committee members remain the same this year, with Chris Taylor as Vice Chair, the grower representatives being James Weeks, Nick Raleigh and David Chirnside and the processor representatives being Andrew Ferrier, Stuart McColl and Chris Taylor.

On behalf of the committee, and in my personal capacity, I wish to thank Ann Morrison, who after 8 years serving the industry as the APTRC Research Manager, has decided to retire. Ann has been responsible for delivering numerous projects and has been instrumental in shaping the cultivar evaluation trial program we use today. Ann's dedication to her work has delivered relevant and successful trial projects which have helped maintain our reputation as leaders in the global industry. I am pleased to add that Ann has agreed to continue providing us with guidance and assistance on a casual basis, as and when required.

In conclusion, the committee and I extend our sincere thanks to the growers and processors for their assistance and cooperation in facilitating the APTRC trial program. Special appreciation goes to Matt and Ann, with assistance from Bill and the volunteer committee members, for their continued enthusiastic efforts to deliver these programs with the support of our industry members.

Sincerely,
Charles Hart Chair, APTRC

Hort Innovation update

Susie Murphy White, Industry Development and Innovation Manager

In 2023/24, the Hort Innovation Processing Tomato Fund continued to invest in the project Processing tomato industry development and extension (TM20000). This project is delivering effective research, development and capacity building solutions to Australian processing tomato businesses, to improve profitability and sustainability.

The industry development project continues to deliver. It is now at the midway point and the annual industry survey will be providing direction for the next project. The delivery of the cultivar trials continues which is increasing quality and reliability of processing tomato seed genetics with the next round of trials underway. The field days for the season ahead are all in the planning stages after excellent support from growers for last season's field days and annual forum.

The Processing Tomato industry development and extension (TM20000) project is the only processing tomato project funded by Hort Innovation, using a voluntary research and development levy, funds from the Australian Government and in-kind contributions from the APTRC.

In the [Hort Innovation | Processing tomato industry development and extension (TM20000) (horticulture.com.au)] you can read about how the extension project has built capacity in the industry through delivery of things like Tomato Topics quarterly newsletters, field days, industry events, an annual magazine and industry survey on production and consumption.

The Hort Innovation processing tomato funds have been contracted to align with the outcomes and strategies in the processing tomato Strategic Investment Plan. The fund is fully invested until 2025/2026 when the Processing tomato industry development and extension TM20000 finishes in August 2026.

As the project approaches its mid-way point, it's a good time to stop and reflect on what some of the wins or highest achievements have been and where some improvements can be made. I hope you all take the time to talk with Matt Stewart, the APTRC or the Hort Innovation team, as this will help shape the next industry development project and enable industry funding to be spent wisely.

Last year Hort Innovation invested over $158 M in levies, Australian Government contributions, grants and co-investment. Our role is to capture value from the investments we make to benefit all levy payers. We look forward to a great year ahead of investment on behalf of the horticulture sector.

This year has seen changes to our Frontiers investment program. We are now more easily able to team up with local and global innovators. Frontiers invests is developing solutions to horticulture's major challenges and seizing big opportunities. A diverse range of investment partnerships are available for private, commercial and government entities, as well as opportunities to propel innovation. You can find out more at www.horticulture.com.au/hort-innovation/our-work/frontiers.

The delivery of industry events continues to excel and steer the industry in the right directions. It is pleasing to see that the processing tomato industry remains resilient and robust despite facing some challenging conditions and potential biosecurity threats.

If you have any questions or would like to discuss anything with Hort Innovation, please feel free to call Susie Murphy White, Industry Development and Innovation Manager (Susie.Murphy-White@horticulture.com.au) in regards to the industry development and extension project or Mark Spees, Industry Services and Delivery Manager (Mark.Spees@horticulture.com.au) in regards to R&D advisory panel and new investment priorities.

Hort Innovation

Table 1. Current contracted R&D project actuals at 2022/23 and forecast to 2025/26

Project code	Project title	2022/23 Actual	2023/24 Forecast	2024/25 Forecast	2025/26 Forecast
TM20000	Processing Tomato industry development and extension		322,278	214,858	214,858
TM22000	Minor Use Permits	350	500	500	500
Total		350	322,778	215,358	215,358

Annual Industry Survey 2024

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 2023/24 season was relatively poor in terms of tonnes and quality, due to severe storms and localised flooding between the 24th of December and the 8th of January.

During the 2023/2024 season, twelve growers produced 211,350 tonnes of processing tomatoes, which is approximately double the volume grown in 2022/23, and the crop was again processed by three companies.

Some 2,741 hectares were planted in total, with sub-surface drip irrigation used for 2,634 ha, a combination of drip irrigation and pivot irrigation used for 50.5 ha and the remaining 56 ha grown using only pivot irrigation.

The use of transplants was slightly lower than in previous years at 85% of the total area under production, with direct-seeded tomatoes making up the remaining 15%.

In 2023/24, the Australian processing tomato industry achieved an average yield of 80.7 tonnes per hectare and 96% of the planted area was harvested.

Soluble solids averaged 5.4%, which is desirable. However, crop yields were down by approximately 20% across many properties so what we're observing is the typical inverse relationship between yield and solids.

On the international scene, imports and exports are reviewed and discussed in the context of the previous calendar year (2023), not the abovementioned processing season (2023/24).

An interesting anomaly occurred in imports during the 2023 calendar year, where the importation of processed tomato products into Australia decreased on a finished product tonnes basis, but increased when considered on an 'equivalent tonnes' basis. This suggests that on an equivalent tonnes basis, the importation of tomato products is still increasing year on year.

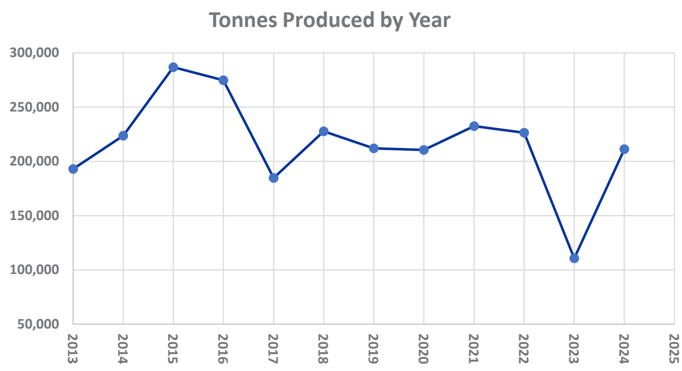
Exports of Australian processed tomatoes on the other hand dropped significantly, to levels not seen since 2011. This drop in exports was predicted in the last industry survey report, on the basis that when we produce only half the usual quantity of tomatoes, it follows that exports will drop. The export figure should ratchet back upwards again from 2024 onwards, assuming adequate yields are achieved under more stable seasonal conditions.

Total Australian domestic consumption increased in 2022, however it was supplied by imports rather than local product. An ideal situation would be to see increased consumption supplied by a higher proportion of domestic production.

Australian domestic per capita consumption decreased substantially in 2023, although the cyclical nature of consumption is not without precedent over the past 10 years and it could very well increase again over the next year or two.

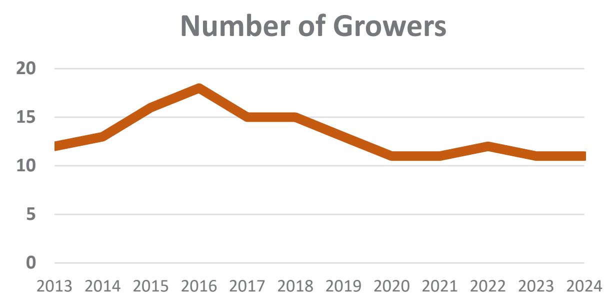
INDUSTRY SIZE

Volume



Paid tomato volumes delivered (tonnes)(APTRC)

Growers produced 211,350 tonnes of processing tomatoes during the 2023/24 season, with the bulk of demand coming from the two major processing operations in Australia. There were no organic tomatoes processed this season.



Number of growers (APTRC)

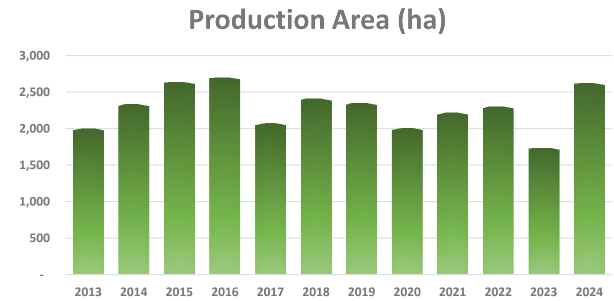
There were 12 specialist businesses producing for the 2023/24 processing tomato season, spread mainly across Northern Victoria, with a lesser number growing in Southern NSW.

Processors

As in the previous season, the entire crop was processed by three organisations, with Kagome taking 77.6%, SPC 19.2% and Billabong Produce 3.2%.

THE CROP

Area and management



Planted production area (ha) (APTRC)

The area under production increased to 2,741 hectares, of which 96% was harvested. The larger area planted was ideally going to help re-bolster local and export supply options, but fell short of expectations due to poor weather conditions.

Season	Transplanted	Seeded
2010/11	79%	21%
2011/12	81%	19%
2011/13	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%

Proportions of transplants Vs seed by area grown (APTRC)

This season, the crop was mainly grown under sub-surface drip irrigation, however in an innovative and bold move, Kagome Farms grew 55 ha using only centre pivot irrigation (i.e., without drip irrigation). This method will be used more extensively in the coming seasons to help maximise existing infrastructure and reduce the need for costly drip irrigation systems. For the 2023/24 season, Kagome Farms extended their crop grown on sand to 163.9 ha.

There was an increase in the proportion of direct seeded crop grown this season. This was due to the Boort region (known for its direct seeding practices) being less affected by floods than the previous season. The Boort region is still the only area direct-seeded and represented 15% of the total industry by area in 2023/24.

Area and Production by State	VIC	NSW
Area Planted	70%	30%
Tomato Volume Processed	72%	28%

Production by State (APTRC)

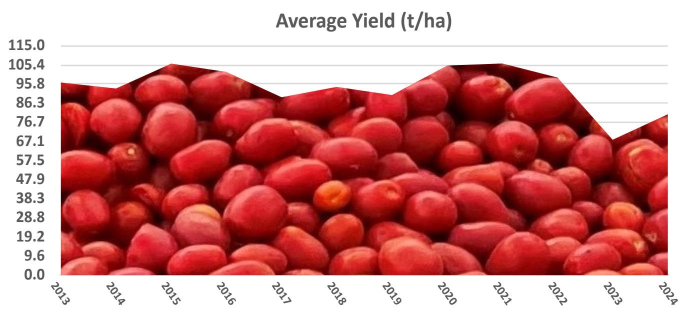
In the 2023/24 season, the relative planted area (%) and production amount (%) by state aligned very closely. This suggests that the area planted and yield per hectare from those areas is relatively stable (on average at least) across not just states, but over different water, soil and climatic conditions.

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

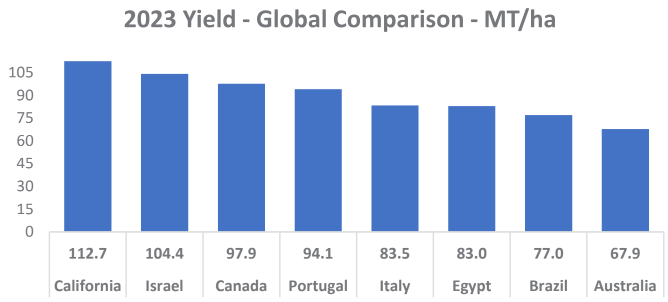
Average yield, harvest conditions (MT/ha) (APTRC)

The storm events between 23/12/23 and 08/01/24 caused direct widespread damage from hail, wind and localised flooding, with consequent growth suppression due to waterlogging and prolonged plant stress conditions.
While the 2023/24 season saw an increase in average yield from the previous season, production was still well below the industry standard of approximately 100 t/ha.



Average yield (t/ha) (APTRC)

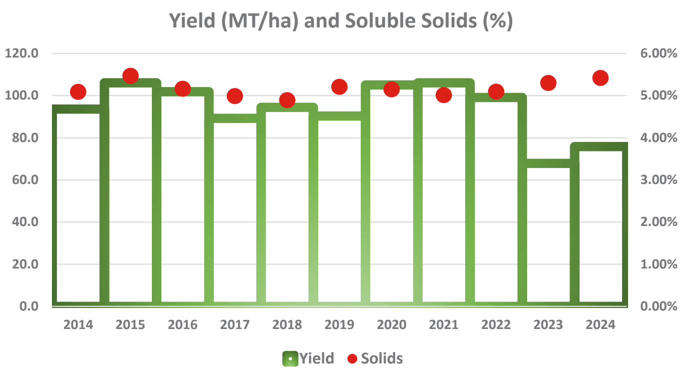
The industry recorded an average yield of 80.7 tonnes per ha for season 2023/24, which is relatively low by global standards but was a direct result of adverse weather conditions. The damage from these weather events ultimately led to the loss of 121 ha of planted crop.



2023 average yield (MT/ha), by country (Colvine)

Note: To get the most accurate global comparison, data for international production is a season behind and in this report, comparisons are drawn with the 2022/2023 season. This is due to the offset availability of data from the Northern Hemisphere.

Soluble Solids



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

Average soluble solids for the season were 5.42%, which is above the minimum benchmark of 5.0% preferred by processors.

Cultivar

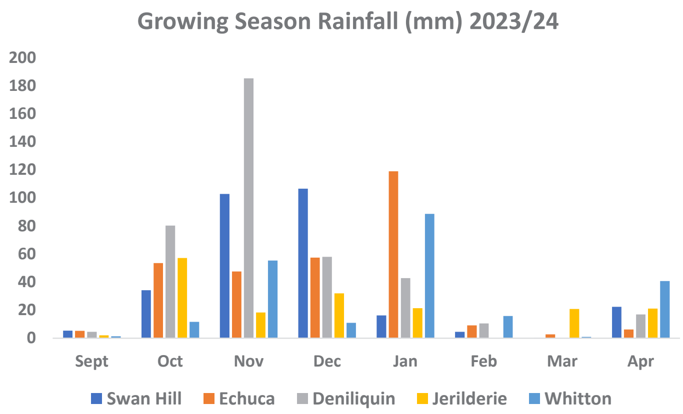
CULTIVARS	Percentage of Total Area Grown	
	2023/24	*2022/23*
H3402	38.3%	24.3%
H1015	22.7%	18.4%
H3406	8.9%	0.6%
UG19406/UG16112	6.9%	12.4%
UG16112	6.8%	2.5%
H1311	6.6%	5.8%
SVTM9023	2.6%	0%
SVTM9000	2.5%	4.7%
H1301	2.2%	7.8%
H1311mix	2.0%	0.4%
SVTM9024	0.48%	2.0%
SVTM9025	0.003%	0%
H3402mix	0.0%	0.9%
H1014	0.0%	14.4%

Cultivar by proportion of total area

When comparing the 2022/23 and 2023/24 seasons, there were some significant shifts in the balance of cultivars grown by area. Many factors influence the mix of cultivars grown from season to season including changing customer requirements, upgrading of processing infrastructure, new market access or loss of previous markets, seasonal harvesting logistics and agronomic suitability to growing region and soil type. (Note: 2022/23 figures will not equal 100% as there was no UG4014 or HM58811 grown last season, which amounted to 5.7% of total area).

There were 2 new Bayer/Seminis (Code STVM) cultivars commercially grown this past season, which is encouraging to see and a direct result of the well supported industry cultivar improvement trial program.

THE SEASON

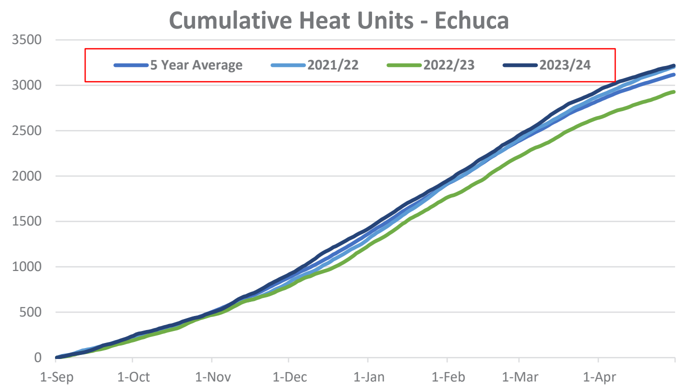


Rainfall across the major growing regions (mm) (BOM)

For most regions, rainfall was significant for the December and January period, but falls were not considered extreme. The rainfall chart suggests that it was not the volume of rain that affected the industry over summer, but the intensity of the rainfall events that hampered production.

The harvest period during February and March was relatively free from rain, which was of great importance to industry in getting the crop off and processed.

Heat Units



Heat units – Echuca (BOM)

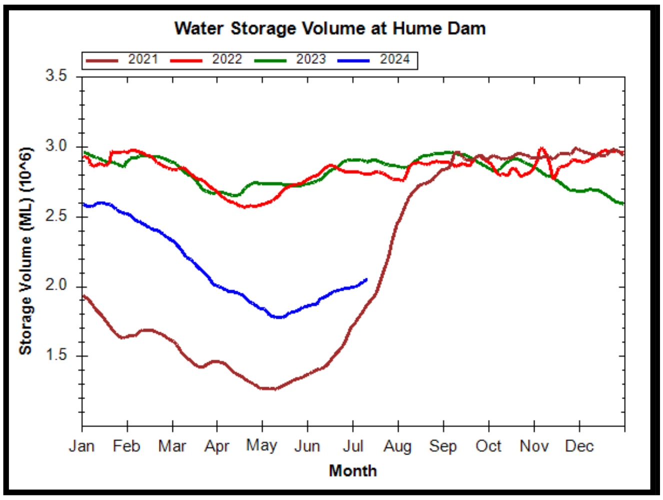
The heat units recorded during the major crop growth period demonstrate that the season was similar to the 5-year average, but warmer than the previous season.

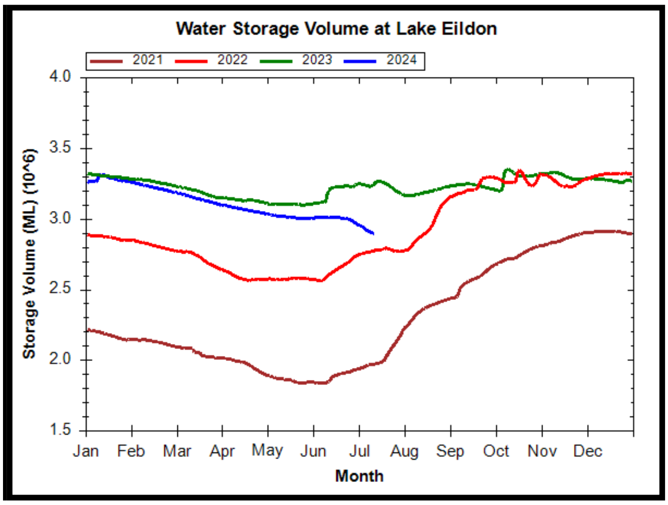
Although this graph uses data from Echuca, it's a central point for industry and can be generally considered indicative of what was experienced by growers in surrounding regions.

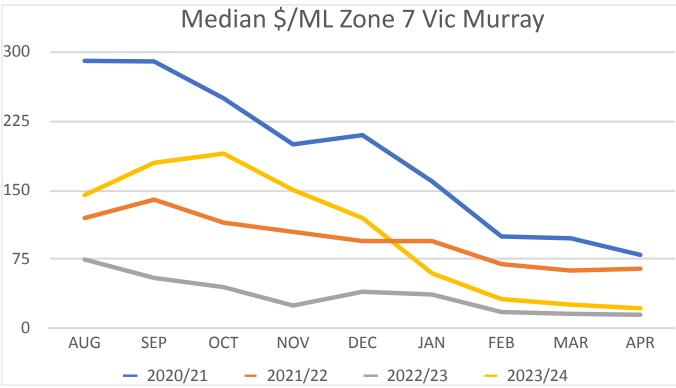
WATER STORAGES

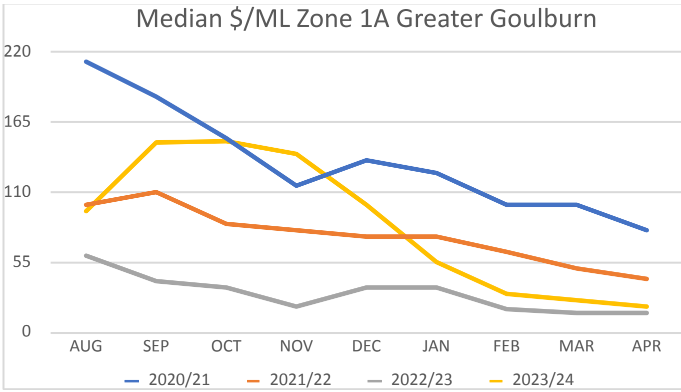
Storage Volume, Lake Eildon and Hume Dam (GMW)

The water storage level in Hume dropped off later in the season last year, whereas Eildon levels remained steady. Both storages remained at desirable levels.









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

The price of water during 2023/24 remained low and the price of water could be seen as a direct reflection of higher allocations and inflows into major water storages for Victoria and NSW.

TRADE

Imports

Product	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Dried/powder	35,940	26,875	34,506	37,934	37,660	34,880	28,017	29,143	34,263	26,638
Whole/pcs <1.14L	42,660	45,222	40,965	43,354	42,683	41,799	51,121	36,356	45,488	38,479
Whole/pcs >1.14L	28,402	28,088	22,997	24,002	24,275	22,369	21,129	21,316	24,029	18,908
Paste/puree<1.14L	83,976	153,210	102,733	107,923	109,578	110,328	159,447	137,971	125,751	147,343
Paste/puree>1.14L	109,242	102,866	130,171	140,532	144,906	133,524	43,118	140,502	187,046	203,539
Juice	116	75	83	38	75	50	30	17	47	27
Sauce/ketchup	38,628	39,276	38,462	45,705	45,946	47,050	48,375	45,788	51,585	58,092
Total Tomato	**338,964**	**395,612**	**369,917**	**399,488**	**405,123**	**389,999**	**451,236**	**411,093**	**468,210**	**493,026**

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

The volume of imports rose again during 2023, due only to increases in 'Paste/Puree' and 'Sauce/ketchup' categories.

This is the largest quantity of imports into Australia since industry started collecting records in 2010.

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 58.18%, China 14.15%, New Zealand 13.49%
- **Whole/pcs** <1.14L – Italy 96.65%
- **Whole/pcs** >1.14L – Italy 93.88%,
- **Paste/puree**<1.14L – Italy 75.82%, China 14.51%
- **Paste/puree**>1.14L – USA 41.88%, China 34.57%, Italy 16.12%
- **Juice** – USA 51.59%, Thailand 21.15%, Mexico 14.6%,
- **Sauce/ketchup** – Italy 38.09%, New Zealand 20.95%, Spain 11.81%

At 60% of total volume (last year 67%), Italy remains the dominant source of imported processed tomato products into Australia. The next largest suppliers were China and USA, supplying 13% and 10% respectively into Australia.

Product	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Dried/powder	6.72	7.44	6.56	6.77	6.83	6.62	7.26	6.10	6.42	7.23
Whole/pcs <1.14L	1.47	1.45	1.50	1.32	1.38	1.47	1.62	3.40	1.67	2.11
Whole/pcs >1.14L	1.25	1.23	1.13	1.07	1.15	1.17	1.17	2.31	1.31	1.78
Paste/puree<1.14L	1.71	1.69	1.65	1.53	1.50	1.63	1.83	1.73	1.86	2.30
Paste/puree>1.14L	1.32	1.58	1.40	1.30	1.36	1.44	1.53	1.35	1.56	3.73
Juice	1.54	1.91	1.09	2.86	2.12	2.17	3.61	3.73	3.02	3.47
Sauce/ketchup	2.05	2.13	2.13	2.11	2.11	2.22	2.56	2.42	2.36	2.72
Total Tomato	**1.51**	**1.54**	**1.52**	**1.44**	**1.47**	**1.56**	**1.70**	**2.33**	**1.70**	**2.67**

Average import prices ($/kg), in 2023 monetary values (ABARES)

Correlation between Imports and Price

The overall price for imports during 2023 rose significantly and this rise was seen across all product categories.

The correlation across the past 10 years for products suggests the following:

- Juice exhibits a strong negative correlation, meaning as price goes down, imports go up.
- Sauce/ketchup exhibits a moderate positive correlation, meaning as price goes down, imports go down.

The correlations for imported product are quite varied and swing from moderately positive to moderately negative and deviate within different package sizes within category groups. Therefore, it suggests that overall, the variability in imported volumes does not appear to be strongly price driven for most categories (except for Juice).

Product	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Whole/pieces	2,552	746	461	133	62	139	623	273	417	513
Paste/puree	33,800	43,747	104,518	21,852	16,402	11,695	32,766	38,323	22,032	9,085
Sauce/ketchup	3,524	8,196	4,039	8,799	11,636	13,227	14,788	17,986	13,660	5,661
Juice	195	131	57	50	80	106	52	47	118	112
Total Tomato	**40,070**	**52,819**	**109,075**	**30,834**	**28,180**	**25,167**	**48,228**	**56,629**	**36,227**	**15,371**

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

Exports

The overall volume of exports decreased significantly for the second year running, most noticeably in the paste/puree and sauce/ketchup categories. Juice remained constant and the whole/pieces category increased; however, they represent a small portion of total exports.

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

- **Whole/pieces** – Thailand 59%, Papua New Guinea 12%, USA 4%
- **Paste/puree** – Vietnam 40%, Japan 21%, Thailand 13%
- **Sauce/ketchup** – New Zealand 34%, China 25%, Japan 24%
- **Juice** – Singapore 22%, New Zealand 14%, UK 8%

At 22% of all products, New Zealand was the major export destination for Australian processed tomato produce, with Japan close behind at 21% and China at 15% of total exports.

Product	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Whole/pieces	1.53	4.79	5.96	7.76	5.52	3.03	1.95	3.41	3.41	3.05
Paste/puree	1.63	1.50	1.15	1.38	1.64	2.08	2.61	2.43	2.32	2.83
Sauce/ketchup	3.06	3.01	3.18	2.26	2.31	2.35	2.71	2.32	2.12	2.88
Juice	1.44	1.49	1.87	1.32	2.01	1.21	1.24	1.14	1.12	1.54
Total Tomato	**1.65**	**1.95**	**1.30**	**1.73**	**1.88**	**2.03**	**2.34**	**2.12**	**2.35**	**2.85**

Average export prices ($/kg) (ABARES), in 2023 monetary values

The real price of exports increased slightly in 2023, which is beneficial for the Australian processing industry.

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.

It's worth noting that there is a diminishing correlation between export volumes and the USD exchange rates across the last 10 years, meaning that exports from Australia are less dictated by exchange rates and that other market forces are having more influence on annual export opportunities.

Calendar Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	5 yr	10 yr
Dom. Demand	520,525	629,620	534,691	553,336	604,579	576,793	613,485	587,025	658,422	588,276	604,800	586,675
Imports	338,964	395,613	368,918	399,488	405,123	389,999	451,236	411,093	468,210	493,026	442,713	412,167
Net Australian	181,561	234,007	165,773	153,848	199,456	186,794	162,249	175,933	190,212	95,250	162,087	174,508
Imported %	65%	63%	69%	72%	67%	68%	74%	70%	71%	84%	73%	70%
Local %	35%	37%	31%	28%	33%	32%	26%	30%	29%	16%	27%	30%
Per capita (kgs)	**22**	**26**	**22**	**22**	**24**	**22**	**24**	**23**	**25**	**22**	**23**	**23**

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

Market Demand

Table above 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 2023 calendar year and are higher than the 10-year average.
- **Net Australian:** The net Australian figure equates to tomatoes processed, less exports and was the lowest observed result since beginning the survey in 2010. This low result means that a significantly low volume of locally grown and processed product was used for domestic consumption.
- **Domestic Demand:** The demand for processed tomato products in Australia was back slightly in 2023.
- **Imported %:** The imported percentage of processed tomato products was at the highest level since these figures were first collected in 2010. Ideally, we would like to see imports decrease, as more Australian produce meets local demand.
- **Local %:** The percentage of local product sold in the Australian market decreased significantly in 2023, largely due to the poor cropping season.
- **Per Capita kgs:** The average per capita consumption fell to 22 kilograms of equivalent raw tomatoes. This result sits just below the 5yr and 10yr averages.

GLOBAL INDUSTRY

Production

In 2023, recorded global production totalled 44,416 million tonnes, compared to 38,449 million tonnes for the previous year; a monumental 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 2023, Australia contributed only 0.2% of global production (compared to 0.6% of global production in 2022) and moved its ranking down to 25th for industry volume (compared to 17th for industry volume in 2022). This drop off in supply is explained by the significant losses incurred in the 2022/23 flood season. Expect Australia's ranking to increase again in 2024.

Country	Season	2022	2023	2024 Prelim	% Change 2023-24E	Ranking 2023	% Total 2023
USA	Jul-Dec	9,964	12,031	10,455	-13%	1	27.1%
China	Jul-Dec	6,200	8,000	10,450	31%	2	18.0%
Italy	Jul-Dec	5,476	5,400	5,250	-3%	3	12.2%
Turkey	Jul-Dec	2,350	2,700	2,700	0%	4	6.1%
Spain	Jul-Dec	2,125	2,600	3,060	18%	5	5.9%
Iran	Jul-Dec	1,800	2,000	1,400	-30%	6	4.5%
Brazil	Jul-Dec	1,632	1,650	1,671	1%	7	3.7%
Portugal	Jul-Dec	1,414	1,500	1,500	0%	8	3.4%
Algeria	Jul-Dec	1200	1350	1300	-4%	9	3.0%
Chile	Jan-Jun	971	1150	1300	13%	10	2.6%
Tunisia	Jul-Dec	649	795	980	23%	11	1.8%
Russia	Jul-Dec	638	660	650	-2%	12	1.5%
Egypt	Jul-Dec	456	600	624	4%	13	1.4%
Argentina	Jan-Jun	626	586	631	8%	14	1.3%
Canada	July-Dec	548	520	512	-2%	15	1.2%
Ukraine	Jul-Dec	120	500	540	8%	16	1.1%
Greece	Jul-Dec	340	390	510	31%	**17**	0.9%
Poland	Jul-Dec	175	250	400	60%	18	0.6%
Dominican Republic	Jul-Dec	227	227	227	0%	19	0.5%
Israel	Jul-Dec	200	197	185	-6%	20	0.4%
India	Jan-Jun	162	162	162	0%	21	0.4%
France	Jul-Dec	142	160	170	6%	22	0.4%
South Africa	Jan-Jun	120	160	140	-13%	23	0.4%
Peru	Jan-Jun	125	150	150	0%	24	0.3%
Australia	**Jan-Jun**	**227**	**110**	**211**	**92%**	**25**	**0.2%**
Hungary	Jul-Dec	80	110	120	9%	26	0.2%
Morocco	Jul-Dec	100	100	100	0%	27	0.2%
Senegal	Jan-Jun	73	73	73	0%	28	0.2%
Syria	Jul-Dec	40	40	40	0%	29	0.1%
Thailand	Jan-Jun	40	40	40	0%	30	0.1%
Mexico	Jan-Jun	40	40	40	0%	31	0.1%
Bulgaria	Jul-Dec	40	37	60	62%	32	0.1%
Japan	Jul-Dec	27	26	26	0%	33	0.1%
New Zealand	Jan-Jun	52	25	39	56%	34	0.1%
Czech Republic	Jul-Dec	25	25	25	0%	35	0.1%
Venezuela	Jan-Jun	20	24	14	-42%	36	0.1%
Slovakia	Jul-Dec	20	20	20	0%	37	0.0%
Malta	Jul-Dec	5	8	8	0%	38	0.0%
Total		**38,449**	**44,416**	**45,783**	**3%**		100.0%

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

Outlook

Looking ahead to the 2024/25 season, it is anticipated that production in Australia will match the offtake in 2023, with current forecasts set at 216,000 payable tonnes

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Processing Tomato Development & Extension

Matthew Stewart, Industry Development Manager

TM20000: Processing tomato industry development and extension

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 10, 2024, at the Rich River Golf Club in Moama. The forum attracted 54 delegates, while the follow-on dinner was attended by 49 industry members and partners.
Throughout the day, 13 engaging speakers presented on a variety of topics across three sessions: 'TM20000,' 'Industry Insights,' and 'Into the Future.' 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.
Attendees praised the high quality and relevance of the presentations, noting that the forum continues to receive excellent support and participation year after year.
The full listing of presentations from the day can be found at https://www.aptrc.asn.au/info-for-industry

Field Days

During the 2023/24 season, both scheduled crop inspection field days were successfully held.

On December 20th in Boort, the Boort & Boga crop inspection day saw active participation from 30 individuals, focusing on crop inputs. This event was followed by an evening dinner for 25 members at the Mystic Park Hotel.

On January 19th, the Netafim-sponsored Rochester Tour attracted 55 members. Nick O'Halloran from Agriculture Victoria conducted an in-field pressure testing and flushing demonstration. Additionally, novel machinery was discussed at GoFarm, APTRC Cultivar Trials were showcased, and a visit to the major local greenhouse tomato operation, Katunga Fresh, broadened the discussions. Following the tour, an Industry Dinner at Moama Bowling Club 'Greens' welcomed 55 members, including children.

A comprehensive record of these discussions is available in the December 2023 and March 2024 editions of Tomato Topics.

Processing Tomato Cultivar Evaluation

Operating exclusively on growers' properties, our trial program covered 11 sites, with 4 early-season and 9 mid-season machine harvest cultivar trials. Research Manager Ann Morrison also oversaw 3 early-season and 3 mid-season screening trials. With collaborative support from Bill Ashcroft, these cultivars were meticulously assessed based on visual evaluation of vine and fruit characteristics. These evaluations are crucial for identifying potential cultivars for the upcoming season's machine harvest trials.

From the 35 cultivars tested, the replicated machine harvest trials yielded promising results, and added to our database allowing these new lines to be compared over multiple years with industry standards. This perspective provides a comprehensive understanding of cultivar performance across diverse conditions over time, as detailed in the cultivar report herein.

However, seed availability remains a concern due to import restrictions limiting the cultivars we can include in the program. We are working with the seed industry and regulatory authorities to address this issue and ensure access to the latest and most relevant material for the Australian industry.

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 (aptrc.asn.au). 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 serves 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.

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 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

This year, the IDM took on the voluntary role of president of the Research Commission for the World Processing Tomato Research Council (WPTC). This role involves directing the WPTC research focus and will help to strengthen connections globally for the betterment of 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.

USA Study Tour

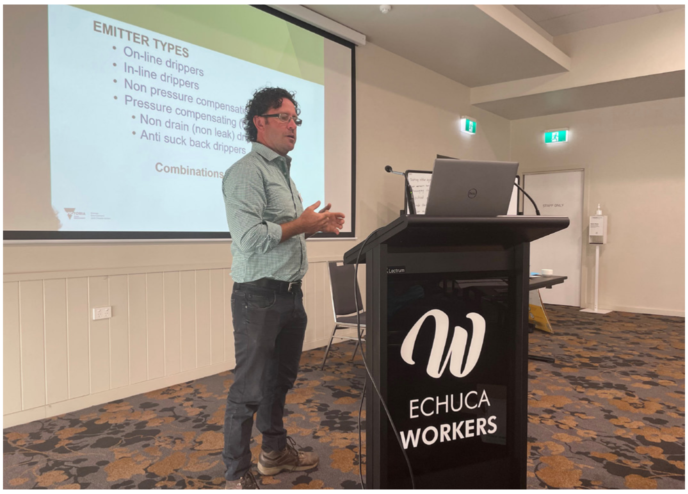
In August 2023, under the management of the APTRC IDM and with the support of Mike Montna from the California Growers Association and Zach Bagley from the California Tomato Research Institute, 17 industry members—including growers, processors, and agronomists—participated in a study tour to California, USA. This week-long tour fostered industry connections, highlighted leading global production and processing practices, and strengthened intra-industry relationships. The IDM role and TM20000 project has been instrumental in helping extend the learnings from this trip.

Budapest World Congress

In June this year, 14 industry members, including processors, growers, APTRC Chair Charles Hart, and IDM Matt Stewart, embarked on a journey to Budapest for the world congress. Although congress attendance wasn't directly a TM20000 activity, the wealth of knowledge and insights gained were invaluable. These were shared with the Australian industry through a report in the June 2024 edition of Tomato Topics.

Acknowledgments

The APTRC sincerely thanks processing tomato growers and processors for their unwavering support. Special appreciation goes to Ann Morrison, Bill Ashcroft, and 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.



Ann Morrison steps back

Since her appointment to the role of the APTRC's Research Manager in 2016, Ann Morrison has become a familiar face to nearly all in the Australian processing tomato industry. Coming from a background in crop scouting and nutrition across Northern Victoria, Ann was ideally qualified for this challenging industry role.

Over the past 8 years, Ann has shown real dedication in setting up, managing and reporting results from a wide variety of field experiments across our growing regions. Whether it be collecting samples on the weekend in scorching heat or standing up to a grumpy harvester driver to ensure her trial plots are properly assessed, she has never (or hardly ever) faltered. She has endured bin trailers through her trials, crows eating her fruit samples, and an instance where a 6-row trial took three days to harvest because of repeated breakdowns. Even a headbutt from one of her horses didn't deter her from attending an APTRC meeting to take minutes and contribute results – although she was a notable absentee from the subsequent group photo. She hates public speaking but gamely faces up each year for the industry forum to discuss the cultivar and other trial results.

Ann is also responsible for compiling a searchable database of all the research conducted by the industry over nearly 50 years – a resource that will find many uses in the years to come. She has worked closely with growers, processors, seed companies and other Ag service providers, and been a vital team member with Liz, and more recently with Matt and Bill in delivering the APTRC's research program.

But the time has come, and Ann has announced that she will step back from her role after the 23/24 season – although she will continue to assist if the need arises and is keen to participate in variety assessment. The APTRC joins with all in the industry in thanking Ann for her hard work over the past 8 years, and wishes her all the very best for the future (horses notwithstanding)

IMPROVING DRIP IRRIGATION UNIFORMITY FOR PROCESSING TOMATO GROWERS

Nick O'Halloran, Senior Irrigation Officer

The processing tomato industry in northern Victoria has adopted subsurface drip irrigation to improve yield and save water. These benefits are made possible due to better control of application depth and irrigation scheduling. However, subsurface drip irrigation systems require close attention to maintenance and monitoring to ensure that they are putting out the correct amount of water evenly across a block or valve.

The majority of systems installed in northern Victoria have non-pressure compensating (non-PC) emitters, which means that as pressure in the system changes, so does the emitter discharge rate. This means that as pressure reduces along the length of a lateral pipe due to friction losses, the application depth also decreases. The industry standard is to design systems with less than 10% flow variation caused by pressure variation. To achieve this, systems are designed to have a maximum pressure loss of about 2 m head (approx. 20 kPa) within a block (this is applicable for systems running valve pressures around 10 m head or 100 kPa).

Pressure loss within blocks is kept below 2 m head by installing correctly sized submain and lateral pipes for required flow rates, and setting appropriate operating pressures. Lateral pipe sizes and run lengths are dictated by emitter discharge rates and emitter spacings.

However, as the systems age, biofilms form on the inside of pipes, increasing friction loss and therefore application variability along laterals. A regular maintenance program of flushing and chemical treatment is required to minimise the accumulation of biofilms to minimise friction loss and blocking of emitters.

In the summers of 2022/23 and 2023/24 Agriculture Victoria undertook performance assessments on several irrigation systems in northern Victoria, to understand how these systems were performing compared to the original designs and what maintenance and monitoring or design changes may be required to ensure an acceptable level of performance.

These performance assessments also looked at other aspects of system performance that could be impacting on application variability, including pump performance, mainline design and valve performance.

The aim of the assessments was to determine:

- How well are systems performing?
- Was underperformance related to system design, installation, operation, maintenance and/or monitoring?
- What upgrades or changes are required?

The overall aim of improving these systems is to minimise application variability, both within and between blocks or valves. This enables more precise irrigation scheduling which will result in more efficient use of water, improved productivity and reduced pumping costs.

What was measured during the assessments?

Assessments were undertaken on 4 farms that had drip tape with non-pressure compensated emitters. One farm had Aries MWD 22250 tape, one with Python 22150 tape, and two had Ozline 25150.

On each farm emitter pressures and discharge rates were measured at the top and bottom of 6 laterals. This was done before and after flushing each lateral.

In this article pressure is expressed as 'm head of water' (m head).

1 m head = 1.42 PSI ≈ 10 kPa (9.8) = 0.1 Bar

Pressures were measured before and after the main filter at the pump. Pressure was also measured upstream and downstream of the valve supplying the blocks being monitored, as well as any other valves operating during the same shift. Flow rate, pressure at the pump and pump speed were measured.

All measurements were made with the system running under the normal operating regime, with all the same valves that would normally run as part of a shift.

Emitter flow variation within a block was calculated as:

$$\text{Flow variation} = \frac{\text{Highest emitter discharge rate} - \text{Lowest emitter discharge rate}}{\text{Highest emitter discharge rate}}$$

Causes of variability with subsurface drip irrigation system

Non-PC emitters have a nominal emitter discharge rate. This is the expected emitter discharge rate at a standard pressure, typically 100 kPa. For example, in Figure 1, the nominal emitter discharge rate (X) is 1.65 l/hr at 10 m head pressure (approximately 100 kPa). The yellow line shows how emitter discharge rate is expected to change with different pressures.

Figure 1 has 3 different scenarios of simulated data showing how different problems may impact on emitter discharge variability. Ideally every emitter in a block would have a discharge rate close to the target. However, there is always some discharge variability which is shown by the scattered points in Figure 1.

Emitter discharge variability caused by pressure

The blue points are indicative of a system with high pressure loss in pipes causing discharge variability. The blue points follow the yellow line reasonably well, but they are spread out horizontally from the nominal discharge rate, due to significant pressure variability in this particular system. This can result from poor system design (i.e. pipes are too small) or system deterioration (i.e. biofilms forming on the inside of pipes causing higher pressure loss).

Emitter discharge variability caused by blocked emitters

The purple points are an example of a system with significant variability in emitter discharge rate caused by partially blocked emitters. For this example, there is not much horizontal spread, so variable pressure within the system is not a problem (i.e. the systems pipe work is designed well), but lack of maintenance (flushing and chlorination) is causing emitters to get partially blocked.

Emitter discharge variability caused by valve pressure variation

Maintaining a constant pressure at the valve is essential to ensuring the irrigation system is applying a consistent application depth from one irrigation to the next. This is key to accurate irrigation scheduling. The green points in Figure 1 show how the emitter discharge rate is likely to change if the pressure at the valve changes from 10 m head (purple points) to 12 m head (green points). Variability of emitter discharge is similar at both pressures (10 m head and 12m head), but emitters are putting out more water at a valve pressure of 12 m head.

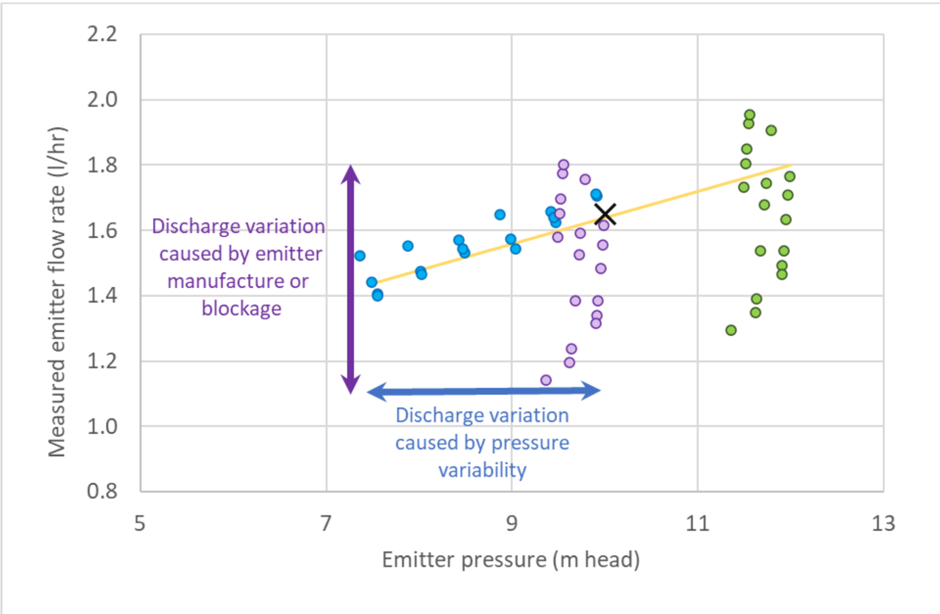


Figure 1. An example using simulated data of variability in emitter discharge rate within a block caused by pressure variability ( ), blocked emitters ( ) and valve pressure changes ( ). Nominal emitter discharge rate (X) and emitter discharge-pressure curve (--).

Within valve emitter flow variation

The irrigation plans for the 4 farms assessed showed they were all designed with a flow variation between 10 and 15% (Table 1). Therefore, we cannot expect flow variation to be any better than this. This is above the current industry standard of designing to flow variation of less than 10%, so emitter flow variation is likely to be high on these farms.

The measured emitter flow variation ranged from 22% to 39% at each farm before flushing and was improved in all cases by flushing (Table 1). However, flushing did not completely restore the systems to new condition, with flow variation still well above the designed variation for all systems.

The difference in emitter pressure within blocks was more than 2 m head on farms 2, 3, 4, and below 2 m head for farm 1. Farm 1 therefore had the lowest designed and measured discharge variability. Flushing did little to change pressure loss within any block.

Figure 2 shows this measured variability graphically. The further the points in Figure 2 are from the line of the same colour, the more variability is being caused by partially blocked emitters. The longer the line of a particular colour, the more pressure loss is causing emitter discharge variability. So overall flow variation within a block is determined by both pressure variability and emitter blockages. Determining a solution for improving uniformity will depend on which of these (pressure variability or blocked emitters) are causing the variability.

Figure 2 shows that Farm 2 (blue) had the widest range of pressures within a block, and therefore the highest pressure loss along the laterals causing variability. Farm 4 (yellow) has points furthest from the line, and therefore the worst blocked emitters.

Table 1. Flow variation for each farm, as designed on the irrigation plan (Designed) and measured before and after flushing. Within in block pressure variation before and after flushing.

	Designed flow variation	Measured flow variation		Measured pressure range (m head)	
		Before flushing	After flushing	Before flushing	After flushing
Farm 1	11%	22%	19%	1.8	1.9
Farm 2	13%	29%	18%	4.0	3.9
Farm 3	13%	26%	19%	2.6	2.0
Farm 4	15%	39%	21%	2.5	2.7

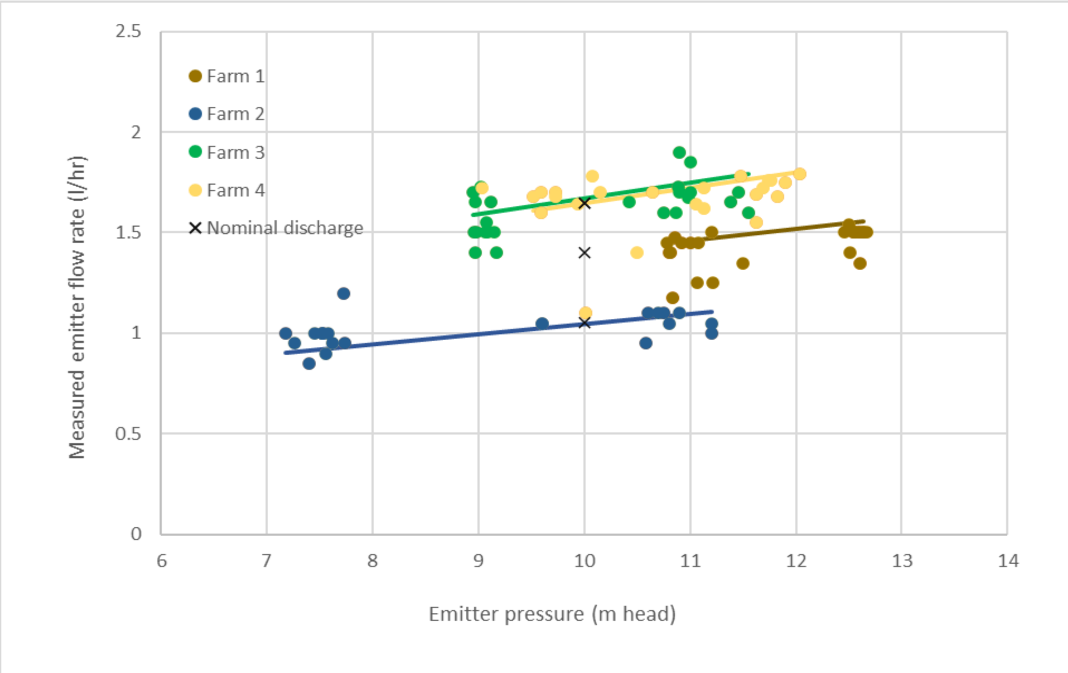


Figure 2. Individual emitter pressures and discharge rates for each farm assessed, with the lines showing the emitter discharge-pressure curves for each farm and the nominal emitter discharge rate (X).

Valve pressure variation

The required pressure downstream of each valve is specified on the irrigation plan. The required downstream pressure is not always the same for every valve within a farm and will vary with different emitter types, submain lengths and lateral run lengths.

On the farms assessed, many valves varied from the designed pressure, causing between 22 and 33% flow variation, see Table 2. This is on top of the flow variation within valves caused by pressure loss and blocked emitters. Causes of valve pressure variation included valve pressures not being checked and reset frequently enough, all valves on a farm being set to the same pressure due to operators not realising individual valves may have different pressure requirements, and valves drifting from their set point over a short period of time. One valve was found to be drifting as much as 9 m head between irrigation events.

Much of the flow variation caused by valve pressure variability can be addressed by routinely checking valve pressures and adjusting to the pressure specified on the plan. This will also help identify valves that are consistently drifting. These valves may require maintenance to ensure the pilot and diaphragm are functioning correctly. Valve flushing and replacement of springs or diaphragms may be required in some cases.

Table 2. Designed and measure valve pressures for each farm and expected impact on flow variation.

	Designed valve pressure	Measured valve pressure range	Flow variation caused by valve pressure variability
Farm 1	11-12 m head	6-15 m head	33%
Farm 2	11-13 m head	8-12 m head	23%
Farm 3	11 m head	12-17 m head	29%
Farm 4	12 m head	11-14 m head	22%

Back pressure

When measuring emitter pressures and discharge rates, some emitters were completely blocked and it was not possible to determine pressure or discharge rate on these emitters. It was also not possible to determine if these emitters were inadvertently blocked during the assessment process of digging up, exposing and cleaning the outside of the drip tape, or if they were already blocked by material in the emitter. Because these emitters were not part of the variability analysis, the true variation of all irrigation systems is likely to be even higher than shown in Table 1.

To determine what percentage of emitters were potentially blocked, the flow rates of entire laterals were measured by installing flow meters at the top of 6 individual laterals on each farm (Figure 3). Flow meters allow the system flow rate to be determined without significantly disturbing the emitters in the soil.

The measured lateral lines were found to be applying 7-13% less water than expected based on the pressure at the top of the lateral (Table 3). This reduction in flow rate could either be caused by blocked emitters restricting flow rate, or 'back pressure'. Back pressure is cause by pressure within the soil restricting flow out of the emitter into the soil matrix. Back pressure is higher with higher flow rates, heavier soils (i.e. clay soils), and wet soil.

Analysis found the reduction in flow rates was equivalent to back pressures of 1.6 to 2.65 m head. This is within the range of back pressure that could be experienced in these soil types (Thebaldi et al, 2022).

We cannot determine exactly what was causing the reduction in flow rate, but it was likely to be back pressure or blocked nozzles or a combination of both. If back pressure was the primary cause, then pressure at the valve should be increased above designed pressure by 2 - 3 m head to compensate for this.

	Measured reduction in flow	Equivalent back pressure
Farm 1	7%	1.8 m head
Farm 2		
Farm 3	13%	2.65 m head
Farm 4	8%	1.6 m head

Figure 3. Photo showing a flow meter installed at the top of an individual lateral.

What can be done?

A key benefit of pressurised subsurface drip irrigation over gravity fed surface irrigation is better control of application depth, efficient adoption of fertigation, and effective irrigation scheduling. However, high flow rate variation within and between blocks may negate these benefits.

This work found there was significant flow variation both within and between blocks assessed.

Measured variability was caused by:

- Head loss along laterals caused by design and lack of maintenance – 11 to 15%
- Back pressure – 7 to 13%
- Valve pressure variation– 22 to 33 %

This variation within blocks is on top of variation caused by leaks and drain out of the system after it is switched off. Variation is further exacerbated if run times vary between irrigation events or different blocks or shifts. Minimising variation where possible is key to realising the benefits of subsurface drip irrigation systems.

The flow variation measured was caused by a range of factors including design issues and deficiencies in operation, system maintenance and monitoring.

Design issues and opportunities:

High designed variation. All farms were designed with flow variations within blocks of greater than 10%. This was acceptable at the time that these older systems were installed, however new developments should be designed with a flow variation less than 10% by selecting correctly sized submain and lateral pipes for the required flow rates.

Lack of flushing mains. Only one of the systems assessed had flushing mains installed. This means that on three of the farms individual laterals had to be located and dug up for flushing to occur. The time and difficulty this causes means flushing and sanitation of the systems is going to be carried out very infrequently. Inclusion of flushing mains at installation is essential to ensuring required maintenance is undertaken on these systems.

Non-PC emitters. All systems were designed with non-PC emitters which means changes in pressure impact emitter flow rates. The adoption of pressure compensated (PC) emitters is potentially one solution. PC emitter tape is more expensive, however longer laterals lengths are possible, potentially requiring fewer submains, which can offset capital costs. With PC tape, system designs can be more flexible and better match farm layout and faming system or machinery. However, regular flushing is essential to ensure the longevity of PC emitter systems, so installation of flushing mains would also be important. We recommend that the processing tomato industry evaluate the benefits and limitations of PC emitters with some trials before widely implementing.

Operating:

Valve pressures. Variation in valve pressures was found to be causing the highest level of flow rate variability. The causes of valve pressure variation included valve pressures not being checked frequently enough, valves not being set to the pressure on the design and valves drifting from their set point over relatively short time periods (days). Routine checking of valve pressures and adjusting to the pressure specified on the plan is essential. Periodic valve maintenance including valve flushing and replacement of springs or diaphragms may be required.

Back pressure. These assessments have shown that subsurface drip emitters are applying less water than expected at any given pressure. This is likely to be caused by back pressure or partially blocked emitters. To compensate for the lower flow rates, pressure at the valves should be set to 2 to 3 m head (20-30 kPa) higher than the designed valve pressure and flow rate monitored by a flow meter at the pump to ensure the correct application depth is being applied for each shift.

Maintenance and monitoring

Flushing and sanitation. Flushing and system sanitation (oxidation and acid treatment) is essential to maintaining the performance of drip irrigation systems. These assessments have shown that systems have deteriorated, and flushing has the potential to improve system performance. However, flushing alone was not able to completely restore the systems to new condition. Sanitation may improve the systems further, but prevention is better than fixing a broken system, so regular flushing and sanitation should be routine from the time the system is installed. Installation of flushing mains will be key to maintenance occurring often enough.

Useful information:

Agriculture Victoria – Drip irrigation site:

https://agriculture.vic.gov.au/farm-management/water/irrigation/drip-irrigation

Drip system maintenance and monitoring:

https://agriculture.vic.gov.au/farm-management/water/irrigation/drip-irrigation/drip-system-maintenance-and-monitoring

Planning a drip irrigation system:

https://agriculture.vic.gov.au/farm-management/water/irrigation/drip-irrigation/planning-a-drip-irrigation-system

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Investigating the race structure and alternative hosts of *Fusarium oxysporum*

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INTRODUCTION

Collar rot and wilt caused by *Fusarium oxysporum* [1] is a serious disease of tomatoes worldwide and has been reported in major tomato production areas including the US, Italy, Japan, China, and Australia [2]. It is particularly damaging to the Australian processing tomato industry, resulting in an annual estimate of 10% yield decline in serious cases [2]. Control of soilborne pathogens such as *F. oxysporum* is principally based on management practises involving switching to different irrigation methods to improve potential waterlogging conditions and enhancing soil organic matter to reduce potential buildup of soil inoculum level [3]. Another potential management strategy is rotation with nonhost crops to decrease pathogen inoculum buildup in the soil, especially because reduced tillage results in carry-over of pathogen inoculum. Finally, use of resistant cultivars, if available, is an effective and cost-efficient approach to manage soilborne diseases. Commercial processing tomato cultivars with resistance to different races of *F. oxysporum f. sp. lycopersici (Fol)* have been developed in the USA. However, these cultivars have been screened against *Fol* populations in the USA, which are genetically different to the Australian *Fol* population [4]. Therefore, resistance of the most promising cultivars developed in the USA needs to be validated in Australia to ensure resistance to Australian *Fol* populations.

Historically, the three *Fol* physiological races were characterised by their pathogenicity on host cultivars carrying different immunity *(I)* genes. In 1992, Ramsey *et al*. [5] used four different fresh tomato cultivars: Grosse Lisse (universal susceptible), Scorpio (resistance to race 1), Floradale (resistant to races 1 and 2), and Delta Tristar (resistant to all 3 known races) as a differential set to characterise 22 *F. oxyspoum* isolates from Queensland. However, some of these historical cultivars are not available anymore, and supply of seeds from other states is limited due to biosecurity reasons. Therefore, our research is investigating suitability of various molecular identification assays for race characterisation of *Fol* isolates.

Molecular identification of *Fol* physiological races has been based primarily on pathogenicity-related factors such as polygalacturonase *(PG)* genes [6-8] and secreted in xylem (SIX) genes produced by the fungal pathogen [9, 10]. *PG* genes, which include cell wall degrading enzymes such as polygalacturonases, are important in the process of hyphal penetration into the host epidermal cells [6, 7]. *SIX* genes are a group of effectors that code for small proteins that are secreted into the xylem of tomato during *Fol* infection [11, 12]. Depending on the tomato cultivar, these genes may be recognised by the host plant and result in an immunity response. As a result, characterisation of these pathogenicity-related gene sequences can inform *Fol* race structure and virulence on different tomato cultivars.

Another important aspect of *Fol* biology with significant implications for disease management is its host range. Similar to many other soilborne pathogens, *Fol* can form non-pathogenic symbioses with plants, in which host colonization occurs with no symptoms [13-15]. Such asymptomatic infections are important from a disease management point of view due to their significant impact on pathogen survival and distribution in the field. For example, previous research at the University of Melbourne reported that various host crops inoculated with *Fusarium oxysporum* isolates, including barley, clover, faba bean, maize and wheat, showed no symptoms or growth reduction, however, the pathogen was able to be re-isolated from these crops [16]. This suggested that crops cultivated in rotation with processing tomatoes in NSW and VIC may have asymptomatic *F. oxysporum* infection. A critical next step is to determine the potential contribution of these rotation crops to *Fol* inoculum buildup in the soil in order to inform crop rotation strategies.

Accurate and reliable detection and quantification of pathogen inoculum in the soil requires access to validated DNA extraction and detection assays. Quantitative polymerase chain reaction (qPCR) of fungal DNA can be employed for accurate, rapid, and reliable quantification of *Fusarium* inoculum levels in the soil [17-19]. Such an assay will also provide a tool for the screening of resistant or susceptible host cultivars that will yield critical information regarding cultivar selection for growers [20, 21]. This project is, therefore, investigating the optimisation of a DNA extraction and real-time qPCR quantification assay with high sensitivity and specificity to use for inoculum quantification and phenotyping.

This report outlines the use of *PG* and *SIX* molecular markers for identification of physiological races of *F. oxysporum* isolates collected from processing tomato fields in NSW and VIC. Furthermore, an update on the ongoing host range and molecular phenotyping experiments at the University of Melbourne is provided.

Molecular characterisation of virulence

From December 2021 to 2024, 33 putative pathogenic *F. oxysporum* isolates were sampled and cultured from field-grown diseased processing tomatoes demonstrating symptoms like stunting, poor growth and yellowing. Molecular identification of *Fol* races was carried out based on different methods generated from *PG* gene *PCR* markers [6], *PG* gene sequences [7], and SIX genes [4]. Amongst our culture collections, molecular characterisation of 21 isolates has been completed so far. Furthermore, four isolates from Ramsey et al.'s study [5] were obtained from the Brisbane Plant Pathology Culture Collection (BRIP) to serve as reference isolates originally designated as *Fol* Race 1, 2, and 3 based on the differential cultivars. These isolates were included as references in order to validate our identification of races via molecular assay. UM991, UM1264 and UM1390 were included from Callaghan's collection for comparison [16].

Table 1 summarises comparative results for physiological races using three different sets of molecular assays. In general, results showed a considerable amount of variability from the three systems. The *SIX* assay was the most unreliable with inconclusive results for many isolates due to the inability to differentiate races 2 and 3 in some cases. The PG PCR assay was the most reliable with correct identification of Race 1 and 3 in the reference isolates. This illustrates that the molecular mechanisms of virulence in Australian *F. oxysporum* isolates are different to those from the USA and elsewhere.

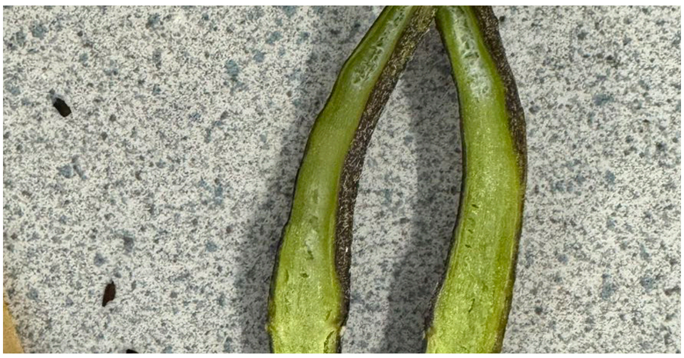

Table 1. Identification of Fusarium oxysporum physiological races based on three molecular assays.

Putative ID	Year	Location	*PG* sequence assay [7]	*PG* PCR assay [6]	*SIX* assay [4]
BRIP 5188	1971	NSW	1	1	3
BRIP 13037	1979	QLD	3	3	inconclusive
BRIP 16848	1986	NSW	1	1	2
BRIP 17552	1980	QLD	1	1	1
UMT01	2022	VIC	1	1	inconclusive
UMT02	2022	VIC	1	1	inconclusive
UMT03	2022	VIC	3	3	inconclusive
UMT04	2022	NSW	inconclusive	3	3
UMT05	2022	NSW	3	3	inconclusive
UMT06	2022	VIC	1	2	3
UMT07	2022	VIC	2	1	3
UMT08	2022	VIC	1	3	inconclusive
UMT09	2022	VIC	3	1	inconclusive
UMT10	2022	VIC	3	3	inconclusive
UMT11	2023	VIC	3	3	inconclusive
UMT12	2023	VIC	inconclusive	3	inconclusive
UMT13	2023	VIC	3	3	inconclusive
UMT14	2023	VIC	3	3	3
UMT15	2023	VIC	3	3	inconclusive
UMT16	2023	VIC	3	3	inconclusive
UMT17	2023	NSW	3	3	inconclusive
UMT18	2023	VIC	3	3	3
UMT19	2023	VIC	3	3	3
UMT20	2023	VIC	3	3	inconclusive
UMT21	2023	VIC	3	3	3
UM991	2017	VIC	inconclusive	3	3
UM1264	2018	VIC	inconclusive	3	2
UM1390	2018	VIC	2	2	1

Host range studies

A replicated glasshouse experiment was set up at the University of Melbourne to 1) assess *Fol* biomass build-up in barley, canola, faba bean and wheat plants compared to the commercial processing tomato cultivar H3402; 2) investigate the impact of barley, canola, faba bean and wheat on *Fol inoculum* levels in the soil compared to the common commercial processing tomato cultivar H3402 (use of rotation crops vs constant cropping with processing tomatoes), and 3) assess survival of *Fol* inoculum in the soil sown to barley, canola, faba bean, and wheat and its impact on the growth of subsequent tomato crops.

The experiment was set up in a completely randomised block design including five crop species, two treatments (*Fusarium* inoculated and mock-inoculated), 5 internal replicates, and three quantification points (150 pots). This design allows for inoculum quantification at two time points from plants and soil as follows: 1. quantification of *in planta Fol* biomass in the root tissues of the five hosts at maturity, 2. quantification of *Fol* inoculum levels in the soil, and 3. quantification of *Fol* inoculum in root tissue of processing tomatoes planted in the inoculated soil after harvesting the rotation crops. Seeds of barley *(Hordeum vulgare* cv. Maximus CL), canola (*Brassica napus* cv. 44Y94CL), faba bean *(Vicia faba cv. Fiesta VF*), wheat *(Triticum aestivum cv. Scepter)* and processing tomato cultivar H3402 were provided by Matthew Stewart. An aggressive *F. oxysporum* strain (race 3, most prevalent), collected from a processing tomato field in Victoria, was selected for inoculum production on millet seed according to Warman and Aitken 2018 [22], and Chen et al. 2019 [23].

The trial is currently ongoing in the glasshouses of the University of Melbourne and plant harvest has been completed for the first quantification. No visual symptoms were detected along the stem and collar regions of any of the crops; however, *Fol* was re-isolated from the collar, stem and roots of all inoculated plants. Assessment of root dry weight showed significant reduction of root biomass in inoculated tomato plants while no significant impact on root dry weight was detected for other crops (Figure 1). Furthermore, generic *F. oxysporum* qPCR assays are being optimised to use for *Fol* biomass quantification in planta and in the soil.

Fol has been previously reported with a narrow host range based on symptomology such as reduced root growth, stunting, and poor development [24, 25]. In our host range trial, which included wheat, barley, faba bean, canola, and processing tomato, none of the plant species developed any symptoms except for the reduced root dry weight in processing tomatoes measured at the end of the bioassay. This is consistent with previous findings that *Fol* can only cause disease within a limited host range [26, 27]. Typically, a specific host to a pathogen is defined by development of disease symptoms on the host, validated by isolation, *pathogenicity* and re-isolation of the pathogen, i.e., Koch's postulates [13, 26]. However, many other crop species may also be able to carry the pathogen but remain asymptomatic. For the current study, since *F. oxysporum* was re-isolated from all five crop species but only processing tomatoes showed clear disease (Figure 1.), the other four crops can be considered asymptomatic carriers [28].

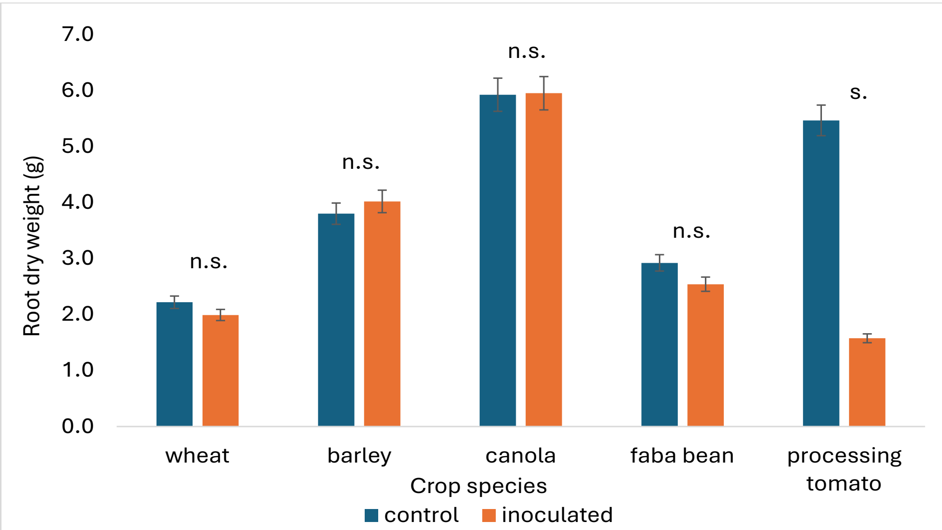

Figure 1. Tukey differences of means for control inoculated dry root weights for five crop species. Error bars represent standard error of the means, n.s. = no significant difference between control and inoculated crops, s. = significant difference ($p < 0.05$).

Conclusion and future studies

While all molecular assays point to the high prevalence of *Fol* race 3 in the Australian population, inconsistencies were observed between assays. These results confirm the different origin of virulence in Australian *Fol* races compared to those characterised overseas in line with previous studies [26, 29]. We are currently working towards whole genome sequencing of the Australian *Fol* isolates to allow for characterisation of molecular determinants of their virulence and compare them with USA isolates. The whole genome sequence data will also provide the industry with an invaluable resource for development of a molecular assay specific to Australian *Fol* races 1, 2, and 3.

Our work confirms previous research conducted at UoM which found several rotation crops to be able to carry over *Fol* inoculum. We are currently working on optimising the DNA extraction procedure and a generic *Fusarium oxysporum* qPCR assay for a more specific, accurate and sensitive quantification of inoculum in our glasshouse trial, which was inoculated with an aggressive *Fol* isolate under controlled conditions. This qPCR assay may be further used to assess the resistance or susceptibility of processing tomato cultivars to Australian race 3 isolates that we collected from the field.

Acknowledgement

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Pythium species isolated from irrigation water in a processing tomato field in Australia

THE UNIVERSITY OF MELBOURNE

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Background

The Australian processing tomato crops are affected by crown and root pathogens, including *Pythium* species, which are soilborne and waterborne oomycetes that result in pre- and post-emergence damping off, root rot, and poor root development in tomato crops worldwide.

Previous field surveys of Australian processing tomato fields (2016-2018) revealed widespread occurrence of *Pythium* spp., including 11 pathogenic species from soil and symptomatic tomato plants (Callaghan *et al.* 2022).

Aim

Assess the potential contribution of irrigation water to dispersal of *Pythium* spp. in processing tomato fields in Australia.

Methods

- Six water samples were collected along the irrigation system of a processing tomato farm in New South Wales, Australia.
- Healthy tomato seedlings grown on tissue culture medium were used to bait *Pythium* spp. from water.
- Isolates were identified using multi-gene phylogenetic analysis of the Internal transcribed spacers of the nuclear ribosomal DNA and the 5.8S region on the nrDNA (ITS), β-tubulin (*β-tub*), and Cytochrome c oxidase subunits I and II (*Cox-1* and *Cox-2*).

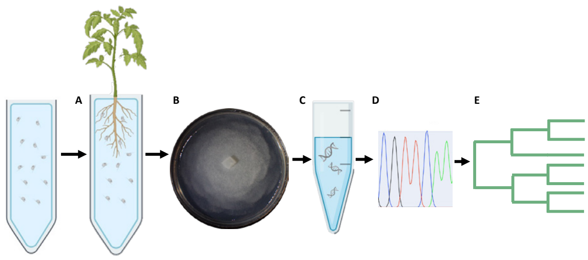

Figure 1. Visual diagram outlining the methods: (A) oomycete baiting using tomato roots, (B) isolated *Pythium* culture, (C) DNA extraction, (D) sequencing, and (E) phylogenetic analysis.

Results

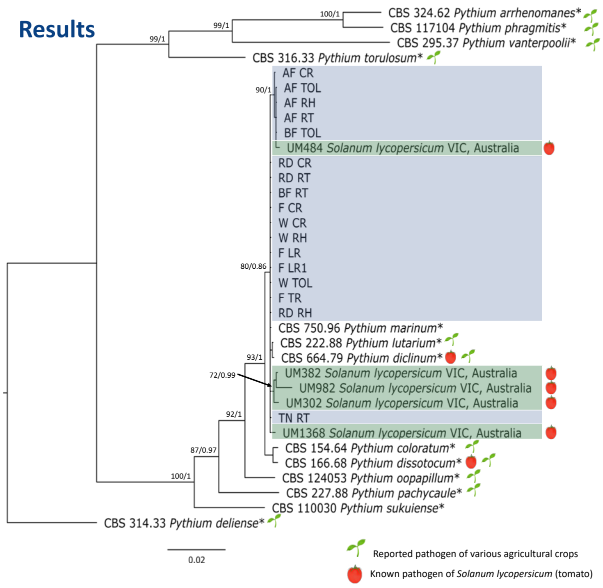

Figure 2. Phylogeny of *Pythium* spp. based on concatenated ITS, *Cox-I*, *Cox-II*, and *β-tub* alignments. Maximum likelihood bootstrap values >70% and Bayesian inference posterior probability values >0.80 are shown at the nodes. Asterisks denote ex-type strains. Isolates from irrigation water are highlighted in blue, and isolates sequenced by Callaghan *et al.* (2022) from symptomatic tomato tissue are highlighted in green.

Take home message

- 17 isolates obtained from irrigation water were identified within the *Pythium* B2a cluster, which features several aggressive pathogens of tomato, and other species that are known to have an affinity to aquatic habitats.
- The irrigation system in processing tomato fields may be facilitating the spread of *Pythium* spp.
- Further work is required to assess aggressiveness of these isolates on tomato, their contribution to yield decline, and interaction with other important soilborne pathogens such as *Fusarium oxysporum*.

Reference

Callaghan *et al.* (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.

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AUSTRALIAN PROCESSING TOMATO CULTIVAR TRIALS 2023-2024

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INTRODUCTION

The APTRC's cultivar assessment program for 2023-24 comprised three early season transplant trials, five mid-season transplant and two mid-season direct seeded trials, with one direct seeded trial lost due to waterlogging. These trials were established across northern Victoria and southern New South Wales - from Lake Boga, Corop, and Nathalia in Victoria up to Pretty Pine in NSW.

The late arrival of some trial seed resulted in an additional late trial site (Kagome Morago Site 2) being established to look at two mid-season high lycopene varieties as well as a very early cultivar.

A total of eleven early and nineteen mid-season cultivars were included in machine-harvested trials, along with five cultivars in screening trials.

MATERIALS AND METHODS

Tables 1 & 2 list cultivars included in the 2023-24 trial program as well as the trial locations.

Table 1. Cultivars included in the 2023-24 machine harvest trials

		Transplants									Direct seed	
		Sawers (Yando Vic)	Kagome (Morago Site 1 NSW)	Go.Farm (Benjeroop Vic)	Kagome (Morago Site 2 NSW)	Kagome (Thyra NSW)	Weeks Ag (Rochester Vic)	Campaspe Ag (Nanneella Vic)	Go.Farm (Yalca Vic)	Kennedy (Corop Vic)	Sawers (Leaghur Vic)	Chirnside (Appin South)
Early	H1015	✓	✓	✓	✓	-	-	-	-	-	-	-
	H1281 (v early)	-	-	-	✓							
	H1301	-	✓	-	-	-	-	-	-	-	-	-
	HM Enotrio	✓	✓	✓	-	-	-	-	-	-	-	-
	SVTM 9018	✓	✓	-	-							
	SVTM 9027	✓	-	-	-	-	-	-	-	-	-	-
	SVTM 9032	✓	✓	-	-	-	-	-	-	-	-	-
	SVTM 9033	✓	✓	-	-	-	-	-	-	-	-	-
	SVTM 9300 (Incipit)	✓	✓	-	-	-	-	-	-	-	-	-
	SVTM9000	✓	✓	✓	-	-	-	-	-	-	-	-
	SVTP9603 (Eventus)	✓	✓	-	-	-	-	-	-	-	-	-
	Syngenta BQ403	✓	✓	✓	-	-	-	-	-	-	-	-
Mid	H1311 (HL)	-	-	-	✓	✓	-	-	-	-	-	-
	H3402	-	-	-	-	✓	✓	✓	✓	✓	✓	✓
	H3406	-	-	-	-	✓	-	-	-	-	-	-
	H1657 (HL)	-	-	-	✓	-	-	-	-	-	-	-
	H1884	-	-	-	✓	-	-	-	-	-		
	HM 58811	-	-	-	-	✓	✓	✓	✓	✓	✓	✓
	HM 58841	-	-	-	-	✓	✓	✓	✓	✓	-	-
	HM 6856 (Adenda)	-	-	-	-	✓	✓	✓	✓	✓	✓	✓
	HM Nava	-	-	-	-	✓	-	-	-	-	-	-
	SVTM 9023	-	-	-	-	✓	✓	-	-	✓	✓	✓
	SVTM 9024	-	-	-	-	✓	-	✓	✓	✓	✓	✓
	SVTM 9025	-	-	-	-	✓	-	✓	✓	-	✓	✓
	SVTM 9034	-	-	-	-	✓	-	✓	-	-	-	-
	SVTM 9037	-	-	-	-	✓	-	✓	-	-	-	-
	Syn Firmus	-	-	-	-	✓	-	-	✓	-	-	-
	Syn Ifox	-	-	-	-	✓	-	-	✓	-	-	-
	Syn Waller	-	-	-	-	✓	-	-	✓	-	-	-
	UG Mix 19406/16112	-	-	-	-	✓	-	-	-	-	-	-

HL – high lycopene H - Heinz, HM - HM Clause, NUN - Nunhems, SVTM – Seminis, Syn – Syngenta, UG – United Genetics

Table 2. Screening trial cultivars and locations

		Sawers (Yando Vic)	Kagome (Morago NSW)	Go Farms (Benjeroop Vic)	Weeks Ag (Rochester Vic)	Campaspe Ag (Nanneella Vic)
Early	LV TOP 96876	✓	✓	✓	-	-
	LV TOP 96879	✓	✓	✓	-	-
Mid	SVTM 9334 (Barrick)	-	-	-	✓	✓
	LV TOP 96877	-	-	-	✓	✓
	LV TOP 96878	-	-	-	✓	✓

LV – Lefroy Valley

TRIAL DESIGN AND ASSESSMENT

Preliminary Screening trials

Screening trials were established using transplanted seedlings and consisted of two six metre plots per cultivar planted in a staggered pattern on adjacent rows. These trials were visually assessed and the cultivars rated prior to the paddock being harvested.

Machine harvested trials

The machine harvested trials were laid out in a randomised complete block (RCB) design. This is a standard design for agricultural experiments used to help mitigate the impact of variations in trial results due to spatial effects in the paddock, e.g. soil type or irrigation.

The trials were set out with five replicates (blocks) repeating along the rows. Plots ranged from 60 to 70 metres in length, and all sites were drip irrigated single row beds of 1.52 metre width. The trial cultivars were assigned at random across each block.

A hand-held GPS unit was used to measure and peg out the machine harvest trial rows. During planting, cultivars were swapped at each peg in accordance with the trial plan. The weight of harvestable fruit produced from each trial plot was measured using load cells on the bulk harvester trailers.

Prior to harvest, twenty healthy red fruit were randomly sampled from each trial plot and taken to the Kagome Laboratory for Brix, pH, and colour testing. A pureed sample of raw fruit was used for Brix and pH testing using a refractometer and a pH meter, respectively. A hand diced fruit sample was also assessed for colour using a Hunter Lab Colorimeter.

From a processing point of view, the preferred raw fruit pH is less than 4.35 and the desirable a/b colour score (obtained by dividing colour a by colour b) is 2.0 or higher. Red fruit yields (tonnes per hectare) from trial plots were calculated using trial plot weights together with the row length and width.

Yield and Brix results were multiplied together to determine the tonnes per hectare of soluble solids (labelled as soluble solids (t/ha)).

Statistics

Trial results were analysed using the ARM 9 statistical program to perform an analysis of variance (ANOVA), comparing the differences between group means. Whether the difference between means was significant or not was determined using Tukey's HSD (honest significant difference) P = 0.05.

RESULTS AND DISCUSSION

The growing season started well, but once again adverse weather impacted final crop yields, with widespread rainfall in late December and early January resulting in crop losses. Trial yields were also affected, with some sites in the Boort and Rochester regions of Victoria and Thyra in NSW being particularly hard hit. One direct seeded trial at Boort had to be abandoned due to waterlogging.

Early Season Trials

This season, the APTRC trial program included six new cultivars in the early machine harvest trials, as well as two cultivars in the screening trials. In addition, six cultivars (including the commercial standards) underwent ongoing assessment.

All the early season trials used transplanted seedlings, with the first site being planted on the 2nd of October at Yando Victoria. The two other early season trials were established within a fortnight. A very late "early season" trial at Kagome Morago Site 2 was established on the 13th of December.

Analysis of Variance Tables

In the tables showing the statistical analysis (ANOVA) of trial results, average values followed by the same letter do not significantly differ (P =.05, Tukey's HSD). Numbers in green signify results that are significantly better than the early season industry standard cultivar (H1015) for that parameter.

Table 3. ANOVA results for the Sawers Yando, Vic early season transplant trial (123 days in the field).

Cultivar	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H1015	78.34	a	5.93	bcd	4.63	a	4.59	a	2.37	ab
HM Enotrio	93.12	a	6.22	abc	5.84	a	4.46	ab	2.62	a
SVTM 9000	73.08	a	6.12	abc	4.43	a	4.57	a	2.22	b
SVTM 9018	99.19	a	5.86	bcd	5.39	a	4.36	b	2.20	b
SVTM 9027	77.04	a	6.67	a	5.13	a	4.47	ab	2.29	b
SVTM 9032	75.51	a	6.67	a	4.91	a	4.41	b	2.30	b
SVTM 9033	69.03	a	5.78	bcd	4.04	a	4.47	ab	2.24	b
SVTM 9300 (Incipit)	86.44	a	5.57	cd	4.82	a	4.60	a	2.42	ab
SVTP 9603 (Eventus)	87.65	a	5.27	d	4.64	a	4.45	ab	2.28	b
Syngenta BQ403	78.14	a	6.42	ab	4.95	a	4.39	b	2.23	b
Tukey's HSD (P=.05)	58.70		0.84		3.310		0.14		0.31	
Treatment Prob (F)	0.792		0.033		0.845		0.0001		0.003	

Average trial yield – 81.8 tonne per hectare Applied automatic data correction transformation 'Log(n+1)' to data Colour b to correct skewness. Excluded replicate 3 from Brix to correct heterogeneity of variance.

Table 4. ANOVA results for the Go.Farm Benjeroop, Vic early season transplant trial (127 days in the field).

Cultivar	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H1015	68.48	a	6.64	a	4.54	a	4.53	a	2.35	ab
HM Enotrio	56.13	a	6.80	a	3.83	a	4.53	a	2.48	a
SVTM 9000	63.07	a	6.44	a	4.07	a	4.51	a	2.39	ab
Syngenta BQ403	73.66	a	6.85	a	5.03	a	4.41	a	2.23	a
Tukey's HSD (P=.05)	21.34		0.80		1.537		0.15		0.17	
Treatment Prob (F)	0.143		0.441		0.153		0.097		0.007	

Average trial yield – 65.3 tonne per hectare

Table 5. ANOVA results for Kagome Morago Site 1, NSW early season transplant trial (119 days in the field).

Cultivar	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H1015	88.66	a	4.92	ab	4.35	ab	4.60	abc	2.28	a
H1301	73.07	a	5.25	ab	3.76	ab	4.62	ab	2.13	a
HM Enotrio	76.17	a	5.17	ab	3.91	ab	4.63	ab	2.29	a
SVTM 9000	72.33	a	4.80	ab	3.48	ab	4.46	d	2.21	a
SVTM 9018	99.39	a	5.13	ab	5.10	a	4.48	cd	2.23	a
SVTM 9032	56.14	a	5.25	ab	2.88	ab	4.47	cd	2.15	a
SVTM 9033	51.62	a	5.17	ab	2.69	b	4.53	a-d	2.20	a
SVTM 9300 (Incipit)	68.42	a	4.71	b	3.19	ab	4.65	a	2.28	a
SVTP 9603 (Eventus)	67.85	a	4.85	ab	3.26	ab	4.62	ab	2.18	a
Syngenta BQ403	70.88	a	5.63	a	3.96	ab	4.51	bcd	2.20	a
Tukey's HSD (P=.05)	49.37		0.84		2.309		0.14		0.30	
Treatment Prob (F)	0.101		0.033		0.045		0.0001		0.612	

Average trial yield – 72.5 tonne per hectare

Table 6. ANOVA results for Kagome Morago Site 2, NSW late planted early season transplant trial (129 days in field)

Cultivar	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H1015	86.43	a	6.28	a	5.41	a	4.65	a	2.48	a
H1281	75.59	a	5.71	a	4.31	a	4.54	a	2.35	a
Tukey's HSD (P=.05)	18.25		1.46		2.271		0.22		0.20	
Treatment Prob (F)	0.125		0.234		0.173		0.1604		0.104	

Average trial yield – 81.0 tonne per hectare

YIELD AND BRIX

Figure 1 and the figures henceforth show trial results in graphical format for ease of comparison. In these figures, green indicates values that are significantly better than the industry standard and red values significantly worse. Data that has been excluded from analysis is shown in grey.

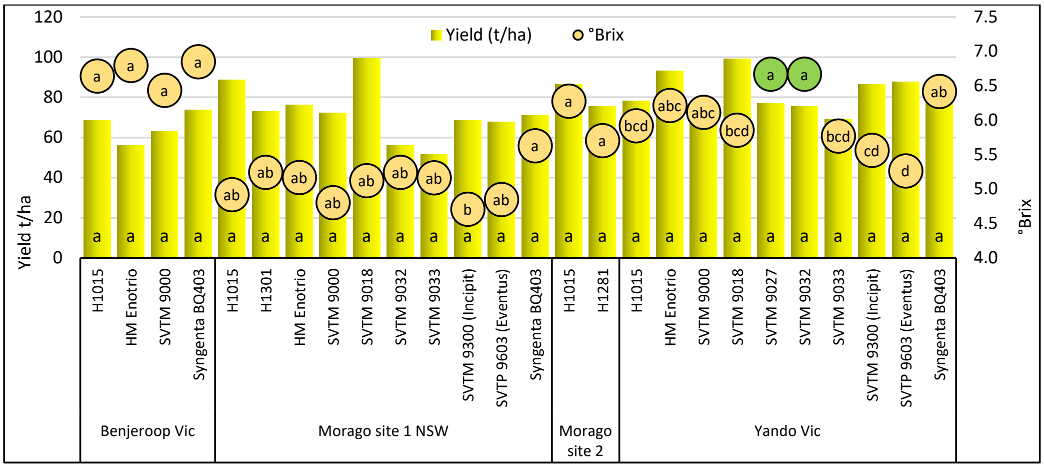

Figure 1. Early season average yields and Brix in comparison to H1015

Early season trial yields averaged from just over 65 to around 82 t/ha, reflecting the negative impact of heavy rainfall during their growing season.

There were no significant differences in yields between cultivars in any of the early trials. However, SVTM 9018 was the highest yielding cultivar in the two trials it was planted in, with yields over 99 t/ha. BQ403 was the highest yielding cultivar at Benjeroop with 73.7 t/ha, and H1015 was best at Morago Site 2 with 86.4 t/ha *(Figure 1).*

The only significant differences in raw fruit brix from that of H1015 occurred in the trial at Yando, where both SVTM 9027 and 9032 had significantly higher brix.

Tonnes per hectare soluble solids

There were no significant differences in terms of tonnes per hectare of soluble solids in comparison to H1015 across any of the early trial sites (Figure 2). However, SVTM 9032 had significantly higher soluble solids than SVTM 9300 (Incipit) at Morago Site 1.

Soluble solids ranged from a low of 2.7 t/ha for SVTM 9033 at the Morago Site 1 to a high of 5.84 for HM Enotrio at Yando.

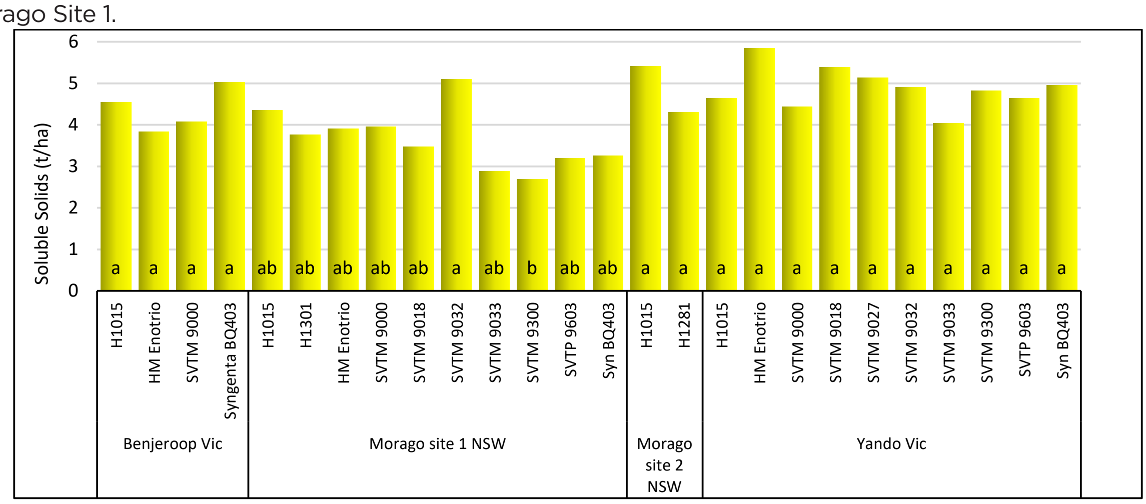

Figure 2. Early season average soluble solids in comparison to H1015

Figure 3 shows yield and brix as a percentage of H1015 (black diamond in centre of cross hairs). Three cultivars, HM Enotrio, SVTM 9018, and BQ 403, all had higher yields and brix than H1015 in at least one trial, although these differences are not significant.

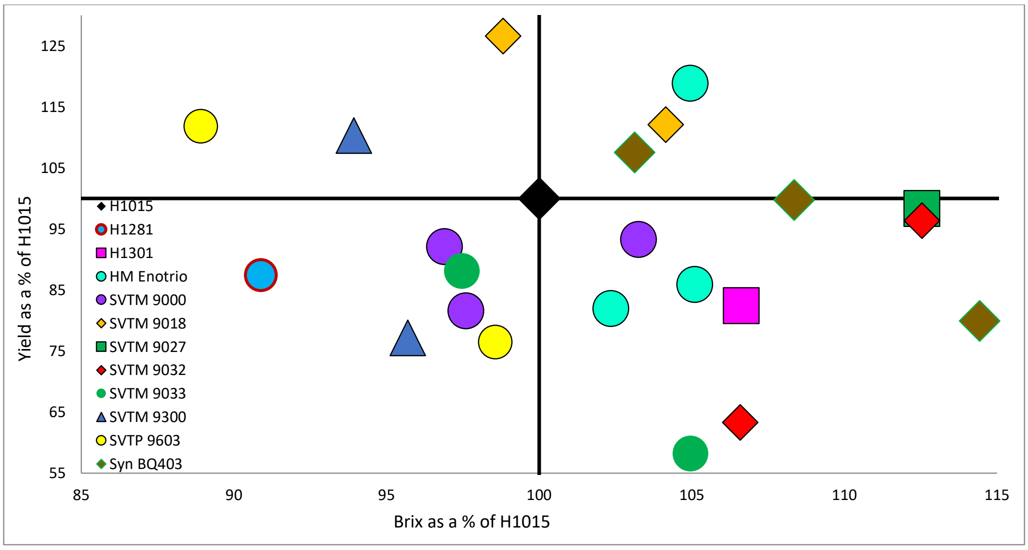

Figure 3. Early season cultivar yields and Brix as a percentage of H1015.

pH

All raw fruit pH readings across the early trials were higher than the processors' preferred maximum pH of 4.35. The pH ranged from 4.36 for SVTM 9018 up to 4.65 for both SVTP 9603 and H1015.

SVTM 9018 had significantly lower pH than H1015 in two trials (Figure 4), whilst SVTM 9032 and BQ403 were also significantly lower in the trial at Yando.

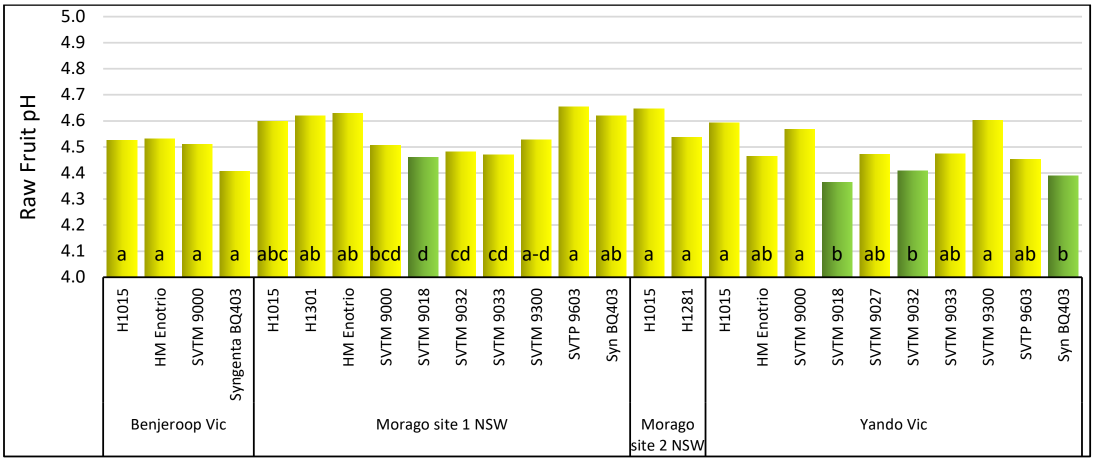

Figure 4. Early season raw fruit pH

Colour

Early cultivar colour a/b scores were higher than the minimum preferred reading of 2.0. Colour a/b scores ranged from 2.13 for H1301 at Morago Site 1 to a high of 3.62 for HM Enotrio at Yando.

HM Enotrio had a significantly higher colour score than seven of the other cultivars in the Yando trial; however, this was not significantly higher than H1015 and SVTM 9300 (Incipit).

MID-SEASON TRIALS

Of the nine mid-season trials established, eight made it through to harvest, with a direct seeded trial near Boort lost due to waterlogging as noted previously. This mid-season rainfall also affected the other direct seeded trial in the Boort region, resulting in the loss of two replicates at the bottom of the valve.

There were four new cultivars added to the assessment program this season (Syngenta Firmus, Ifox, Waller, and Seminis 9037), plus twelve varieties that were undergoing further assessment.

Seven of the eight mid-season trials were planted over an 11 day period beginning on the 25th of October and the last trial, a high lycopene comparison trial, was planted on the 13th of December. Trial harvests began on the 25th of February and finished on April 20th, with crop days in the field ranging from 121 to 143.

Analysis of Variance Tables

Cultivar results from these trials were compared to those of the mid-season industry standard cultivar H3402.

Again, the results that are significantly better than H3402 are in marked green, and those that were significantly worse are in red, while data that has been excluded from analysis is highlighted grey with the reason for exclusion listed below the table

Table 7. ANOVA results for Appin Sth, Vic direct seeded trial (138 days in field).

Variety	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H3402	114.81	ab	5.48	a	6.28	abc	4.45	a	2.32	a
HM 58811	132.24	a	5.97	a	7.88	a	4.46	a	2.30	a
HM 6856	122.77	ab	5.62	a	6.90	abc	4.40	ab	2.29	a
SVTM 9023	125.56	a	5.78	a	7.22	ab	4.40	ab	2.38	
SVTM 9024	97.31	b	5.52	a	5.40	c	4.35	b	2.38	a
SVTM 9025	95.87	b	5.93	a	5.71	bc	4.31	b	2.37	a
Tukey's HSD (P=.05)	27.51		0.61		1.638		0.09		0.20	
Treatment Prob (F)	0.002		0.080		0.001		0.0004		0.477	

Average trial yield – 114.7 tonne per hectare

Table 8. ANOVA results for Thyra, NSW transplant trial (143 days in field).

Variety	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H3402	127.78	abc	5.71	a	7.22	ab	4.55	a	2.28	a
H1311	123.74	abc	6.37	a	7.54	ab	4.43	a	2.15	a
H3406	137.90	abc	5.79	a	7.63	ab	4.55	a	2.16	a
HM 58811	130.06	abc	6.30	a	8.38	ab	4.42	a	2.23	a
HM 58841	110.07	c	6.26	a	6.80	ab	4.53	a	2.13	a
HM 6856 (Adenda)	114.88	bc	5.53	a	6.09	b	4.55	a	2.28	a
HM Nava	120.19	bc	5.53	a	6.52	ab	4.43	a	2.35	a
SVTM 9023	150.31	a	6.04	a	8.96	a	4.40	a	2.20	a
SVTM 9024	129.81	abc	5.84	a	7.04	ab	4.48	a	2.31	a
SVTM 9025	131.58	abc	5.50	a	6.86	ab	4.49	a	2.25	a
SVTM 9034	112.35	c	6.01	a	6.92	ab	4.42	a	2.26	a
SVTM 9037	143.98	ab	6.35	a	8.98	a	4.41	a	2.21	a
Syngenta Firmus	130.31	abc	5.84	a	6.83	ab	4.47	a	2.29	a
Syngenta Ifox	68.32	d	5.77	a	3.50	c	4.49	a	2.35	a
Syngenta Waller	135.12	abc	5.65	a	7.58	ab	4.52	a	2.36	a
UG Mix (19406/16112)	124.11	abc	6.30	a	7.72	ab	4.42	a	2.44	a
Tukey's HSD (P=.05)	29.22		1.25		2.496		0.23		0.0538t	
Treatment Prob (F)	0.000		0.097		0.000		0.131		0.365	

Average trial yield – 124.4 tonne per hectare
Applied automatic data correction transformation 'Log(n+1)' to Colour a/b to correct kurtosis.
Excluded replicate 5 from Yield to correct skewness/kurtosis.
Excluded replicate 2 from Soluble Solids to correct skewness.

Table 9. ANOVA results for Corop, Vic transplant trial (129 days in field).

Variety	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H3402	113.56	a	5.77	bc	6.59	a	4.58	a	2.26	a
HM 58811	139.48	a	6.25	abc	8.70	a	4.45	b	2.34	a
HM 58841	121.86	a	6.64	a	8.10	a	4.45	b	2.36	a
HM 6856	129.55	a	5.59	c	7.24	a	4.39	b	2.32	
SVTM 9023	129.56	a	6.18	abc	7.98	a	4.44	b	2.09	a
SVTM 9024	121.86	a	6.38	ab	7.75	a	4.37	b	2.26	a
Tukey's HSD (P=.05)	35.68		0.71		2.283		0.11		0.28	
Treatment Prob (F)	0.331		0.002		0.115		0.000		0.072	

Average trial yield – 126.0 tonne per hectare
Excluded HM 6856 from Colour a/b to correct heterogeneity of variance.

Table 10. ANOVA results for Yalca, Vic transplant trial (138 days in field).

Variety	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H3402	208.65	a	5.77	ab	12.02	a	4.61	ab	2.33	a
HM 58811	189.15	ab	6.16	ab	11.75	ab	4.49	b-e	2.38	a
HM 58841	173.87	ab	6.26	a	10.87	a	4.46	de	2.39	a
HM 6856	172.23	ab	5.89	b	10.13		4.43	e	2.38	a
SVTM 9024	154.25	ab	5.95	ab	11.36	ab	4.48	cde	2.41	a
SVTM 9025	147.17	a	6.29	a	12.97	a	4.42	e	2.46	a
Syngenta Firmus	131.78	bc	5.44	ab	7.63	bc	4.59	a-d	2.34	a
Syngenta Ifox	163.16	c	5.37	b	5.89	c	4.62	a	2.34	a
Syngenta Waller	174.11	ab	5.67	ab	9.95	abc	4.59	abc	2.40	
Tukey's HSD (P=.05)	58.46		0.0556t		4.208		0.13		0.27	
Treatment Prob (F)	0.000		0.019		0.000		0.000		0.714	

Average trial yield – 173.6 tonne per hectare
Applied automatic data correction transformation 'Log(n+1)' to Brix to correct heterogeneity of variance.
Excluded HM 6856 from Soluble solids (t/ha) to correct heterogeneity of variance.

Table 11. ANOVA results for Leaghur, Vic direct seeded trial (three replicates & 137 days in field)

Variety	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H3402	111.28	a	5.85	a	6.69	a	4.50	a	2.43	a
HM 58811	82.96	a	6.03	a	5.08	a	4.34	b	2.35	a
HM 6856	95.39	a	5.90	a	5.93	a	4.26	b	2.39	a
SVTM 9023	107.58	a	6.02	a	6.92	a	4.34	b	2.35	a
SVTM 9024	89.09	a	6.02	a	5.92	a	4.29	b	2.32	a
Tukey's HSD (P=.05)	0.2442t		0.0374t		3.004		0.12		0.37	
Treatment Prob (F)	0.404		0.264		0.316		0.001		0.854	

Average trial yield – 97.3 tonne per hectare
Applied automatic data correction transformation 'Log(n+1)' to Yield and Brix to correct skewness/kurtosis.

Table 12. ANOVA results for Rochester, Vic transplant trial (121 days in field).

Variety	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H3402	66.80	a	5.97	bc	3.99	a	4.46	a	2.31	a
HM 58811	73.89	a	6.28	ab	4.65	a	4.38	a	2.23	a
HM 58841	75.30	a	6.46	a	4.86	a	4.36	a	2.28	a
HM 6856 (Adenda)	70.44	a	5.78	c	4.06	a	4.33	a	2.24	a
SVTM 9024	75.71	a	6.35	ab	4.79	a	4.37	a	2.22	a
Tukey's HSD (P=.05)	21.02		0.41		1.226		0.15		0.24	
Treatment Prob (F)	0.667		0.001		0.125		0.000		0.747	

Average trial yield – 72.4 tonne per hectare

Table 13. ANOVA results for Nanneella, Vic transplant trial (133 days in field).

Variety	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour a/b	
H3402	127.13	b	4.94	b	6.27	c	4.60	a	2.23	a
HM 58811	165.79	a	5.05	ab	8.38	a	4.44	bcd	2.21	a
HM 58841	155.06	a	5.53	a	8.58	a	4.43	bcd	2.17	a
HM 6856 (Adenda)	127.73	b	5.02	b	6.42	c	4.25	abc	2.15	a
SVTM 9024	154.25	a	5.20	ab	8.00	a	4.36	d	2.23	a
SVTM 9025	147.17	ab	5.31	ab	7.80	ab	4.33	d	2.25	a
SVTM 9034	131.78	b	5.23	ab	6.89	bc	4.55	ab	2.19	a
SVTM 9037	163.16	a	5.17	ab	8.42		4.42	cd	2.17	a
Tukey's HSD (P=.05)	21.20		0.50		1.104		0.12		0.27	
Treatment Prob (F)	0.000		0.019		0.000		0.000		0.902	

Average trial yield – 146.5 tonne per hectare
Excluded SVTM 9037 from Soluble Solids to correct heterogeneity of variance.

Yield and Brix

Average mid-season trial yields ranged from 72 to 174 t/ha, once again reflecting the adverse effects of the major rain event on yields in some locations. The highest yielding trial at Yalca missed the worst of the weather and produced the highest individual cultivar trial yields, with H3402 coming in at 208 t/ha, closely followed by SVTM 9025 with 204 t/ha.

In the trial at Nanneella, four cultivars (HM 58811, 58841, SVTM 9027, and 9037) produced significantly higher yields than H3402 (shown by the green bars in Figure 5).

Syngenta Ifox had significantly lower yields in both trials it was included in and Firmus in one trial (red bars in Figure 5). These varieties appeared to mature earlier and had significant fruit breakdown and vine collapse by the time harvest occurred. It is planned to include these varieties in early season trials next season.

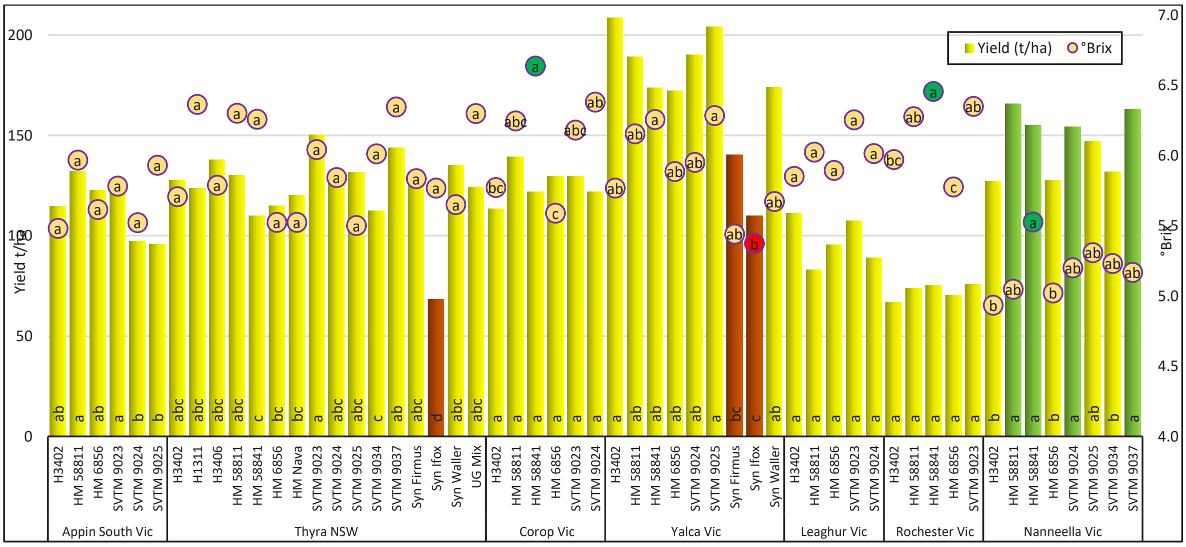

Figure 5. Mid -season red fruit yields and Brix

Brix

Raw fruit Brix readings across the trials ranged from a low of 4.94 for H3402 at Nanneella, to a high of 6.64 for HM 58841 at Corop. HM 58841 Brix readings at Corop, Nanneella and Rochester trial sites were significantly higher than those of H3402 (Figure 5), whilst Ifox was significantly lower at Yalca.

Tonnes per hectare soluble solids

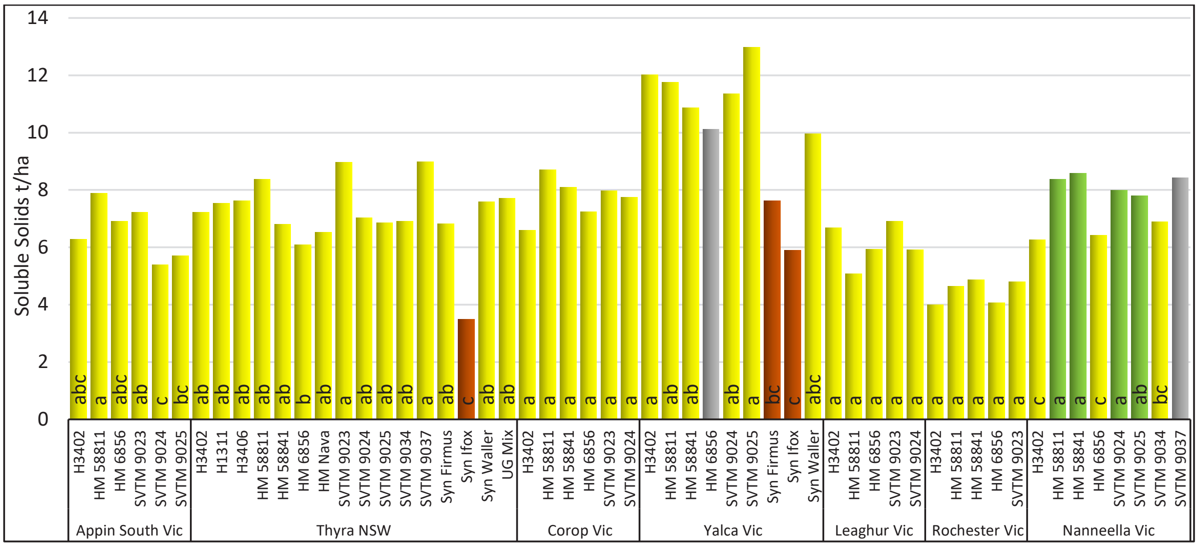

Figure 6. Mid-season trials tonnes per hectare of soluble solids

Soluble solids ranged from a low of 3.5 t/ha for Syngenta Ifox at Thyra to a high of 12.97 t/ha for SVTM 9025 at Yalca.

Syngenta Ifox had significantly lower soluble solids than the commercial standard H3402 in both trials it was in, and Syngenta Firmus was also significantly lower in one of these trials. These two cultivars were well past their optimum harvest window and will be assessed in the early season trials in the 2024-25 season.

Four varieties, HM 58811, 58841, SVTM 9024, and 9025, had significantly higher soluble solids than H3402 in the trial at Nanneella, and a fifth (SVTM 9037) was also higher but was excluded from the statistical analysis (see Figure 6).

Figure 7 shows a comparison of the 23-24 average trial yields and Brix of each cultivar expressed as a percentage of that for H3402 (represented by the black diamond in the cross hairs). Eight cultivars had both higher yields and Brix than H3402 in at least one trial, as shown by the markers in the upper right quadrant of the graph; however these are not necessarily a statistically significant improvement on H3402's performance.

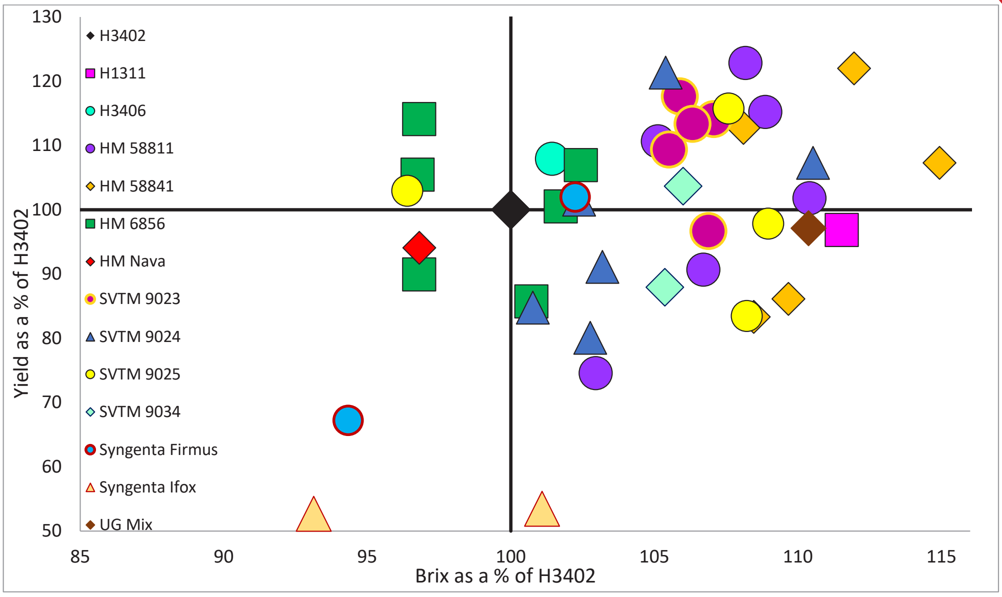

Figure 7. Average yields and Brix as a percentage of H3402.

pH

The pH across all the mid-season trials ranged from 4.26 for HM 6856 at Leaghur up to 4.62 for Syngenta Ifox at Yalca. Seven cultivars had significantly lower pH than H3402 in at least one trial (Figure 8). In addition, SVTM 9023, 24 and 25, as well as HM 5811 and 6856, all had raw fruit pH readings lower than the processors' preferred maximum pH of 4.35 in at least one trial. From a processing perspective, the relatively high raw fruit pH values recorded for the industry standard H3402 across most sites this season may warrant further examination.

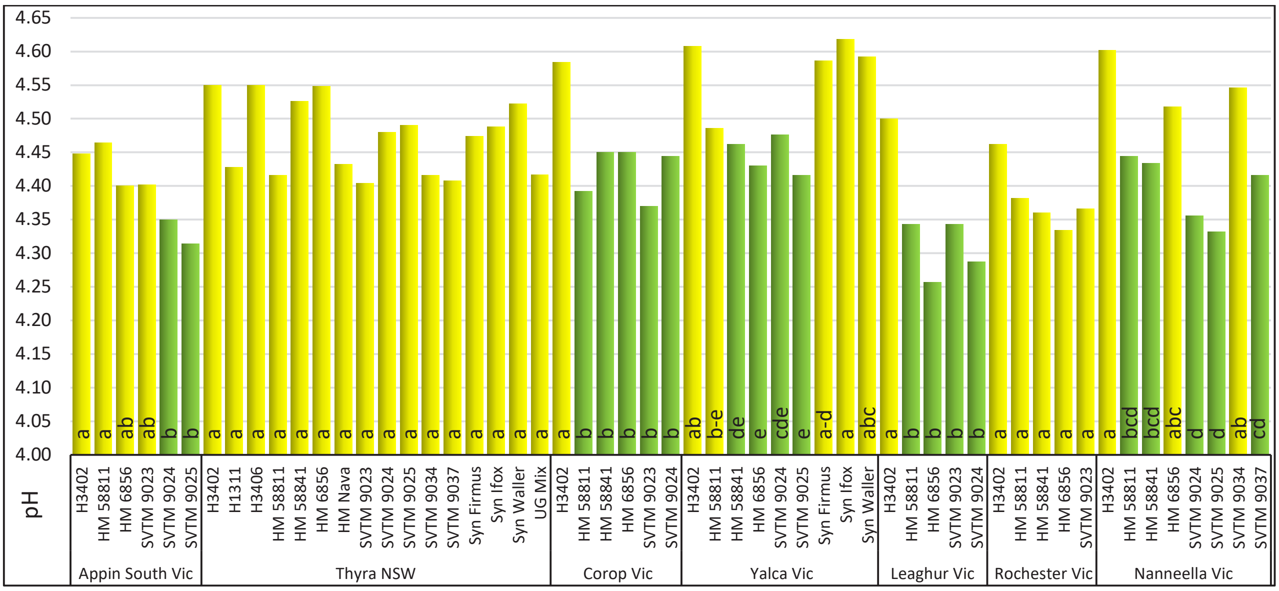

Figure 8. Mid-season raw fruit pH

Colour

There were no significant differences in the Colour a/b values across the trials, and all colour scores were higher than the minimum preferred limit for processing of 2.0. The Colour a/b values across the trials ranged from 2.09 for SVTM 9023 to a high of 2.46 for SVTM 9025.

Yield variation within mid-season cultivars

The greatest difference in red fruit yields between the highest and lowest yielding replicates within a trial was over 110 tonnes per hectare for Syngenta Firmus in the trial at Yalca to around ten tonnes per hectare for SVTM 9037 at Nanneella (Figure 9). This large variation in plot yields for a cultivar at an individual trial site highlights the difficulties in obtaining statistical significance differences in yields.

The highest yielding replicate across all trial sites this season was 250 t/ha produced by SVTM 9025 at Yalca, followed by HM 58811 with 231 t/ha at the same trial site.

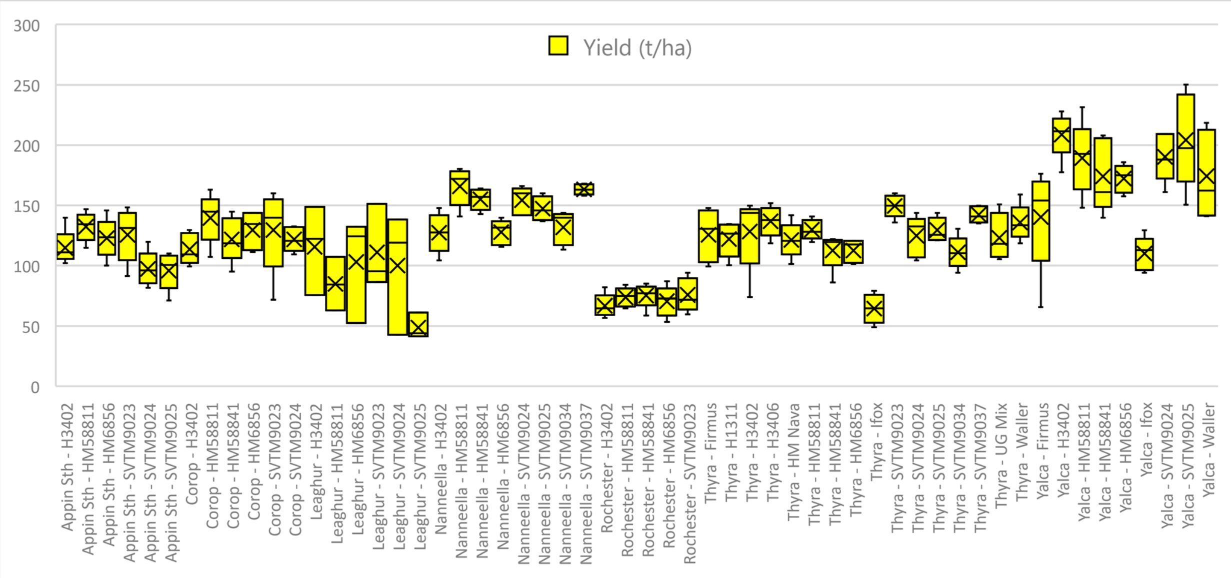

Figure 9. Box and whisker plot of mid-season replicate yields grouped by grower

Yearly average yield and Brix over five seasons

Figure 10 shows the yearly average red fruit yield and Brix as a percentage of H3402 for the last five seasons. These results are not necessarily statistically significant but show a range of cultivars that are consistently performing "as well as" the industry standard over several seasons (upper right quadrant of graph). These longer-term results give confidence that these varieties should perform under a range of seasonal conditions.

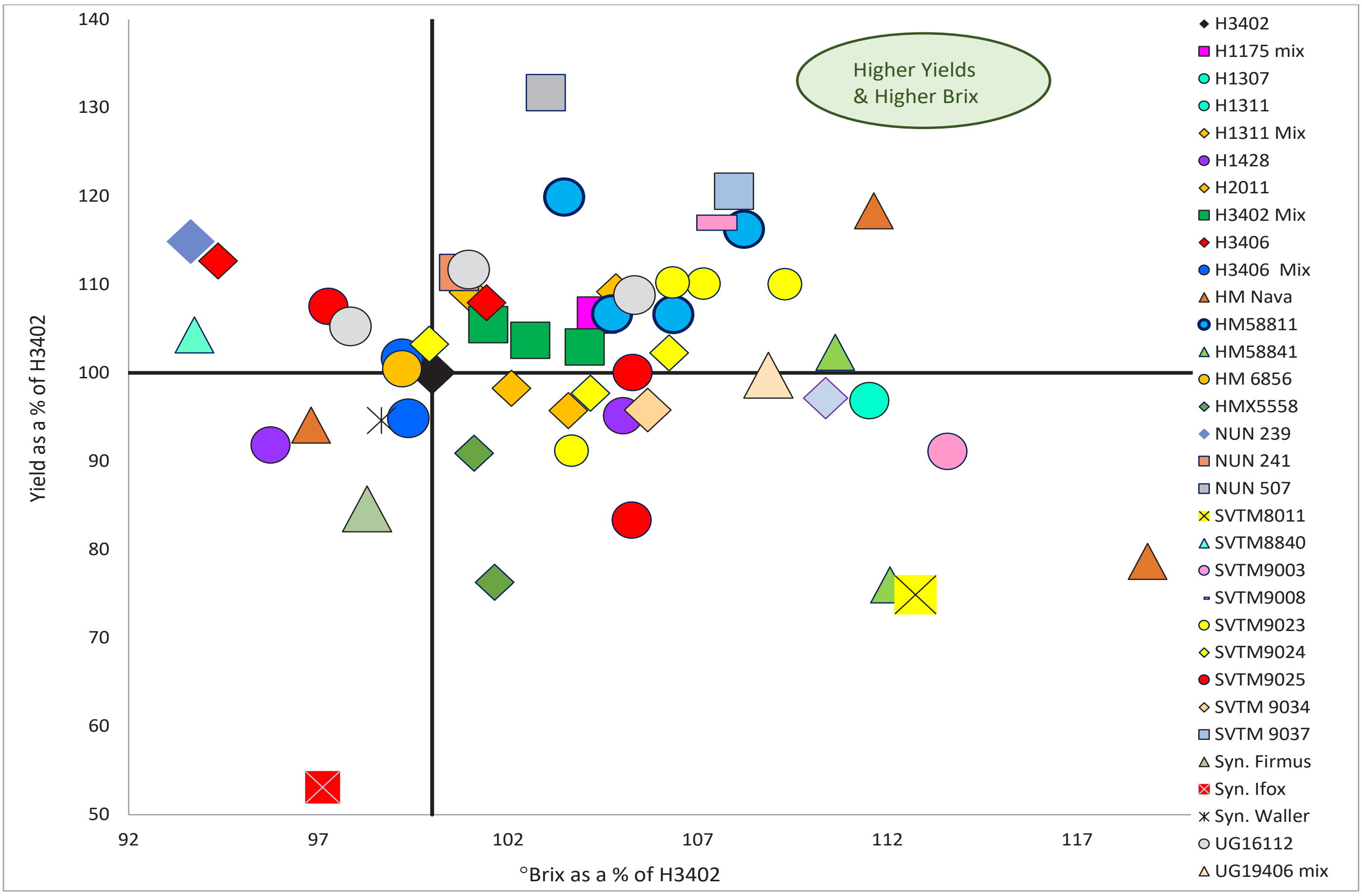

Figure 10. Yearly average mid-season trial results as a percentage of H3402 for the past five seasons (2020-2024)

Mid-season high lycopene mid-season trial

There is a perceived yield penalty when growing high lycopene (VHL) varieties. In an attempt to quantify this under Australian conditions, two high lycopene cultivars, H1311, a commonly grown industry cultivar, and a newer high lycopene cultivar (H1657), were grown in a replicated trial with a standard colour cultivar (H1884) for comparison.

The Morago Site 2 was planted with a Ferrari automatic planter with full row length trial plots of 170 metres and yield data collected from three replicates.

H1884 produced just over 95 t/ha, which was significantly higher (by over 20 t/ha) than the two high lycopene cultivars (Figure 11). There were no significant differences in the Brix readings between the cultivars. However, H1311 had significantly lower soluble solids than H1884, and both high-lycopene cultivars also had significantly higher raw fruit pH.

The only statistical differences in colour were found in Colour L values, where H1884 was significantly lighter than H1657. There were no statistical differences in Colour a (red/green) or Colour b (blue/yellow) values between the three cultivars, but the high lycopene varieties were more red and yellow than the standard colour cultivar H1884.

Table 14. ANOVA results for Morago Site 2, NSW high lycopene transplant trial (129 days in field).

Cultivar	Yield (t/ha)		°Brix		Soluble solids (t/ha)		pH		Colour L		Colour a		Colour b		Colour a/b	
H1311 (VHL)	74.17	b	5.90	a	4.37	b	4.51	a	27.30	ab	37.04	a	14.76	a	2.52	a
H1657 (VHL)	74.30	b	6.19	a	4.57	ab	4.52	a	26.87	b	37.07	a	13.96	a	2.66	a
H1884	95.20	a	5.95	a	5.66	a	4.38	b	29.27	a	36.53	a	15.18	a	2.41	a
Tukey's HSD (P=.05)	15.13		1.04		1.094		0.09		2.04		2.47		2.18		0.53	
Treatment Prob (F)	0.012		0.605		0.027		0.0096		0.028		0.705		0.242		0.346	

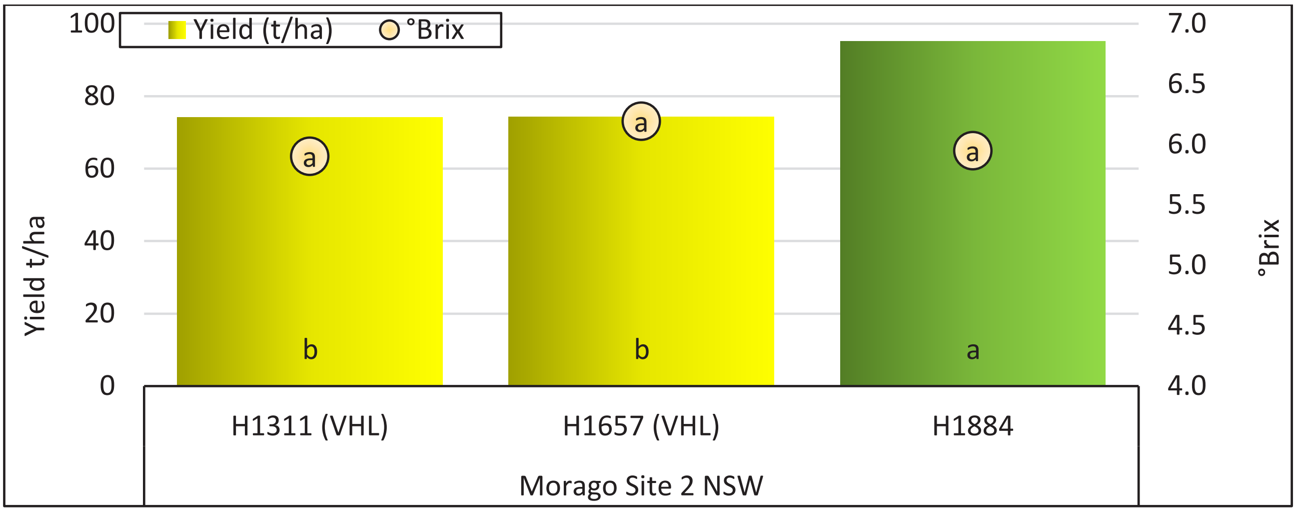

Figure 11. Mid-season high lycopene trial red fruit yields and Brix

Cultivar Visual Assessments (including screening trial cultivars)

All cultivars in the trial program were visually assessed prior to harvest and given a score out of 10 based on a range of vine and fruit characteristics.

The results are presented in Table 15 and Table 16 where lines proposed for further assessment are colour coded with black font, cultivars being dropped from the program are in marked in grey italics. Cultivars were dropped based on poor yields, unsuitable plant characteristics, or in the case of H1884 inadequate field holding.

A number of cultivars planted in the mid-season trials would perhaps perform better in an early season program, these are marked as early in Table 16 under scores.

Table 15. Early season screening trial assessment

Cultivar	Comments - Early Cultivars	Score
Hz 1015 (Std 2 sites)	Sprawling vine but on the bed. Medium size generally but a few smalls. Good yield. Firm fruit, colour ok. Bit of bleach and breakdown (2 sites)	6.5/7.5
H1281 (1 site)	Medium-vigorous vine on the bed in a patchy stand. Medium sized blocky elongated fruit to pear shaped. Firm with good colour although a bit of core. Yield ok.	7
Heinz 1301	Medium/vigorous, on the bed. Firm blocky plum-egg fruit of small-medium size. Bit of bleach and core but colour ok. Holding and yield looks good.	7 (smalls)
Syn BQ 403	Vigorous dark vine spreading but lacking yield. Firm blocky egg- plums with thick walls. Size a bit variable but most ok. Some very good colour. Concentration ok but a few greens. Holding.	6
HM Enotrio	*Medium vine on the bed. Good yield for vine. Medium blocky plums, medium size, firm. Good conc. Colour ok although a bit for core and puffiness. Holding.*	*6.5*
SVTM 9000	Medium/vigorous vine with dark foliage, looks later. Very firm blocky plum-eggs of good size. A bit puffy with exposed fruit showing sunburn, but otherwise holding. Good conc. Colour just ok and yield ok also.	7
SVTM 9018	Darker m/v vine looks a bit floppy. Very firm blocky eggs of good size. Good colour, conc. and yield ok. Some bleached/ sunburnt fruit suggesting breakdown. Earlier?	6
SVTM 9027	Medium/vigorous vine sprawling vine with light foliage, bit floppy. Fruit plum, firm, medium sized. Colour only ok. Yield?	6.5
SVTM 9032	Medium/vig. vine on the bed – most leaves gone. Bleach and cooked fruit evident. Fruit plum-round, firm with some dimpled, mainly medium sized. Poor colour, yield ok, good conc. Early.	6 (col?)
SVTM 9033	*Medium/vig spreading vine opening up a bit. Very firm medium sized egg-plums. Some good colour although a bit puffy. Quite a bit of b/d and scorched fruit. Lacking yield for vine.*	*5.5*
SVTM 9300 (Incipit)	Medium/low vine looks early, with good conc and leaves all gone. Firm, medium-sized blocky plums. Colour ok and yield ok for vine size. Bleach and cooked fruit suggest past harvest.	6.5
SVTP 9603 (Eventus)	Med/vig sprawling vine a bit floppy. Firm, elongated fruit of good size. Medium colour and yield ok. Some bleach and b/d again so over-ripe? Worth another look.	6
	Observation lines	
LV TOP 96876	Med/vig vine spreading on the bed. Medium blocky plum-egg fruit – a few dimples. Medium firm and colour ok. Conc good and generally holding. Yield ok for vine but looks a bit down. Worth another look.	6
LV TOP 96879	*Taller more vigorous vine with dark foliage and secondary growth on top. Firm blocky egg-plums, good size. Colour ok. Some b/d in exposed fruit and yield again lacking.*	*5.5*

Table 16. Mid-season screening trial assessments

Cultivar	Comments - Mid-Season (Combined site observations)	Score
H1311 (2)	Vigorous vine, dark foliage, may open up a bit. Egg shaped, v/b size. Some good yield and colour but concentration variable. Very firm.	6
H1657 (1)	Medium-tall vine, a bit floppy with dark foliage. Medium sized plum- egg fruit with some dimples. Very firm with excellent colour. Good concentration and holding but yield medium. Grow for colour?	6.5
H1884 (1)	*Medium-vigorous vine on the bed with good yield and fruit size. Foliage med-light. Very firm egg-plum fruit with good colour. Good concentration but a hint of bleach.*	*7*
H3402 (Std, (3)	Medium-vigorous spreading vine on the bed. Good yield, colour ok, not much bleach, a few smalls, and greens but most of good size.	8
H3406 (1)	Sprawling vine into gutters a bit but on the bed. Light foliage. Yield and colour ok-good, some small fruit.	7
Syn Firmus (2)	Medium/vig, tall and opening a bit. Dark foliage. Firm fruit. Good size, yield ok for vine. Some good colour	6 (early)
Syn Ifox (2)	Compact vine, rolled leaves, on bed. Looks early, losing cover but holding so far. Good yield for vine, colour ok, medium firm – try in early season trials	7 (early)
Syn Waller (2)	Vigorous upright vine on the bed, dark foliage. Very firm, good colour but may have v/b size and yield / concentration issues.	7/5.5
HM Nava (1)	Medium vine on the bed, dark foliage. Good cover. Fruit firm, good size, colour ok. Yield ok.	7
HM 58811 (3)	Vigorous vine may open up a bit. Good size, medium colour, very firm. Bit puffy. Yield and concentration may be issues.	6
HM 58841 (3)	Vigorous spreading vine - looks later. May be floppy. Med-large fruit, very firm, colour and yield ok, bit of bleach. Old ground.	7
HM 6856 (3)	Medium-compact vine, early. Blocky plum-round fruit. Firm, med colour, medium sized. Yield good for vine. Bit of bleach. Holding?	7
SVTM 9023 (1)	Medium-vigorous vine, opening a bit but on the bed. Very firm fruit of good size, colour ok. Yield and concentration not bad either.	7
SVTM 9024 (3)	Medium/vig vine on the bed with light foliage. May open up a bit. Good fruit size, very firm, medium colour and yield ok.	6
SVTM 9025 (3)	Vig. spreading vine opening up a bit. Fruit very firm, colour ok – good. Yield ok-good for vine size. Poor at one site a/c vine & conc.	6.5 (old gnd)
SVTM 9034 (2)	*Erect vine, dark foliage, a bit floppy. Bad for mites. Fruit very firm, colour ok, good size. Yield medium, vine the main issue.*	*5.5*
SVTM 9037 (2)	Vigorous-medium spreading vine on the bed. Very firm fruit of good size. Medium colour but yield not bad.	6.5
UG mix (1)	Medium-vigorous on the bed. Yield ok-good. Fruit firm, good size, colour ok. (Mix is 16112/19466)	7
	Observation lines (single site)	
SVTM 9334 (Barrick)	Low, compact vine with good yield for vine. Small-medium sized round-plum fruit. Medium firmness and colour ok. All ripe, with a bit of bleach and breakdown.	6.5 (early)
LV TOP 96877	Medium-vigorous vine providing cover still. Fruit firm with good size and colour (for site). Good concentration. also. Yield ok? Re-test.	7
LV TOP 96878	Medium-vigorous vine on the bed. Size variable, most ok. Medium colour but yield looks ok. Some breakdown evident. Try early?	5 (b/dn - early)

Grey italic font indicates cultivars to be dropped from the trial program

Summary and future trials

Once again, the milder harvest conditions did not fully test the resistance of trial cultivars to sunburn and bleaching, and similarly, field holding attributes under more extreme temperatures have not been assessed.

In the early season trials, all cultivars yielded “as well” as H1015, though after consultation with processors and other interested parties, HM Enotrio, SVTM9033, and TOP 96879 will be dropped from the trial program. Both Syngenta Ifox and Firmus will be moved from the mid to early season trials next season.

The mid-season cultivars HM 58811, 58841, SVTM 9027, and 9037 produced significantly higher yields in comparison to H3402 in one trial. All the remaining cultivar yields, apart from Ifox and Firmus, were statistically similar to those of H3402.

SVTM 9034 and H1884 will also be dropped from the program; the latter, though yielding well, has disappointing field storage.

Given the difficulties of the past two growing seasons, APTRC would be happy to include any of the other cultivars from this season for ongoing assessment.

Acknowledgements

We are very grateful to participating growers, seed companies and processors for their co-operation and interest in the conduct of these trials.

In late July and led by IDM Matt Stewart, some 18 industry representatives, comprising growers, processors and industry service providers, set out for California to see how things are done by the world's leading producer of processing tomatoes. The schedule was a hectic one, and while farms were visited, there was also strong interest in research activities and technology – including farm equipment. Participants were encouraged to record their highlights and learnings from each day, and these were reported and discussed with the wider industry group on their return.

The tour kicked off with a visit to the **Westside Equipment Company**, where they assemble Johnson and Commander harvesters, and plan to introduce robotic welding. Driver training was also noted as a critical factor in the harvesting process.

A visit to the **United Genetics** plant breeding facility in Huron followed, where breeders are prioritizing the incorporation of Fusarium race 3 and Tomato Spotted Wilt Virus resistances into their new material. **Kagome's Los Banos factory** was the next stop and their steps into automated packaging were a notable highlight.

The **Madrigal Family Winery** in the Napa Valley provided a nice change of pace and chance to meet the tour's Californian hosts, **Mike Montna** of the California Tomato Growers Association (CTGA) and **Zach Bagley** from the California Tomato Research Institute (CTRI).

The next day saw the group tour **Rominger Bros' Farm** at Winters, featuring an Agri-planter discussion with **Bruce Rominger.** They run a mixed cropping operation, with nearly 300ha of tomatoes. It was noted that some processors provide variety lists to pick from while others dictate what to grow, and that 60% of their tomatoes are harvested by contractors/processors. Normally, their tomatoes are grown on about 610 mm of water, but some years require as little as 457 mm. Drip irrigation is used and maintenance is a high priority, with irrigation lines flushed up to 3 times per week.

A series of presentations from industry professionals, farm advisors and researchers followed, covering a range of industry topics and research activities.

- **Mike Montna** outlined the role of the CTGA and how it is funded. He also discussed the quality/price proposition where there is more focus on the quality of the product to achieve market advantage.
- **Zach Bagley** described the CTRI as similar in function to the APTRC, and stressed the need for our industries to work together for mutual benefit in addressing future challenges.
- **Tom Turini,** UC Vegetable Crops Farm Advisor, talked about measures to mitigate the spread of TSWV, for which Western Flower Thrips are the primary vector. With the breakdown of genetic resistance to this virus, other measures are now on the table – including drip-injected control chemicals.
- **Patricia Lazicki**, UC Vegetable Crops Farm Advisor, discussed nutrient management in processing tomatoes, particularly in relation to organic nitrogen sources.
- **Gene Miyao**, Emeritus Vegetable Crops Farm Advisor and long-time tomato researcher then provided a riveting discourse on soil health, past, present and future. He highlighted key advances as Drip Irrigation, Genetics/Hybridisation, Propagation method and Nutrient Management; but emphasized that in his opinion, irrigation management remains the most important factor. He is also focused on why there is such a yield disparity between new and old ground – a problem that we also continue to investigate.
- **Brenna Aegerter,** Vegetable Crops Farm Advisor, talked about the management of soilborne disease with drip-applied fumigants and fungicides – particularly using Metham Potassium through the drip system. This has proven to have both cost and yield benefits, with bladed Metham rarely used any more.
- **Scott Stoddard,** Vegetable Crops Farm Advisor, then gave a presentation on Processing Tomato Weed Management Practices. Reliance on mechanical weed control methods, including robotic cultivators and laser weeders, is growing, but needs careful management to avoid damage. With break-even yields currently around 94MT/ha and a price of $240/MT AUD, labour-saving measures become very important.

A visit to **TOMRA** (whose equipment is widely used in Australia) was hosted by **Diarmuid Meagher**, and featured discussion on the latest advances in fruit sorting technology. The group then called into **Wilcox Equipment** to see their tillage implements, manufacturing and design workshops, and went on to inspect the **Heinz** plant breeding facility near Stockton. John Marchese, Heinz Seed Global Sales Manager, described the lengthy process to produce a commercial variety. The group was shown how seed is graded, cleaned, stored and tested for germination and viroids. He highlighted that "3402" was still a benchmark for Extended Field Storage – an essential feature for Australia.

A day's visit to the **Ingomar** processing facility, hosted by CEO **Greg Pruett**, was notable for their commitment to sustainable waste-water management, using an artificially created wetland environment to clean and re-use water.

Terranova Ranch, with over 3640 hectares under cultivation and 25 different crops, illustrated the sheer scale of operations on some Californian properties. Of the 890 hectares dedicated to tomatoes, 243 ha are grown organically. The organic tomato crop produces over 148 MT/ha at 5.5-6.3˚ brix, whilst conventional crops yield an impressive 148 - 222 MT/ha, depending on the location. Water availability is a major concern, and the farm is allowed to recharge the water table with flood irrigation in wet years, buying them water credits for the dry ones.

The cultivar HM7103 attracted interest at **Ferguson Farm,** as the crop was set to yield nearly 200 MT/ha at 5.2˚ brix. Interestingly, the plant density was 20,000 plants per ha on 6-foot beds.

The group were able to witness a rare event on a visit to the **Tulare Lake** system, with its greatest flood since 1983. The massive modular flood lake system covers nearly 50,000 hectares of land, which prior to the high rainfall and snow melt in the months preceding the tour, was home to dairy farms, pistachios, almonds, cropping and poultry farms.

The tour concluded with a visit to **Woolf Farm**, where Farming Manager Chris Quaylo and Sustainability Director Daniel Hartwig gave the group an overview of their second generation family farming enterprise. With excellent water and soil quality, the property supports over 10,100 ha of production, including 1740 ha of tomatoes. Many of their farming practices were discussed, notably including the use of Metham Potassium via drip for disease control and via knife for weed control. They also conduct vine training and trimming routinely. Crop rotation is an integral part of the farm's practices, typically following a 1 in 4 rotation pattern of tomato - cotton - wheat - garlic - tomato. Water use for tomatoes is typically around 500 mm on early crops and 750mm for later crops, with deficit irrigation used for brix control. More than 34 different varieties of tomatoes are grown, with key ones including Seminis 9023 and 9016, as well as Heinz 1996 and HM 7103. The farm also participates in a groundwater replenishment program, where around 90% credit is received for the volume of water pumped into the recharge system, providing future water allocation security.

Overall, the trip was an enriching experience for all participants, helping to strengthen bonds between our two industries and expand our professional networks, while providing hands-on learning opportunities. The generous hospitality and free exchange of information from all hosts is gratefully acknowledged – particularly recognising Mike Montna and Zach Bagley not only for helping to organise the tour, but also for spending a week of their time chaperoning their Aussie visitors.

2024 Kagome Field Report

The 2023-24 processing tomato season in Australia once again presented a unique set of challenges for Kagome growers and indeed our entire processing tomato industry. And once again, extreme weather events were to blame for our production headaches.

Our planting season was cool and wet, starting on the 26th of September and continuing until the 12th of December. Kagome growers planted 2164 ha in total. Of that, Heinz cultivars made up over half the program, with 818 ha planted to H3402 and 524 ha to H1015. The area planted to United Genetics and Bayer/Seminis cultivars is ever increasing, but they still fall well short of becoming dominant in Australia.

Our partnership with APTRC remains a valuable means of road-testing new cultivars in Australia and it's out of their machine harvest trial program that we see some potentially high producing, reliable cultivars emerging in the coming years.

Between December 24th and January 8th, growers across most growing regions experienced intense and sustained weather events, including rainfall that caused localised flooding, severe winds, and some isolated hail storms. Rainfall totals were high, with one grower in Boort recording a total of 244mm during this period. For some growers, this was the second year in a row with devastating losses on their properties.

Kagome processing operations ran from January 27th to April 28th, spanning 93 days in total. Kagome processed a total of 164,004 payable tonnes of raw material, with an average Brix of 5.53. The factory dedicated 81 days to paste and only logged 12 downtime days. Due to the heavy losses incurred just prior to harvest beginning, Kagome achieved only 74% of our contractual target of 220,521 payable tonnes. This shortfall was reflective of the broader impact felt by the Australian industry.

On a positive note, I would like to extend thanks to our growers and farm managers, who through their skilful adaptation and extra effort to combat the hardships delivered by our climate, helped us to harvest, deliver and process enough tonnage to satisfy all our contracts last season.

The NSW growing team took on the challenge of establishing more hectares on sand again this year and were even successful in producing one crop entirely with overhead centre pivot irrigation! The plan is to further extend this irrigation practice in the coming years and assess if overhead irrigation is a viable future alternative for NSW sand grown tomatoes. This is just one example of how our growing and agronomy team are pushing the known boundaries and creating ways of better utilising existing infrastructure as well as hopefully reducing growing costs.

Maintaining staff was a challenge in both the field and factory due to the start/stop nature of the season. We consistently see the problem increase towards the back of the season as staff see their work coming to an end and want to secure the next job placement.

With year-on-year pressure on growing costs, labour continues to be a significant economic factor. Consequently, Kagome have invested in another Ferrari automatic transplanter for the 2024/25 season. The target for next season is to have 100% of our 5-foot operation planted with automatic planters. While reducing labour costs, these machines also show a reduction in transplant shock versus conventional methods. However, the key here is reliable and consistent plants from our nursery partners.

As we prepare for the 2024-2025 tomato season, we cross our fingers for less problematic conditions and hope to get the factory back to its desirable production capacity. Including Kagome, there will be a total of 5 contracted growers for the coming season (down from 7 in 2022/23).

There may be some relief in growing costs for producers, with a notable decrease in fertiliser prices and continued low-moderate water costs. This reduction presents a valuable opportunity for cost savings which we hope can have a net positive effect on our growers' financial outcomes. While chemical costs have also seen a decline, the reduction has been less substantial compared to fertilisers.

Chris Taylor,
General Manager, Field Operations

2024 SPC Field Report

Following on from the wild weather events of the 2022-23 season, 2023-24 again saw record rainfall, flooded fields, hailstorms and tornado-like winds, once again testing the resilience of the Australian Processing Tomato industry.

With one more grower retirement but the return of another to the fold, SPC once again contracted 4 growers to an increased tonnage (from 2023) of 49,500 tonnes. H3402 was again the most planted variety (45%) with UG16112 (32%) and H1015 (22%) making up the bulk of the remaining area and around 1% of the planted area devoted to trial varieties. 445Ha in total was planted for SPC.

While an El Nino weather event with dry conditions and high temperatures was predicted, a cool, wet and windy spring with a relatively mild summer instead ensued. Planting began on time around the beginning of September with early blocks getting away steadily. Spring rainstorms however battered several blocks across all growing areas, stifling the potential shown to that point. With the mercury creeping above 33˚C on only a few occasions throughout the growing season, Christmas eve through the first week of January instead saw more rain and plenty of it! Our Boort paddocks received 185mm of rain over this period, Rochester and Corop around 160mm while hail and high winds significantly damaged 2 paddocks in the Rochester area in January. The Rochester township was again flooded, thankfully below the 2022 levels with no homes affected, but the floodwaters engulfed one of our paddocks to the north of town, with 15Ha sadly being abandoned. The inundation of fields across all growing areas led to losses of around 20% of contracted tonnes. Despite this, most paddocks did recover to a point where growers had some optimism that a reasonable year could still be salvaged.

Harvest began at Corop on the 30th of January with Boort and Rochester starting 1 and 2 days later respectively. Following the well above average rainfall in January, below average rainfall was received from February through April with only a minor rain delay on the 19th of March slowing the harvest. Combined with mild summer conditions where Echuca received only 12 days above 35˚C throughout January (1), February (7) and March (4), growers enjoyed a largely uninterrupted harvest with dust, not mud, the only source of discomfort. Paddock yields varied, as expected, ranging from a low of 35T/Ha up to an impressive 173T/Ha. The majority of paddocks were completed by the 26th of March with the last paddock in Rochester, which had been delayed by the January hailstorm/tornado, harvested between the 15th and 19th of April.

40,599 nett tonnes were processed through the SPC facility in 2024, 82% of the contracted volume. Average yield across the 430 harvested hectares was 94T/Ha at 5.49˚brix average. H3402 accounted for 40% of the intake, H1015 23%, UG16112 36% with the trials contributing 1% of the total tonnes. Quality for the most part was very good.

With yet another grower retirement, only three growers will supply SPC in 2025. Continuing high cost of living pressures and an abundance of cheaper imported product on the supermarket shelves, means SPC will look to consolidate their position in the marketplace with a reduction in contracted tonnes for 2025. Hopefully this downturn is short-lived and customers return to the superior, trusted Australian processed tomato products. With near full water storages and water allocations edging closer to 100%, growers and processors will be hoping the next 12 months bring good fortune to the entire Processing Tomato Industry in Australia.

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