

Final Report

Citrus Agrichemical and Export MRL Program

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Project:

Citrus Agrichemical and Export MRL Program (CT18001)

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Public summary

Project CT18001 aimed to develop a coordinated approach to agrichemical risk management for the Australian citrus industry. The citrus industry requires access to modern and effective agrichemicals in order to control pests, diseases and optimise post-harvest quality. At the same time, it must ensure that residues on fruit do not exceed regulatory limits in Australia and overseas.

An Agrichemical Manager was appointed by Citrus Australia at the commencement of the project who managed the annual residue testing program and engaged with industry on other agrichemical issues. A key component of the project was ensuring that citrus growers, packers, exporters and other service providers had access to up-to-date information about importing country maximum residue limits. The Agrichemical Manager provided regular updates to industry participants on MRLs in major export markets and information on how to achieve them.

From 2019 – 2021, the residue testing program was managed through Citrus Australia under CT18001. The program provided the industry with a mechanism on how to assess and manage residue risks. Eighteen major packing companies from Queensland, New South Wales, Victoria, South Australia and Western Australia submitted 1 760 samples for analysis from 2019-2021. The citrus residue testing program was expanded in 2020 and again in 2021 by adding additional test options for heavy metals and biological contaminants and a new reporting option was tailored to accommodate the requests of customers in Thailand.

Sample submissions increased by 44 percent between 2019 and 2021, indicative of the value placed by industry on the residue testing program. Half of all samples submitted in 2021 had no detectable residue from orchard applications and could be considered as ‘ultra-low’ residues. Many samples had been exposed to multiple post-harvest fungicides.

The Agrichemical Manager provided technical and commercial advice to the Australian Pesticides and Veterinary Medicines Authority (APMVA) towards maintaining access to a number of agrichemicals under review. The project leaders also engaged with regulators and the chemical industry regarding accessing new chemistry and issues around older chemistry under review. The Agrichemical Manager provided input into the independent review of the pesticides and veterinary medicines regulatory system in Australia in 2020, proposing processes to streamline introduction of new and softer chemistry into Australia.

The project leaders ensured that growers, packing houses and service providers were well-informed about agrichemical issues via various mechanisms including:

- Australian Citrus News (quarterly tabloid)
- Citrus eNews (fortnightly newsletter)
- the Juice (periodic industry snapshot)
- AgChem Updates (email alerts in response to substantial regulatory changes)
- social media
- presentations at Citrus Australia’s regional forums and issues forums.

The AgChem Updates that were emailed to more than 800 subscribers, were a key feature and success of the project. Three short videos on fruit fly baiting in citrus were distributed via social media and reached a wide audience, with more than 8 000 viewings. Practical information about spray application was presented at field days in Victoria, South Australia and Queensland. Resources to improve the efficiency of chemical application were made available on Citrus Australia’s website.

Key recommendations from the project related to:

- maintaining currency of the Citrus Export MRL tables for major export markets, and finding a mechanism to make the data more accessible to participants across the citrus industry
- continuing administration of the annual testing program, so that the industry has an efficient, effective and reliable mechanism to manage residue risks
- the importance of recognising that while the citrus industry is classified as a major crop in terms of planted area, it represents a minor crop globally in the prioritising by AgVet companies and therefore needs support to attract investment into new crop protection products to replace older chemistry.

Keywords

Maximum Residue Limit; Export Harvest Intervals, MRL; Australian citrus exports;

Introduction

Project CT18001 (Citrus Agrichemical and Export MRL Program) was developed to bring a coordinated approach to agrichemical management for the Australian citrus industry.

The Australian citrus industry prides itself on being recognised in export and domestic markets as producing fruit that meets the most stringent quality specifications — optimum fruit size, blemish free, optimum sugar to acid ratios, compliant with all phytosanitary specifications, and free from any unacceptable chemical residues.

To achieve those specifications, the citrus industry requires access to modern and effective agrichemicals to control pests and diseases and optimise post-harvest quality. At the same time, it is of paramount importance that residues on fruit do not exceed regulatory limits in Australia and overseas.

Withholding periods stated on Australian chemical labels are to ensure that from time of application, residues decay to meet Australian MRLs. For some of the products registered for use on Australian citrus, key importing countries have a lower MRL than Australia or have no MRL established. The withholding period indicated on the label may be insufficient for residues to decay to meet export MRLs that are lower than the Australian MRL.

For six seasons prior to the commencement of CT18001, Citrus Australia partnered with the Australian Government's National Residue Survey (NRS) to deliver a coordinated residue testing program for the Australian citrus industry. Data from the program collected over six seasons indicated that in some instances some residue levels on sampled fruit might exceed regulatory limits in overseas markets if fruit was consigned to certain markets. Under the NRS program, approximately 350 samples were tested each year (2012 to 2018). A summary of de-identified data was provided to Citrus Australia annually.

The suitability of the NRS program was reconsidered by the citrus industry in 2019 due to the following:

- NRS staff did not have capacity to provide one-to-one support to citrus growers or packers, regarding chemical choices or residues
- interpretation and timely responses to the data were somewhat limited because the data were only sporadically aggregated and provided to Citrus Australia
- samples were not representative of all citrus regions
- the administration costs associated with the government program could be better spent by supporting the citrus industry with a dedicated Agrichemical Manager.

Project CT18001 offered an opportunity for Citrus Australia to manage the annual citrus residue survey so that data would be more accessible, allowing Citrus Australia to engage immediately with international authorities, agents, service providers, packing-houses and growers, in event of MRL breaches. Equally, Citrus Australia would be able to liaise directly with the contracted laboratory regarding testing and reporting. Timely access to residue testing data also allowed the project leaders to identify and prioritise agrichemical threats and challenges.

Prior to the commencement of CT18001, a table of Citrus Export MRLs was provided to the citrus industry by AKC Consulting. The table was updated every six months up to February 2019. The importance of the tables to industry increased as more growers, packing houses, agents and agronomists focused on export markets.

Project CT18001 offered an opportunity to employ an Agrichemicals Manager within the citrus industry, to update the MRL tables and engage directly within the citrus and chemical industries regarding chemical choices and use, and MRLs, towards industry moving closer to a status of ultra-low residues.

Prior to project CT18001, a Guide to Achieving Citrus Export MRLs was also produced by AKC Consulting. The document was distributed by Citrus Australia to growers, packers and exporters, as an accompanying document alongside the table of Citrus Export MRLs.

The Guide to Achieving Citrus Export MRLs was a quick reference tool to show chemical users the withholding period on the Australian label and then also compare the Australian and export MRLs.

The withholding period on the label for any particular agrichemical product can be considered a suitable period between a) the last application, and b) harvest – for residues to decay to below the Australian MRL.

If the MRL in an export market is the same as or higher than the Australian MRL, then the label with holding period (WHP)

should also be appropriate as an Export Harvest Interval.

Export Harvest Intervals relate to the period of time that needs to elapse between a) the last application, and b) harvest for compliance with export MRLs that are lower than Australian MRLs.

The Guide to Achieving Citrus Export MRLs did not propose an extended Export Harvest Interval – the Guide flagged instead that the export MRL was lower than the Australian MRL. Agrichemicals are reviewed by regulatory authorities if there are concerns about consumer health or environmental impacts, or if the original data supporting registration is outdated. The process often ends in the old chemistry being withdrawn because chemical companies are not motivated to defend chemistry once the patent expires.

Citrus producers are therefore anxious to ensure that new chemistry becomes available before the old products are withdrawn.

The Australian citrus industry is a relatively small market sector for the agrichemicals industry which has recently consolidated, is a global industry and is not given high priority when companies are seeking registrations in Australia due to the poor prospect of economic return to the chemical company.

Project CT18001 raised the profile of the citrus industry within government and the chemical industry. Engaging with chemical companies and regulatory authorities brought the needs of the citrus industry to the attention of companies registering new chemistry and, where appropriate, to defend the continued use of chemistry under review.

Project CT18001 offered an opportunity to bring chemical expertise to the team at Citrus Australia. The Agrichemical Manager liaised with and supported stakeholders involved in pest and disease identification, spray equipment, chemical distribution, spray recommendations, new technologies related to pest and disease management, education, biosecurity, residue testing or auditing, and agencies involved in research, regulatory or extension roles. Meanwhile Citrus Australia utilised its communications team (CT18000) to extend messages to a broad audience, to ensure that messages were extended broadly throughout the industry.

Methodology

Here we report on the range of activities that were undertaken throughout the life of the project.

Appointment of an Agrichemical Manager for Citrus Australia

An Agrichemical Manager was appointed by Citrus Australia in February 2019, under CT18001, to manage and expand the annual residue monitoring program, update the Export MRL tables and engage with industry and AgVet companies on agrichemical issues. The ultimate goal was to ensure that the industry maintained and improved its access to effective crop protection products while at the same time fulfilling regulatory requirements in all markets.

Annual citrus residue monitoring program

Citrus packing houses that had previously submitted samples for residue testing via the National Residue Survey (NRS) were invited to submit samples to Symbio Alliance Laboratories under the new residue monitoring program managed by Citrus Australia as part of project CT18001. The opportunity for residue testing was also promoted via Citrus Australia's established communications channels. The project leaders worked with the contract laboratory to develop the coordinated program, maintain the multi-residue screen, negotiate pricing for testing, and coordinate freight. Samples were subject to a multi-residue-screen that included more than 300 analytes and contaminants. The multi-residue-screen was based on the products approved for use in Australia as well as those analytes that overseas regulators have an interest in. Over time, the multi-residue-screen evolved to become an 'all of horticulture screen' and the laboratory now uses this screen for a range of crops. On that basis, test results will show a range of analytes not used on citrus in Australia, but this is of no consequence.

At the commencement of the season, the Agrichemical Manager contacted each packing house regarding the estimated number of samples the packer was likely to submit, and arranged sampling kits to be delivered. Season predictions were provided to Symbio Alliance and this informed the test price for each sample. For obvious reasons, the analysis cost per sample was reduced if more samples were analysed. Sampling kits which included pre-paid consignment slips for TOLL transport were provided to each packer at the commencement of the season.

During the season, some packers requested additional sampling kits because they had underestimated their sample submission. Conversely, some other packers bundled several samples in one consignment and therefore had left-over kits or consignment notes, which they held over to the subsequent season.

Personal communications by the Agrichemical Manager were important for increasing participation by packing houses in states that had not been active in the National Residue Survey (NRS) – in particular Western Australia and Queensland.

Symbio Alliance Laboratories in Brisbane was selected as the contracting laboratory based on the following criteria.

1. Previous experience receiving and analysing citrus samples.
2. Successful proficiency testing over many years through the NRS program.
3. NATA accreditation across the range of analytes used in citrus in Australia.
4. Demonstrated willingness to respond to the needs of the citrus industry with regard to reporting or analytes.
5. Capacity to analyse for analytes not used in citrus but of concern to citrus export markets.
6. Efficient freight and logistics systems.
7. Price competitiveness.

Residue testing data were provided regularly to Citrus Australia. The samples were identified only by a code number and privacy was preserved. Residue data were not published nor released in any form, other than as a general summary of results.

Database of Citrus Export MRLs

A database was created, listing the MRLs for chemicals registered for use on citrus in Australia. For each chemical, the spreadsheet lists eighteen MRLs set by:

- Australia and New Zealand

- the International Food Standards *Codex Alimentarius Commission*
- the European Union
- fifteen other importing countries.

The database was designed to be easy to maintain and updated by staff within Citrus Australia, and so that data can be searched and sorted easily, using filters to narrow searches by pesticide or country or chemical type or date of updates.

Information on importing country MRLs in key export markets was derived from a range of sources including:

- government websites and databases in each importing country
- importing country regulations
- ePing alerts from the World Trade Organisation
- official translations from the United States Department of Agriculture Foreign Agricultural Service (Gain reports), if the website or source document was not already translated into English.

Officers from the National Residue Survey also provided a reliable ‘backstop’ to keep a watch on overseas importing country requirements.

World Trade Organization member states are required to provide formal notifications (SPS notifications) when there are proposed changes to import conditions, including MRL changes. However, in practice this is not always the case. For that reason, the Agrichemical Manager reviewed official sources of importing country requirements (e.g. websites, regulations, databases) on at least an annual basis.

Table of citrus export MRLs

MRLs from the database were transformed for distribution into an easy-to-read, hard copy table of citrus export MRLs. The initial intent was to update the table twice annually — in September (to coincide with the emergence and treatment of the spring complex of pests) and in March (just before the start of the export season). However, updates became much more frequent during the three years of the project as there were a large number of significant MRL changes that needed to be notified to stakeholders immediately.

Updated tables were made available on the Citrus Australia website and distributed within industry networks via email. The tables were not made available in the public domain, to avoid MRL information being misunderstood by individuals outside the industry and to avoid adverse publicity. Moreover, it would not be reasonable that other citrus producing nations had free access to the intellectual property generated by project CT18001. No reasonable request for access by an Australian citrus value-chain business was denied.

Growers, packers, exporters and other service providers were informed of key changes to the MRL tables and that a new version was released. Notification was made via:

- direct emails to growers, packers, exporters and service providers
- AgChem Updates via MailChimp
- the fortnightly newsletter, Citrus Australia E-news
- newsletter to Citrus Australia members “The Juice”.

The transfer of the citrus export MRLs table into electronic format (e.g. an application for mobile device) has been discussed with the sector. There is a resounding view by industry participants that the project leaders should ‘keep it simple’ by remaining with the pdf version of the table.

Guide to achieving MRLs

Under previous iterations of this project, a ‘Guide to Achieving Citrus Export MRLs’ was developed by AKC Consulting and provided to the citrus industry. The guide lists Australian label withholding periods and compares MRLs in Australia and other markets.

As part of project CT18001, the 'Guide to Achieving Citrus Export MRLs' was merged with the table of citrus export MRLs.

The assumptions were as follows:

1. If the export MRL is equivalent to or higher than the Australian MRL, then the label withholding period is also appropriate for that particular market.
2. If the export MRL is lower than the Australian MRL, then the label withholding period may be insufficient for residues to decay to achieve the MRL for that particular market.
3. If the export MRL is lower than the Australian MRL, and there are no data to support the export MRL, then an export MRL cannot be determined.

New product registrations and minor use permits

The Agrichemical Manager worked with citrus businesses and other members of the value-chain to identify potential solutions to pest and disease issues and commence the regulatory approval process for a number of products.

- facilitating trials towards an application for the use of bifenthrin (Talstar®) as a control option for citrus gall wasp in lemons
- supporting two agrichemical retailers to apply for research permits
- updating industry regarding progress in bringing new chemistry to market under Hort Innovation projects ST16006, ST17000 and MT20007 and new products from Bayer, Syngenta, Corteva, Ori Ag and Nufarm.

Industry communications

Outcomes and outputs from project CT18001 were communicated to industry and other stakeholders by:

- engaging with agrichemical companies and resellers
- engaging with pest scouts and agronomists
- providing regular 'Agrichemical Updates' (Citrus Australia email alerts on critical agrichemical issues via a mailout to a subscription list)
- providing technical and commercial advice to government in response to issues that impact the citrus industry
- participating in Citrus Australia's regional committees and issues committees
- providing a contact point for enquiries from growers, packers, chemical companies, auditors, resellers, and government
- delivering presentations at workshops and regional and national forums
- providing content for Australian Citrus News, Citrus eNews and 'the Juice' and videos in social media in collaboration with project CT18000.

Results and discussion

Citrus residue monitoring program

During the period March 2019 – January 2022 there was a 44 per cent increase in the number of samples submitted for residue testing across all regions (Table 1) through CT18001. When assessed by region, the number of samples submitted from South Australia decreased by 21 per cent but each other region submitted more samples during the project period.

Table 1: Citrus sample submissions to Symbio Laboratories for multiresidue screen CR06.24, 2019-2021 – by region

Sample submissions - multiresidue test	2019	2020	2021	Change since 2019	percent change since 2019
Central Burnett Qld	16	30	34	+18	+113 percent
Riverina NSW	86	100	100	+14	+14 percent
Western Australia	1	5	8	+7	+700 percent
Riverland SA	260	215	199	-61	-21 percent
Sunraysia Vic/NSW	87	165	366	+279	+321 percent
Unknown	46	32	8	-38	-83 percent
Total	496	547	715	+219	+44 percent

During and prior to 2019, a multi-residue-screen was offered to growers at a bulk price negotiated by Citrus Australia. Additional tests were offered for dithiocarbamates, heavy metals and biological contaminants.

In response to MRL changes in 2020 and an increasing focus on glyphosate and paraquat in some overseas markets, the project leaders worked with the contract laboratory to offer a sample submission form that included testing for glyphosate/glufosinate/AMPA testing, and for paraquat/diquat/amitrole at a negotiated price. Separate tests are required for these chemicals because these analytes cannot be extracted and tested using the same multi-residue-screen.

In 2020 and 2021 there was a significant increase in requests for the additional tests, once knowledge of these tests were made available (Table 2).

Table 2: Number of each test requested in each Citrus Residues Survey, 2019-2021

Year	CR006.24 multi-residue test	CR007 dithiocarbamates	CR015-3 glyphosate, glufosinate, AMPA	CR015-2 paraquat, diquat, amitrole	ESMO2 Lead (Pb)	Bacteria – <i>E. coli</i> , <i>Listeria</i> , <i>Salmonella</i> ,
2019	496	90	-	-	115	<i>E. coli</i> 76 <i>Listeria</i> 87 <i>Salmonella</i> 93
2020	547	57	6	6	130	<i>E. coli</i> 112 <i>Listeria</i> 106 <i>Salmonella</i> 112
2021	715	55	33	33	239	<i>E. coli</i> 203 <i>Listeria</i> 151 <i>Salmonella</i> 220

The analytes most commonly detected in CT18001 were post-harvest fungicides (imazalil, thiabendazole, fludioxinil, propiconazole and pyrimethanil) and this was not an unexpected result because residues of post-harvest fungicides need

to fall within an efficacious range — high enough to provide protection against post-harvest pathogens, but below the MRLs in overseas markets. The citrus residue monitoring program provided packers with a way of optimising fungicide application by ensuring that residues are both within the efficacious range and also below the MRL in the market where the fruit is being consigned.

Analysis of residue data in project CT18001 enabled Citrus Australia to monitor the industry's progress towards being an ultra-low residue crop. Based on residue testing data from 2019 – 2021, fifty per cent of citrus samples submitted for residue testing had no detectable residues other than post-harvest fungicides. In 357 of the 715 samples submitted for testing (50 per cent), residues from all pre-harvest treatments were below the limit of reporting (<LOR). In a further 28 samples, residues were just detectable at 0.01 mg/kg. This brings the total to 385 of the 715 samples (54 percent) with residues at or below the limit of reporting and which could be considered a 'ultra-low'.

In CT18001, Citrus Australia found that achieving ultra-low residues is compromised by the requirements of Interstate Certification Assurance (ICA) protocols for prevention of movement of Queensland fruit fly. Queensland growers routinely apply dimethoate as a post-harvest disinfestation treatment for fruit flies to access some interstate markets. Omethoate, while not used in citrus, is a key metabolite of dimethoate and will be detected as dimethoate is breaking down on citrus. Several citrus export markets have no tolerance for omethoate. Moreover, omethoate is banned from use on all crops in Australia. There was a slight increase between 2019 and 2021 in the proportion of samples with detectable dimethoate. Residue data from CT18001 and the National Residue Survey (2012-2018) data were used to confirm that when omethoate was detected in citrus, it was associated with the use of dimethoate in every instance. In 2019, traces of omethoate were detected in Australian citrus exported to Thailand. Thailand has an established MRL for dimethoate but not for omethoate. As a consequence, in 2020 Thailand gave notice that fruit from the offending businesses would be subject to mandatory on arrival testing, for 134 chemicals including omethoate.

Dimethoate and omethoate residues in exported fruit are presumed to be due to cross-contamination from the packing line, after domestic fruit has been treated to comply with Interstate quarantine requirements for fruit flies. Residues on the packing line were thought to be transferred to fruit that was packed at a later date for export.

The project leaders worked with the Australian Government Department of Agriculture, Water and the Environment, Australian Embassy in Thailand, and Adama Pty Ltd in an effort to influence policy change regarding Thailand's residue definitions for omethoate and dimethoate. Despite those efforts, Thailand's position did not change. The issue was further complicated by the Chinese importing authorities announcing in October 2020 that the MRL for dimethoate in China had been revoked. The position of the Thai and Chinese authorities now essentially means that the use of dimethoate as an interstate quarantine treatment in Australia is no longer an option, without creating risk for export from those facilities. While in theory it is possible to run a dedicated a packing line for the Australian domestic market, this is not a feasible option for most packing houses.

The majority of samples submitted for testing were collected from packing lines. However, some samples (67) had no detectable post-harvest fungicide, suggesting that they were collected directly from orchards or before sending through the packing line. It is unlikely that any fruit would be consigned to market without post-harvest fungicide controls in place. While these only represent 9 per cent of the total sample submissions, it is interesting to look at the residue load on that fruit because the fruit was sampled prior to washing, and screened for more than 300 analytes. A total of 54 per cent (36 samples) of the orchard-sampled fruit had no detectable residues. Thirty samples did contain residues from pesticides applied in the orchard.

Table 3 shows a decline from 2019 to 2021 in detections of chlorpyrifos and 2,4-D. The decline supports trends observed by analysis of the previous data from 2012 – 2018, provided by the National Residue Survey. Note, the data cannot be used to distinguish whether there has been a shift away from using those chemicals, or just more strategic use of the same chemicals. The data is also influenced by use patterns in each region, and seasonal variation in pest pressures. There was an increase in detections of dithiocarbamates between 2019 and 2021. The increase corresponds to an increase in submissions of samples from Queensland, where mancozeb is relied on heavily, for control of fungal diseases. Detections of dimethoate increased between 2019 and 2021.

Filtering data by variety, region, chemical group, or other variable provided insights into usage of chemical groups, for example to compare usage and a shift between the neo-nicotinoid and organophosphate insecticides.

Table 3 Proportion (per cent) of samples with detectable residues of each analyte

Year	2019	2020	2021	Use
Total samples tested	496	547	715	
Analyte detected				
Imazalil	77%	83%	93%	Post-harvest
Thiabendazole	80%	80%	84%	Post-harvest
Fludioxonil	27%	38%	52%	Post-harvest
Pyrimethanil		16%	21%	Post-harvest
Dithiocarbamates ¹	9%	7%	17%	Orchard
Dimethoate	8%	10%	12%	Pre/Post-harvest
Propiconazole		14%	12%	Post-harvest
Imidacloprid		14%	8%	Orchard
Chlorpyrifos	10%	7%	5%	Orchard
Clothianidin		9%	5%	Orchard
Pyriproxyfen		4%	5%	Orchard
2,4-D	11%	0.2%	4%	Post-harvest
Omethoate	5%	3%	4%	Breakdown product
Malathion	1%	1%	3%	Orchard
Acetamiprid		2%	3%	Orchard
Iprodione		0%	3%	Orchard
Spirotetramat		1%	2%	Orchard
Fenbutatin oxide		2%	1%	Orchard
Lead (Pb)		4%	1%	Orchard
Azoxystrobin		2%	1%	Orchard
Cyantraniliprole		0%	1%	Orchard
Methoxyfenozide		0%	0.4%	Orchard
Simazine	0.2%	0%	0.4%	Orchard
Bromacil	0.2%	1%	0.3%	Orchard
Etoxazole		0.2%	0.3%	Orchard
Sulfoxaflor			0.3%	Orchard
Bifenthrin		0.2%	0.1%	Orchard
Carbaryl	1%	0.2%	0.1%	Orchard
Diuron			0.1%	Orchard
Pendimethalin			0.1%	Orchard
Pirimicarb			0.1%	Orchard
Methidathion	1%	0.4%	0.1%	Withdrawn

While the analytes shown in Table 3 were detectable, it is important to note that they were predominantly well below the target MRLs for citrus (the lowest MRL across key markets).

The citrus residue testing program provides packers with critical information prior to packing and exporting fruit. If a residue is detected and exceeds a target MRL, fruit could potentially be re-directed immediately to a market with an

appropriate MRL for that analyte. However, this is an unlikely scenario. Rather, growers and packers use the residue testing service to 'calibrate' their systems prior to making packing decisions. This is similarly the case with post-harvest fungicides. After ten years of providing the service, professionally managed packing houses have a strong understanding of which products represent the greatest risk in each market. Packing house managers have reported using the service to 'dial-in' fungicide concentration on the packing line to effectively manage post-harvest rots while at the same time remaining below importing country MRLs.

The most commonly detected post-harvest fungicides are as follows:

- 404 samples (57 percent) had residues of imazalil and thiabendazole
- 216 samples (30 percent) had residues of imazalil and fludioxonil
- 187 samples (26 percent) had residues of thiabendazole and fludioxonil
- 180 samples (25 percent) had residues of three fungicides: fludioxinil, imazalil and thiabendazole
- 48 samples (7 percent) had residues of four post-harvest fungicides

The project leaders were encouraged by the fact that the uptake of more modern fungicides (fludioxonil and pyrimethanil) increased during the life of the project. Many years of effort had been dedicated to achieving regulatory approvals for these molecules and uptake by industry had previously been relatively slow. Adoption of these new chemistries goes some way to preserving the efficacy of a suite of post-harvest chemicals by providing a break in use patterns and reducing likelihood of chemical resistance in packing sheds.

Citrus export MRL tables

During the life of the project, the citrus Export MRL tables were updated at least biannually to coincide with the emergence of spring pests and the start of the export season. As stated, there were also a large number of extraordinary updates provided when there were significant changes to importing country requirements. In total, there were 16 official updates during the three-year life of project CT18001.

Communications

Documents and data regarding the communication reach of Project CT18001 are provided as outputs

Enquiries to Citrus Australia: The Agrichemical Manager responded to an average 1.6 enquiries or contacts per day (based on 12 months data). The nature of those enquiries or contacts are summarized in Appendix 6. This average does not include repeated contacts regarding a particular topic. The average was calculated on new issues only, not repeated contacts. Most contacts related to export MRLs, residue testing program and pest management. Most contacts from agrichemical companies related to chemistry in the pipeline for regulatory approval as well as residue data.

Field days: Information was provided to a range of industry participants at fields days and forums (Table , page 16).

Social Media: The Agrichemical Manager collaborated with Citrus Australia’s communications team (CT18000) to produce three short videos released via social media to encourage citrus growers to commence their seasonal programs of fruit fly baiting. The premise that ‘growers like to learn from other growers’ was paramount to the production. In each video a respected grower portrays the ease, simplicity and cost-benefits of bait spraying. The three videos were watched by 8385 viewers (summarized in Appendix 5).

Agrichemical Updates: Nine updates were emailed via Mailchimp to a base of over 800 subscribers. Statistics returned from Mailchimp revealed that most emails are successfully delivered (no bounces) and after each mailout, approximately half of the emails were opened. The emails that were opened, were opened multiple times. The low rate of unsubscribing suggests that while a reader may not have found content directly relevant to them, they valued being able to receive the information.

Australian Citrus News (ACN): content was provided to the quarterly tabloid, Australian Citrus news in collaboration with the project leaders of CT18000.

Citrus eNews: content was provided to the fortnightly newsletter, Citrus eNews in collaboration with the project leaders of CT18000.

Outputs

Table 4: Output summary

Output	Description	Detail
Citrus Export MRL tables	Document (pdf) containing text and tables. Current edition is 16 pages. Sixteen updates released 2019 – March, July, October, December 2020 – February, March, May, June, July, October 2021 – January, March, May, June, November 2022 – January	Citrus Export MRLs: a pdf document available to growers, packers and service providers to assist growers and packers to meet MRLs in export markets. MRLs listed for 12 countries, the European Union as well as those established by the Codex Alimentarius Commission. Updated to and accessed from Citrus Australia website, via member portal or Info Citrus. Also distributed via email directly to packing sheds and service providers.
Guide to achieving export MRLs	Document (pdf) containing text and tables. Current edition is 16 pages. Three updates released in March 2019, November 2021 and January 2022	Withholding period information was incorporated into the Export MRL tables released in late 2021 and early 2022. Updated to and accessed from Citrus Australia website, via member portal or Info Citrus. Also distributed via email directly to packing sheds, growers and service providers.
Analysis of the residue survey data	Data summarized as charts, showing results from 2012-2018 (NRS data) 2019-2021 (CT18001 data)	Overview and annual summaries of key points emerging from the residue testing program were provided to members of regional committees and issues committees, and in milestone reports to Hort Innovation, and summarised in presentations to audiences at regional forums.
Contact point within Citrus Australia	Response to ad hoc enquiries and contact from other stakeholders.	Enquiries or email contacts averaged 1.6 per day, from growers, packers, chemical reps, auditors, resellers, and government (average excludes repeat contacts on same issue).
AgChem Updates	Nine alerts regarding changes to MRLs or registration were sent via email to approximately 800 subscribers	Approximately 50 % of 800 subscribers opened the AgChem update emails, and these readers re-opened several times.
Submissions (two) responding to requests for information about chemical use in citrus.	Response to the 2019 50126-Agricultural Uses Survey, submitted to APVMA.	Response regarding usage in citrus and importance to industry of pesticides scheduled for review by APVMA.
	Response to the CCFICS Secretariat, Codex Contact Point for Australia	Response regarding CCPR53: CL 2021/97-PR - Request for comments and information on national registrations for pesticides for periodic review by JMPR. January 2022.
Submissions (six) regarding proposed policy or regulatory	Two submissions to <i>The Agricultural and Veterinary Chemicals First Principles Review Council</i> – directed to the Department of Agriculture, Water and the	Future reform opportunities submission on the Review of the Agvet Chemicals Regulatory System. August 2020
		Submission in response to the <i>Draft report of the independent review of the Agvet</i>

changes	Environment, Canberra ACT 2601.	<i>Chemicals Regulatory System</i> . February 2021
	One submission to Victorian Department of Jobs, Precincts and Regions	Submission in response to a proposal to remove the prohibition of off-label use of 'restricted use' chemical products in low-risk circumstances, to align Victoria with a national harmonization agreement. September 2021.
	One submission to Environmental Protection Agency Docket Centre, Pennsylvania Ave, Washington, DC, USA	<i>Neonicotinoid insecticides</i> - registration status (in USA). Docket ID: EPA-HQ-OPP-2020-0306 - August 2019
	Two submissions to the APVMA	<i>Review of neonicotinoids – invitation to make submissions</i> regarding proposed process for an APVMA chemical review of neonicotinoids. February 2020 <i>Chlorpyrifos</i> – submission regarding use patterns and safety measures that minimize user exposure to chlorpyrifos - to defend ongoing registration in citrus, 2019.
Technical documents	Situation summaries re pesticides suitable for control of Asian Citrus Psyllid (ACP) for preparation against exotic pest threats: Data for emergency permits for ACP provided to the biosecurity project and the pest and disease committee.	Understand which chemicals we should focus on and what we need ready. Information used to support emergency use permit applications prepared by Plant Health Australia and held in readiness to be used if/when ACP is detected in Australia.
	Situation summary regarding pesticides entering the great barrier reef from catchments that include citrus production.	Document for CA CEO outlining citrus industry position regarding pesticides on the Great Barrier Reef with reference to measured levels (Office of the Great Barrier Reef, 2019) and <i>Reef 2050 Water Quality Improvement Plan</i> (Queensland Government, 2018).
Extension – Field days	Ten field days	<i>Spray baiting of fruit fly</i> Six grower field days in May 2019 (Swan Hill, Tooleybuc, Nangiloc, Euston, Cardross and Merbein) organized in collaboration with the Greater Sunraysia PFA. The field days were used as an opportunity to also share information about biosecurity – in particular <i>Asian Citrus Psyllid</i> and <i>Xylella</i> .
	Tatura Nangiloc Merbein Cardross Swan Hill	<i>Spray application</i> : October 2019 two spray application field days: Tatura (attended by 50 NVFG and citrus growers); and Paringa (attended by 25 Costa Group staff).
	Paringa Euston Tooleybuc	<i>Spray application</i> : March 2021 two spray application field days held as an adjunct to the 2021 Regional Forums in Mareeba and Mundubbera.
Extension – Facilitating adoption of new technology (AI & robotics)	<i>NSW DPI Citrus Roadshow 2021</i> Dareton, Renmark and Griffith <i>Ag Tech Hub 2021</i> (postponed) - collaboration between CA, ATGA, DFA and SuniTAFE	Coordinated presenters on new technologies in citrus (AI & robotics) for the <i>NSW DPI Citrus Roadshow</i> . Focus on sensors and robots – these will feed eventually into pest and disease management and eventually to improved use of chemicals. <i>The Ag Tech Hub</i> was a to give growers hands-on exposure to a range of new

		technologies – postponed due to COVID lockdown. Rescheduled for May 2022.	
Extension – Spray demonstrations	Six sprayer demonstrations supported by specialists Dr David Manktelow (ART, NZ) and Dr Jason Deveau (OMAFRA, Canada)	October/November 2019: Six orchard visits with spray application demonstrations in Sunraysia and Western Australia, to raise awareness of the opportunities for improving work rate efficiencies, and focus on maintenance and sprayer configuration.	
Extension – Resources on the Citrus Australia website www.citrusaustralia.com	Links to excel calculators to assess financial costs/benefits of changes to spraying practices	Are you wasting chemical? Simple excel calculator soon to be available Link to download a Work rates Calculator to compare scenarios. Available with permission from Dr. David Manktelow, ART, Hawkes Bay, New Zealand.	
	Link to website containing many resources related to orchard spraying	Link via www.citrusaustralia.com to the Sprayers101 website and resources	
	Link to manual and training for orchard sprayers	Link via www.citrusaustralia.com to download the Airblast 101 manual	
Extension – Publications	Articles published in Australian Citrus News and made available on the Citrus Australia website. Co-produced with communications project CT18000.	MacGregor, A. (2020). Finding a happy medium for effective spraying <i>Australian Citrus News</i> Summer 2019/20:30-31 MacGregor, A. (2020). MRL compliance an essential part of trade. <i>Australian Citrus News</i>. Autumn 2020:11 MacGregor, A. (2020). Q&A – Residue Testing Service. <i>Australian Citrus News</i>. Winter 2020:28 Altman, J. & MacGregor, A. (2020). Red Scale suppression with <i>Aphytis melinus</i> wasp. <i>Australian Citrus News</i>. Winter 2020:29 Altmann, J. & MacGregor, A. (2020) The importance of IPM practices in citrus. Citrus Australia website. https://citrusaustralia.com.au/growers-industry/the-importance-of-ipm-practices-in-citrus	
Extension – Presentations at industry forums	Presentations about MRLs, raising awareness about the residue testing service, markets of concern, chemistry in the pipeline – Eleven Regional Forums – Citrus Marketing Forum, Melbourne March 2020	July 2019 Iraak November 2019 Mundubbera November 2019 Loxton March 2020 Melbourne (<i>Citrus Marketing Forum 2020</i>) November 2020 WA (<i>virtual</i>) & Mundubbera (<i>virtual</i>) & FNQ (<i>virtual</i>) December 2020 Griffith & Gol Gol Jan 2021 Renmark March 2021 Mundubbera & Mareeba	

Extension – Videos and social media	Three videos to encourage spray baiting Queensland fruit fly, co-produced with communications project CT18000.	Three videos distributed via social media, e-news and the CA website. Videos were under the banner “Show us your rig”. In each short video a different grower presented a Qfly baiting rig, to demonstrate that building a rig can be simple and cheap and that baiting is fairly fast, and that the benefits outweigh any nuisance factor. The videos have been viewed 8385 times on Facebook and the website.
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Outcomes

Table 5: Outcome summary

Outcome	Alignment to fund outcome, strategy and KPI	Description	Evidence
Knowledge/awareness: Growers and packers are aware of and increasingly knowledgeable about MRL requirements of citrus export markets and practices to meet those requirements.	SIP OUTCOME 2 – Growers and the industry reduce biosecurity, phytosanitary and agrichemical-related risks 2.2 safeguard the citrus industry from injudicious use of agrichemicals through the value chain	MRLs in export markets can change at short notice. Chemical users had timely access to information about changes to MRLs. Industry was informed of changes in registration status or permitted uses of agrichemicals in export markets. Frequently updating of MRL information lessened the risk of MRL breaches on exported crop.	MRLs in export markets were closely monitored and industry provided with timely updates to the MRL tables. Information from the Guide to Achieving Export MRLs was incorporated into the MRL tables. The modification was well received.
		Awareness about changes to export MRLs was generated via the MRL tables, Agrichemical Updates (emailed), presentations at the marketing forum and regional forums, articles, e-news and other media.	Mailchimp statistics showed that AgChem Alert emails sent to more than 800 subscribers were opened and often shared. The alerts summarise pertinent changes and direct readers to the Citrus Australia website to access the MRL tables.
		Good stewardship of data from the annual residue survey has generated trust among growers and packers that their data will not be mis-used.	Participation in the annual residue testing program increased between 2018 and 2021. 411 tests were requested prior to the 2019 season. 496 tests were submitted in 2019, reflecting promotion of the service. 547 tests were submitted in 2020. 715 tests were submitted in 2021.
Compliance: Monitoring of compliance within the industry ensures that issues are identified. Feedback to industry ensures that issues are also addressed. The citrus residue survey		The Agrichemical Manager coordinated the annual citrus residue testing program. De-identified data was collated and analysed so that industry could be informed about chemicals or use patterns that pose a risk to export markets. The laboratory responded to industry requests and expanded their testing capacity to offer a moderately priced screen for herbicides of concern in particular markets: glyphosate, glufosinate and paraquat.	Residue survey data shows a very high rate of compliance with importing country requirements. 50 per cent of residue test samples had zero detectable residue of any pesticide applied in the orchard. The only residues were from post-harvest fungicides. Industry was alerted to risks associated with non-compliance. An increase in sample submissions requesting the

shows a reduction overall in the chemical residue load compared with 2016. Citrus samples are meeting and exceeding MRLs in target markets.	The laboratory responded to requests to reformat test reports to meet requirements of Thai importers.	additional tests for dithiocarbamates or glyphosate, glufosinate and paraquat was in response to requirements of particular markets and facilitated by offering these tests at an affordable price and listing them as options on a sample submission form designed for the citrus industry. There was an increase in sample submissions during the project – In 2021, the laboratory reported on 715 multi-residue tests as part of the survey.
Technical and commercial advice to government regarding production systems, pest and disease control and availability and use of chemicals has focused on maintaining access to chemicals, while understanding the agendas of government, commercial, environmental, consumer and industry stakeholders. Regulatory bodies are supportive of and collaborating with industry to achieve full compliance and move towards ultra-low residues.	Citrus Australia had input into the APVMA Existing Chemical Review Program, to maximise retention of chemistry undergoing review. Citrus Australia made several submissions to Australian and international agencies regarding proposals about access to and use of chemicals. Citrus Australia engaged with chemical companies and state and commonwealth departments regarding minor use, off label use, new chemistry and any detected breaches of domestic or export MRLs. Timely access to data from the residue survey ensured that issues were identified and addressed within that season.	Written submissions relating to Review of the Agvet Chemicals Regulatory System – future reform opportunities Submission re draft report of the independent review of the Agvet Chemicals Regulatory System To US EPA regarding registration status of the neonicotinoid insecticides APVMA review of neonicotinoids – invitation to make submissions Request for comments and information on national registrations for pesticides for periodic review by JMPR (NRD) Citrus Australia was invited to participate in round-table discussions about the proposed reforms to the regulatory system for AgVet chemicals. Negotiations with the Thailand FDA, Australian embassy staff in Thailand and chemical industry after omethoate was detected on Australian citrus exports in 2020. Prompt sharing of information about changes to testing by India in 2020.
Practice change:	Provide a contact point for growers seeking chemical information.	Enquiries received by Citrus Australia about chemical use, and spray machinery.

		Provide extension material about efficient chemical application and machinery maintenance. Analysis of spray diaries to gain insights into patterns of chemical use and changing practices. Analysis of the residue survey data to understand practice change revealed an increased proportion of samples with no detectable residue other than from post-harvest treatments.	Attendance by growers and consultants at two spray demonstrations in Qld in 2021. Number of follow up contacts with consultants for sprayer maintenance checks.
Communities of practice: - Hort Innovation - CA - researchers - laboratories - growers - packers - exporters - chemical reseller - pest scouts - chemical industry - media - chemcert trainers - APVMA - state regulators (agchem)	OUTCOME 4 – Industry participants have increased skills, capacity and knowledge 4.1 Increase skills in existing participants, and attract a new generation of willing participants to the citrus industry	Outcomes from R&D identify and provide access to new 'softer' chemicals. Growers are confident using softer chemicals and chemical that leave less residue, with greater efficacy. Provide grower extension and education programs to promote chemical compliance and adherence to MRLs across the entire industry. Citrus Industry stays abreast of other sectors with regard to innovative/robotic/ digital technologies for choosing and using chemicals, in particular with regard to decision making for spray application and integrated management. Provided information to support the ACP emergency permits.	The project team provided input to a workshop in Canberra that aimed to develop tools for growers to reduce the risks of spray drift. Liaising with authors/creators of the website Sprayers101 and the spray manual Airblast101 led to an increase in the relevance of those resources for Australian citrus growers. Feedback after spray demonstrations and field days. Agrichemical control options are in place for exotic pests as part of the citrus crisis management plan.

Monitoring and evaluation

Key Evaluation Question	Project performance	Continuous improvement opportunities
Effectiveness: <i>CT18001 aimed to reduce the biosecurity, phytosanitary and agrichemical related risks for growers and the industry</i>		
Are industry participants complying with importing country MRLs through having better access to simple information.	A 50 per cent increase in residue testing submissions indicates a higher awareness and priority in relation to export MRLs. The testing service provided under CT18001 enables growers to tailor spray programs to their export markets. Growers and service providers received up-to-date information about MRLs in key markets, in an easy-to-use format. The frequency of releasing updated MRL tables increased when there were critical changes to importing country requirements. A wide audience received alerts about critical changes to MRLs, using a Mailchimp subscription service.	Citrus producers require alternative chemistry to replace older chemistry that is no longer accepted by trade partners or that is currently at risk of future regulatory decisions. Future R&D to support introduction of new crop protection products to replace old chemistry, to address market failure – perception by Agvet companies that Australia is a low-returning market.
Are agrichemical options in place for exotic pests as part of the citrus crisis management plan?	CT18001 provided technical documents to the Citrus Pest and Disease Prevention Committee identifying and ranking treatment options for Asian citrus psyllid. Industry has improved capacity to respond to an incursion of Asian citrus psyllid.	
Has project CT18001 increased the knowledge, skill and capacity of industry participants to manage biosecurity, phytosanitary and agrichemical related risks?	CT18001 co-produced a series of videos for social media with a focus on fruit fly baiting.	Social media reaches growers. Post insights from Facebook indicate that the majority of video viewers on Facebook were men aged 25-55.
	The Agrichemical Manager provided a contact point for enquiries (Table 6 & Table 7).	Pest scouts, chemical distributors and agronomists provide an importance service recommending pest and disease control to growers. They need easier access to the export MRL tables.
	An increased number of pest scouts agronomists and other service providers are accessing the MRL tables, increasing their capacity to support growers. They gained access via their InfoCitrus KCT login.	
	In collaboration with Bayer Crop Sciences, project CT18001 hosted a visit by sprayer extension specialist Jason Deveau in Australia. As a	A plethora of new technologies that incorporate AI and robotics are becoming available to orchardists. Interest is now high, to improve

	consequence, spraying resources available to citrus growers via Sprayer101 and in Airblast101 have increased relevance to Australian orchards and machinery.	labour efficiency and address social licence. However, growers lack experience using the new technology. There is a need for R&D to explore opportunities to apply technologies and to support adoption.
Are changes to MRLs and EHIs promoted in ways that positively impact on grower and consumer confidence?	Importers and marketers understand that the citrus industry has a coordinated and closely monitored residues program. Through e-news, The Juice, and AgChem updates, a large base of stakeholders (growers, packer and exporters, re-sellers) know that growers are abreast of key changes to MRLs in overseas markets. In each updated edition of the MRL tables, changes are highlighted to make locating new information easy.	
Have changes to pre-harvest intervals been adopted?	New export harvest intervals were not promoted within the lifetime of the project. However, growers and their advisers are aware of the need to extend withholding periods to achieve lower export MRLs.	
Were key findings analysed and reported to industry stakeholders each season?	Key findings, always de-identified, were reported in milestone reports, at regional forums, at the 2020 Market Outlook Forum, to regional advisory committees, and directly to the chemical industry.	
Relevance: <i>How relevant was the project to the needs of intended beneficiaries?</i>		
Do growers and packers see value in participating in the residue testing program?	Participation in the annual residue survey increased by 50 per cent from 2019 to 2021. This was largely due to a heightened level of monitoring by overseas regulators.	
Did CT18001 support growers to comply with export protocols?	Growers are using their residue test results together with the MRL tables to calibrate their systems (including in-field spray programs and post-harvest fungicides) and continue to avoid MRL breaches.	
Did CT18001 increase confidence among trade partners that Australian citrus growers are complying with	Reporting by the laboratory was modified with an option tailored to satisfy the Thai importing authorities.	

importing country requirements?	The suite of analytes in the citrus residue screen was expanded in 2020 to address a wider list of chemicals of concern to India and Thailand.	
	In 2020 omethoate was detected in Australian citrus exports in Thailand. Using residue survey data and technical expertise from CT18001, Citrus Australia was able to provide Thailand with a satisfactory explanation and exports suffered minimal interruption.	
Process appropriateness: <i>How well have intended beneficiaries been engaged in the project? To what extent were engagement processes appropriate to the target audience/s of the project?</i>		
Was the process of updating export MRLs appropriate?	An excel spreadsheet with filtering functions, created in CT18001, allows for easy updating of MRLs when notifications are received. The data is easily transferred to update the pdf released to industry. Using primary sources for MRL information ensured the data was accurate and interpreted appropriately.	Sourcing MRL information directly from importing country regulations, websites and databases is more reliable than sourcing it via a third-party. Some accuracy would be lost if future data was sourced from a third-party. Automating the transfer of data from the excel into pdf format (and potentially html format) would enhance the process.
Was the annual residue testing program worthwhile?	A high number of sample submissions has enabled Citrus Australia to negotiate an affordable price for the multi-residue-screen that is competitive against cheaper but less useful residue screens provided by other laboratories. A productive working relationship between the laboratory and the project leaders ensures that issues can be resolved quickly. Businesses were able to refine the post-harvest chemical use to an optimal level using the service.	Administration of the residue testing program should be maintained under Citrus Australia. If growers and packers submit samples independently of Citrus Australia, the laboratory price will certainly increase to cover administration, and Citrus Australia would lose access to the aggregated data. A price increase would discourage participation in the residue testing program.

Are growers accessing the easy-to-interpret Citrus Export MRLs?	The Guide to Achieving MRLs was incorporated into the MRL tables, to make a single document. This was well received.	The new Citrus Australia website (in development) could record when MRL updates are downloaded. Providing access to the MRL tables for all relevant stakeholders remains challenging. Open access would allow Australia's competitors (e.g. Chile, South Africa) to capitalise on work being done in Australia. Currently, the tables are held behind a locked screen on Citrus Australia's website. Industry participants must either be members of Citrus Australia or apply to Citrus Australia for access. While the system in its current form is 'clunky', no reasonable request for access to the tables has ever been refused.
Efficiency:		
What efforts did the project make to improve efficiency?	The Agchem updates used a subscription database within Citrus Australia to reach approximately 800 subscribers. The impact was monitored by tracking emails delivered and opened/re-opened, and proportion of un-subscribers.	Continue to inform industry of changes via brief but far-reaching Agrichemical Updates.
	Administering the annual residue testing program within CT18001 ensured a competitive price for the residue tests.	Continue to administer the residue survey.
	Citrus growers have access to improved resources with simple but highly relevant information about chemical application methods (via Sprayers101 and Airblast101).	Maintain links to the Sprayers101 resources on the new Citrus Australia website, because this site continues to be managed and updated independently of CT18001.
	Consideration was given to providing the Citrus export MRL tables on an app, accessed using a mobile device. Restricted access to the MRLs is appropriate to prevent it being used to misrepresent industry. Industry interest in a web-based app was limited.	Continue to consider the appropriateness of a web-based app.
	Social media provided a medium for accessing a wide audience, mainly men aged between 25-55.	Continue to use social media for quick short messages. Key message needs to be within first 15 seconds – approximately half the viewers watched for at least 15 seconds.

Recommendations

There is a strong view among the citrus industry participants that the work undertaken under CT18001 remains important to the sector and adds value to citrus businesses. Here we table the key recommendations from the project.

Updating the Citrus Export MRL tables	The export MRL tables provide a method for businesses to remain informed about importing country requirements. While there are methods of obtaining MRL information from third party providers, the process of obtaining the information directly from importing country regulations, websites databases and SPS notifications remains the most reliable of ensuring accuracy and ensures that proposed changes are also communicated well before entry into force. This is obviously critical for producers who apply crop protection products many months before fruit is harvested and consigned to market. Moreover, detailed investigation, analysis and interpretation of importing country requirements is often required. Given the large number of enquiries related to MRLs over the life of the project, it is evident that MRL compliance is more complicated than simply providing industry participants with a table of values (the residue definitions for omethoate and dimethoate in Thailand are a good case in point). A dedicated resource within the citrus industry to monitor, interpret communicate and assist industry with MRL enquiries is clearly an ongoing need of the sector. While there have been discussions in the past on providing the MRL table in an online format (e.g. via a web-based app that can be accessed on a mobile device), key export businesses have indicated that the existing format (simple pdf document) is more than adequate. There is strong evidence that the pdf format provides an easy-to-use tool that can be quickly interrogated. Businesses appear to enjoy the ability to simply examine a particular compound and look across the row at each importing country, or vice versa, they can look up the importing country and scan down the column at each crop protection product.
Residue testing program	The project leaders are recommending that the coordinated residue testing program continues so that citrus businesses have access to a reliable, competent and timely residue testing service. Given the disparity between Australian MRLs and overseas importing country MRLs, it is critical that businesses are provided with an efficient residue able to conduct testing to verify and calibrate their own systems and manage MRL risks. The residue testing program in its current form also represents a substantial cost saving for businesses. An ad hoc residue testing system would undoubtedly increase the cost associated with each test and ultimately discourage participation, therefore increasing trade risks with potential loss of reputation for the Australian citrus industry. The citrus multi-residue-screen is the most extensive residue screen offered by any testing laboratory in Australia and includes more than 300 analytes and contaminants. The screen has been developed over the last decade in cooperation with the contracting laboratory and industry participants and is based on the agrichemicals used in Australia as well as those chemicals of interest to trading partners. When new crop protectants have entered the Australian market, the contracting laboratory has accommodated the changes, purchased the test standards from overseas, and developed the test methodology for the new compounds. While there are a number of other testing laboratories in Australia, the services offered by these laboratories are less than satisfactory and do not always capture the most fundamental crop protectants used in Australian citrus production. For these reasons, the project leaders recommend that the program continues using the same contracting laboratory.
New crop protectants	The market for crop protectants in Australia is small, relative to the total global market. Since 2014, globally there has been a global downturn in the agrichemical industry due to low crop prices and low profitability. At the same time, increasing regulation has made the introduction of new chemistry quite challenging, particularly in the European Union. As a result, Agvet companies are looking towards alternative technologies which includes bio stimulants, biological control agents and genetic modification. At the same time there has been a large amount of industry consolidation, which has considerably altered the

	competitive environment. AgVet companies have also reported that the costs associated with regulatory approvals in Australia far exceed the costs in other more profitable markets (e.g. California) Given the difficulties and the relative size of the Australian market, attracting investment by Agvet companies in the Australian market will remain a key challenge for the citrus industry for the foreseeable future. The current agrichemical toolbox for citrus producers in Australia could be currently described as 'adequate'. That said, several of the critical actives in the toolbox are attracting a large amount of regulatory scrutiny in Australia and overseas. For example, Australian citrus growers are heavily reliant on neonicotinoids for the control of citrus gall wasp. Similarly, growers in Australia's northern regions are heavily reliant upon dithiocarbamates to control Citrus Black Spot and Emperor Brown Rot. Both of these actives are currently under review in a number of global markets as well as in Australia. There are few viable alternatives at present and the Agvet companies appear reluctant to invest in Australia. The project leaders strongly assert that continued engagement with Agvet companies will be critical to the industry maintaining access to effective crop protection products. Strong advocacy is essential to assist Agvet companies to truly understand the industry's pest and disease pressures as well as the market opportunities and the potential return on future investment.
Future research and development	Market failure is a very real issue for the Australian citrus industry. Global Agvet companies have global budgets for investment and Australia is competing for attention with other more profitable markets. To maintain access to modern and effective chemistry, the industry must consider co-investment with Agvet companies to bring new crop protectants to market.

Intellectual property

No project IP or commercialisation to report

Appendix 1 – Sources used to update the export MRL information

Table 4: Sources used to update the export MRL information in key export markets for Australian citrus

Country	Source of MRL information	Most recent reviewing or revisions ²
AUSTRALIA	Agricultural and Veterinary Chemicals Code (MRL Standard) Instrument 2019 – Compilation No 21. Version F2021C01017 updated October 2021 (Australian Government, 2021). Food Standard Schedule 20 of the FSANZ Food Standard Code, Authorized Version F2021C01025. (Australian Government, 2021).	October 2021
CANADA	http://pr-rp.hc-sc.gc.ca/mrl-lrm/index-eng.php .	July 2020
CHINA	ICS 65.100 G25; GB 2763—2019, GB 2763—2016, GB 2763.1—2018 National food safety standard—Maximum residue limits for pesticides in food 2019-08-15 (2020—02—15 实施) 03-2020. ALSO Gain report CH2020-0099, August 2021.	August 2021
CODEX	http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/pesticides/en/ Updated.	November 2021
EU	https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=pesticide.residue.selection&language=EN .	June 2021
HONG KONG	https://www.cfs.gov.hk/english/mrl/mrl_select_pesticide.php .	October 2021
INDIA	Food Safety Standards Authority India - Food Safety and Standards (Contaminants, Toxins and Residues) Regulation, 2011 (Food Safety and Standards Authority of India, 2011).	August 2020
INDONESIA	Regulation of the Minister of Agriculture of The Republic of Indonesia; Number 55/permentan/kr.040/11/2016 Regarding food safety control on the importation of fresh food of plant origin (Permentan Nomor 55 Tahun 2016 Tentang Pengawasan Keamanan Pangan Terhadap Pemasukan Pangan Segar Asal Tumbuhan).	September 2019
JAPAN	http://db.ffcr.or.jp/front/ .	November 2021
SOUTH KOREA	농산물의 농약 잔류허용기준 (Pesticide MRLs in Agricultural Commodities) https://www.foodsafetykorea.go.kr/foodcode/02_01.jsp	August 2021
MALAYSIA	http://fsq.moh.gov.my/v6/xs/page.php?id=72	September 2020
NEW ZEALAND	Australia New Zealand Food Standards Code – Schedule 20 – Maximum residue limits. Version F2021C01025. https://www.legislation.gov.au/Details/F2021C01025 .	October 2021
OMAN	Oman newly enforced pesticide requirements for fresh produce, GAIN Report No UAE-12-17 (USDA, 2017)	August 2019
PHILIPPINES	Philippines National Standards PNS/ BAFS 292:2020 ICS 65.100.01 http://www.bafs.da.gov.ph/pesticides_commodities Updated	October 2021.
SINGAPORE	https://www.sfa.gov.sg/docs/default-source/default-document-library/food-regulations1.pdf . Updated.	November 2021

² Most recent revisions at the time of preparing this report.

TAIWAN	Standards for Pesticide Residues in Foods, 2021-08-18, Ministry of Health and Welfare 衛生福利部: Appendix tables 1-5. Updated. https://law.moj.gov.tw/ENG/LawClass/LawAll.aspx?pcode=L0040083	September 2021
THAILAND	A) Thai Agricultural Standard: TAS 9002-2016. Pesticide Residues: Maximum Residue Limits. ICS 67.040. www.acfs.go.th Referred to February 2020. B) Unofficial Translation - Ministry of Public Health Notification No. 387 B.E. 2560 (2017) Re: Food Containing Pesticide Residues (Pesticide Residues in Food)..	August 2020
USA	Pesticide MRLs published by Bryant Christie https://bcglobal.bryantchristie.com/db#login	November 2021

Appendix 2 – Articles

MANAGEMENT



Finding a happy medium for effective spraying

Achieving pest control without blowing the farm budget is important when it comes to agchem use.

As an industry, we want to guarantee pest and disease control without leaving residues.

However, we also need to do that on a viable budget, and demonstrate environmental stewardship! It's a big ask, because those goals can sometimes seem incompatible (much like the conundrum below).

When chemicals are phased out, growers are forced to use newer, and usually more expensive alternatives. That increases production costs, unless we can apply less chemical.

In some situations chemical use can be reduced by reducing spray volumes.

In October 2019, Citrus Australia, Bayer Australia and Southern Cross Farms hosted visiting spraying gurus from New Zealand (Dr David Manktelow) and Canada (Dr Jason Deveau).

On a Southern Cross farm in Nangiloc, Victoria, we asked: "Can we reduce the cost of labour and chemical in this orchard without compromising control of pest and disease".

A simple way to compare spray deposits after different applications is

Key points

- ❖ Get inside canopy
- ❖ Use paper cards
- ❖ Don't fall into old habits

by using water sensitive papers.

The papers can be clipped to poles, or pinned to leaves. It's very useful to compare the outer canopy (five folded papers) to the inner canopy (another five folded papers).

When we did exactly that, in a patch of mature navels in Nangiloc (3m tall, 6.5 m row spacing, well managed and relatively open), we achieved interesting results.

For the first run the sprayer travelled at 1.5 km/hr and applied 4000 L/ha. The sprayer was a Silvan Radak fitted with pink ceramic discs and stainless steel core nozzles - these are old school disc and core nozzles that put out a wide range of droplet sizes.

For the second run we shifted up a gear. Travelling at 3.7 km/h halved the sprayer output per hectare. Now we were applying 2000 L/ha using the same nozzles as before.

For the third run we stayed at 3.7 km/h, but flipped the nozzles to Red ATR 80° hollow cones. The ATR nozzles reduced the volume to just 1000 L/ha, and produced finer droplets which changed the spray pattern and would be expected to give better coverage than the coarser droplets produced by the other nozzles.



Water sensitive papers (WSP) are pinned to leaves inside and outside the canopy.

The conundrum can look like this:

I need optimum pest and disease control

Wetting trees thoroughly gives me good control

The chemical I used last year was cheap, and I was happy to waste a bit in the interests of good coverage.

I am seriously worried about compromising pest control if I apply lower volumes.



...but I need to reduce costs

...but labour costs would be lower if I sped up a gear

...but some of the new chemicals are very expensive! I can't afford to waste any. I need to reduce run-off.

Can I avoid wastage by applying a lower volume, but still get control?

Before each test run, Water Sensitive papers were folded in half and five papers were pinned to branches in both the outer or inner foliage zones. Wherever water lands on the yellow water sensitive papers they turn blue.

How did deposits on the outer canopy compare?

The proportion of surfaces wet to run-off was similar on the outer

canopy after spraying at 4000, 2000 or 1000 L/ha. [See Figure 1]

How did deposits on the inner canopy compare?

On the inner canopy, 1000 L/ha using the ATR cones did not provide wetting to run off. However the deposit patterns after using 4000 L/ha and 2000 L/ha were similar, with four of the 10 inner canopy surfaces at both 2000 and 4000 L/ha showing significantly

lower deposits than the rest. [See Figure 2]

How would these deposits affect pest control?

If the spray is an oil, we need full wetting and coverage for efficacy. The inner canopy was not thoroughly wet in any of the test runs. David was asked what he would do to get more thorough wetting of the inner canopy. *continued on page 32*

Figure 1: Deposits on the outer canopy

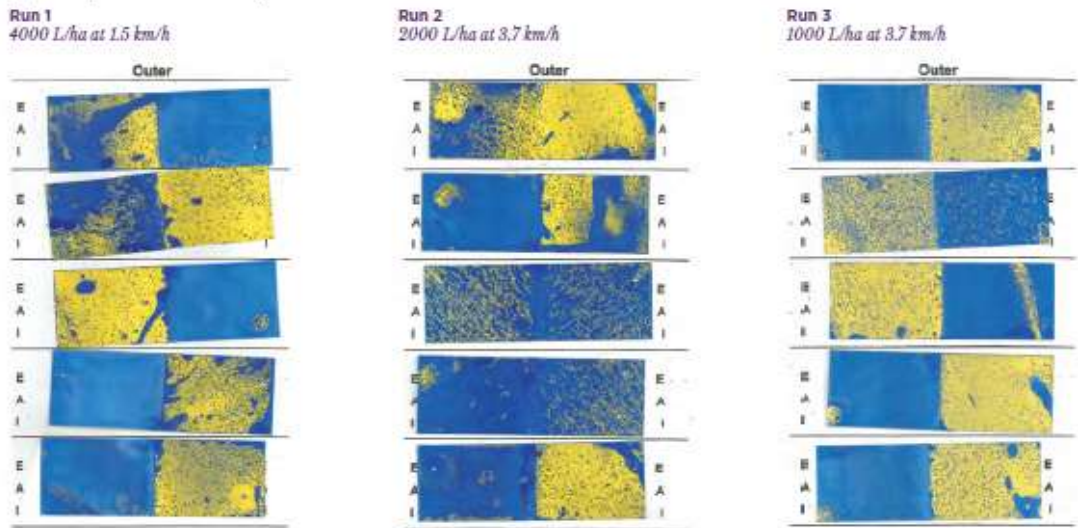
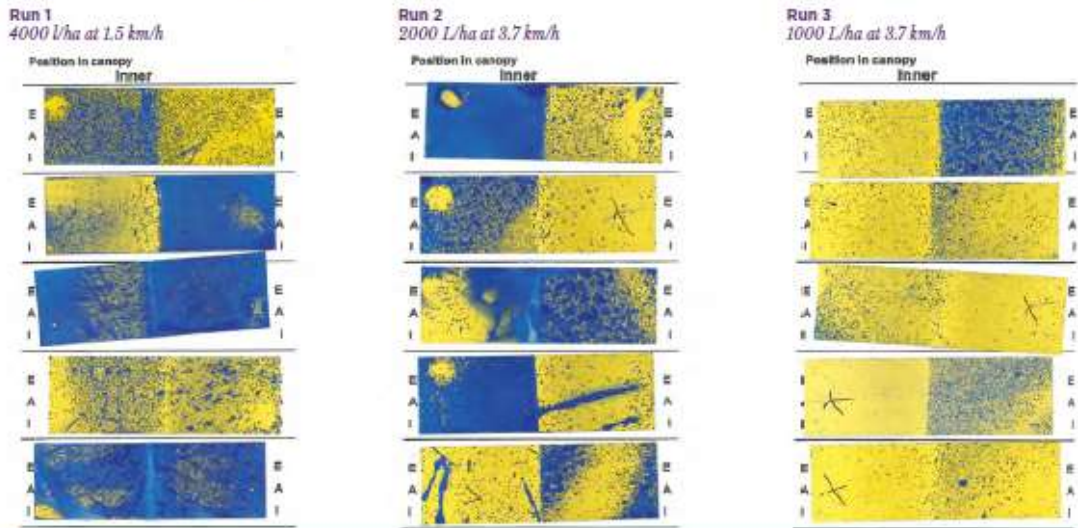


Figure 2: Deposits on the inner canopy



MRL compliance an essential part of trade

Agrichemical manager Alison MacGregor said communicating changes in MRLs was central to Citrus Australia's role in supporting trade.

"A Maximum Residue Limit is the maximum concentration of an agrochemical that's legally permitted to be present in food at harvest," Alison told MOF 2020 delegates.

"Internationally, MRLs are set by the World Health Organization, and known as the Codex Alimentarius MRLs, but every country can also set its own MRLs for each agricultural chemical in each crop.

"The challenge our industry has is making sure we comply with MRLs within all these markets."

Alison said "when a country is setting MRLs for citrus, they consider the 'acceptable daily intake' of each chemical – essentially, how much of the chemical we can consume, from all sources in our diet, without any effect on health".

"It's not just how much chemical we're getting in citrus; they have to consider how much chemical we're getting in everything we eat.

"Then they work out the proportion of that chemical that could be in our diet from citrus, based on how much citrus the average consumer eats.

"In Australia there are fruits that children eat a lot of. Think about how many mandarins go into primary school lunch boxes.

"Because kids eat a lot of mandarins, MRLs for chemicals in popular fruit like mandarins need to be set VERY low to limit the potential intake of chemicals from mandarins.

Another factor is that diets vary between countries. Alison said consumption of cabbage was an example.

"Each year, the average Korean eats 12 kilograms of cabbage. In Australia we eat less than half of that."

She said if a chemical is permitted in a staple food, like cabbage in Korea, but is also applied to citrus, then MRLs for citrus imported to Korea could be set comparatively low in order to keep the total residue of that chemical in Korean diets well below the acceptable daily intake.

Alison said Citrus Australia produced an up-to-date table of MRLs every six months covering Australia's 15 major markets. Any changes to MRLs in the preceding year are highlighted in yellow.

More frequent alerts on specific topics are also circulated.

She said participation in a screening program that is aligned with the Federal

government's National Residue Survey provided citrus with an accurate annual assessment of industry's compliance with MRLs.

"In 2019, 17 packers were involved and sent off samples for more than 500 tests – an amazing cross-section of the industry," Alison said.

"The screening includes 310 chemicals and metabolites – a wide screen to take in as many agrichemicals as possible during the test.

"Only 51 of those in the screen are actually registered for use in citrus, but it's important to show our overseas customers that we screen for everything that could possibly be in there."

Alison said about 20 per cent of samples were also analysed for biological pathogens such as E-coli, Salmonella and Listeria, and for heavy metals.

She said in 2019 the detection of just one chemical in a sample was confirmed as exceeding an Australian MRL; just a single sample out of 500 multi residue or biological test samples suggested Australia's citrus industry was "doing very, very well". ●

Contact Alison at alison.macgregor@citrusaustralia.com.au or on (03) 5023 6333

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MANAGEMENT

Q&A

Residue testing service

Citrus packing houses and growers in Australia are careful to make sure that chemicals used for pest and disease control in Australia are also permitted on citrus in our overseas markets. The practicalities of this are made difficult by the fact that tolerances for chemicals keep changing in our export markets.

Tolerance limits for chemicals in food are called Maximum Residue Limits (MRLs). Because MRLs in citrus can vary between different countries, orchards need to tailor their chemical program around the MRLs of each export market.

To help growers make suitable chemical choices, Citrus Australia collates and regularly updates lists of the MRLs for all chemicals permitted in citrus in our major export markets.

Sometimes changes to export MRLs happen without warning. Planning the season's pest and disease management program is challenging when export markets suddenly change MRLs mid-season.

Citrus Australia facilitates a citrus residue testing program because exporting growers need certainty that residues on their crop are compliant with the MRLs set by each market.

Why do laboratories offer a selection of multi-residue screens?

Laboratories develop screens to suit the commodities they test: water, soil, wool, meat, milk, grains, fruit and vegetables. Not all screens are relevant to citrus samples. Laboratories keep testing affordable and relevant by including chemicals that match clients' needs. Sometimes a unique method is required to extract and quantify a particular chemical from a sample, and a separate test is required, adding significant cost to a multi-residue test.

Why send samples from other states to Queensland rather than using a local laboratory?

Symbio Laboratory in Queensland has a large amount of expertise in

testing citrus. Over a ten-year period, the laboratory has been subject to proficiency testing with spiked samples to ensure that it can accurately measure chemicals used on citrus. The same laboratory is also testing for the Australian Government National Residue Survey. The laboratory is accredited to screen citrus for more than 200 chemicals and more than 100 key breakdown products. That wide screen of chemicals is very relevant to our major export markets.

What is the difference between requesting tests through Citrus Australia or testing through the National Residue Survey, since Symbio Laboratories services both?

The same chemicals are included in both screens, but Citrus Australia keeps costs down by reducing administration. Participants also have a direct line of contact to the laboratory via Citrus Australia, so we can negotiate and tailor reporting or tests.

What is the difference between testing through Citrus Australia or through FreshTest or through another market agent?

A multi-residue screen for the domestic market is typically cheaper than the Citrus Australia screen, because it includes fewer chemicals. Fruit in the domestic market is only tested for chemicals that are relevant and of interest in the Australian domestic market. Domestic market tests do not include all the chemicals needed to satisfy export markets. Export markets want a broader screen because they import fruit from a wide range of countries and want testing to include chemistry used everywhere, not just chemicals available in Australia and/or used on citrus.

Who sees our results if we send samples via the Citrus Australia program?

Results are sent to the grower or packing house who submitted the sample. Individual results are not sent to Citrus Australia. In fact, if you have an issue and need our help you will have to reach out to us because we don't know until you ask.

De-identified summary results are sent to Citrus Australia in bulk, to help with industry-wide analysis. There is no grower information in the summary. The bulk data only shows lab codes for samples, so no-one can link any data to an orchard, grower or packer.

If I have a breach are my results shared with export markets?

If the residue in a sample breaches an Australian MRL, the laboratory is obliged under Queensland law to notify the Queensland Government, who then notify officers in the state or territory where the fruit came from.

If the residue exceeds an export MRL, there is no action. Some packers worry that residues are reported to export markets. Under the Citrus Australia testing program that won't happen, because the laboratory has no detail about your destination markets. Packers are responsible for comparing their results against the MRLs of importing countries, and some packers choose to send the test result to their import agent.

How long do we wait for test results?

Under our contract with Symbio, results are sent within five working days to whoever submitted the sample.

How many patches do I need to test, or samples do I need to send?

That's entirely up to you, your packer and your agent. The program is to help your business manage MRL risks. ●

This article was written by Citrus Australia Agrichemical Manager **Alison MacGregor** as part of the Hort Innovation-funded project CT18001. Email: Alison.macgregor@citrusaustralia.com.au



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Red Scale suppression with *Aphytis melinus* wasps

Aphytis melinus is a parasitic wasp that was introduced to Victoria in 1961, when red scale was spreading rapidly and causing serious problems in citrus orchards.

For the next decade, the parasitic wasps were released throughout the southern citrus districts and significantly reduced red scale populations.

This resulted in the first commercial insectary in Australia in 1971 – Biological Services in Loxton. Since then *A. melinus* has been widely used by growers.

To maintain good populations in their orchards, many growers release extra wasps each year. The wasps control red scale naturally, and many orchards still only require occasional back-up controls with sprays.

A. melinus reproduces by laying its eggs inside nymphs and crawlers of red scale. The wasp larvae grow inside the immature scale, eventually killing the scale. One or two new parasitic wasps emerge from each parasitised red scale, to continue the process.

To improve establishment of parasitic wasp populations, and increase their effectiveness, growers should employ practices that reduce dust, raise humidity and reduce summer temperatures. For example, the use of cover crops between rows, vegetation on borders, windbreaks and irrigation is known to be effective.

Parasites also work well under netting which is becoming popular for wind and hail protection. Large populations of ants are detrimental for all beneficial insects and where ants are in high numbers, baiting is recommended.

Some of the newer chemicals available for red scale control are not directly toxic to parasitic wasps. They are also very effective against scale because of their systemic nature or residual activity.

However, these chemicals mostly control the young early stages of



Red scale on a young citrus tree.

scale development, which means they remove a significant portion of the scale population that *A. melinus* can attack.

The result of removing young scale is that wasp numbers are also reduced. To avoid wiping out the wasp population, IPM specialists recommend that growers avoid spraying whole orchards at any one time and avoid repeatedly spraying the same chemical in one season, or subsequent seasons. Preferably, avoid using systemic-type chemicals as a preventative strategy.

Only use systemic chemicals to control scale where necessary. This is appropriate for general pest control, because overuse or regular use of certain chemistry will eventually lead to chemical resistance, and then these valuable tools will be lost.

Releases of parasites should commence in spring and continue through summer and autumn. Nearly all red scale over-winter as adults, which *A. melinus* cannot parasitise. Therefore, top-up releases of parasites should occur in spring, when the next generation of scales start to appear.

Further releases should occur after toxic spray use, and after significant

periods of severe heat. Parasites are most active in autumn and releasing is still worthwhile in March/April.

However, research has shown that releases in spring and early summer lead to the highest wasp populations later in the season.

Best practice with many larger growers is to release modest amounts of parasites throughout the year into areas of low to moderate scale history, and into varieties that do not need harsh chemical treatments, on boundaries, and for replenishment after chemical use or heatwaves.

Using this strategy combined with a sensible IPM plan will help to limit scale outbreaks, reduce pesticide resistance, and maintain a healthy environment. ●

James Altmann is the Owner/Director of Biological Services in Loxton, SA.

Appendix 3 – Programs and images from spraying workshops



INVITATION



Workshop and Field Demonstration: Improving Spray Application in Orchards

International & Local Expertise:

Jason Deveau:

(OMAFRA, Ontario Canada) sprayers101.com

David Manktelow:

(Applied Research and Technologies Ltd, New Zealand)

Alison MacGregor:

(Citrus Australia)

Date: Friday 25th October, 2019

Time: 10:00 AM - 2:00 PM

Where: MJ Hall & Sons Orchard
750 Ferguson Road
Tatura East VIC 3616

RSVP: Monday 21st October, 2019
Julie Lagoni
julie.lagoni@bayer.com

Enquiries: Aedan Gorman
aedan.gorman@bayer.com
0438 331 184

Cost: Free for registered participants

Lunch will be provided

We look forward to seeing you there!





Figure 1: Alison MacGregor (Citrus Australia) and Jason Deveau (OMAFRA, Canada) speaking at a field day in Tatura, Victoria in October 2019 as part of a tour sponsored by Citrus Australia and Bayer Crop Science, to discuss new spraying technologies for orchards (Good Fruit and Vegetables, 2020).



Figure 2: Alison MacGregor with growers and consultants at field demonstrations in Mareeba and Munduberra in March 2020, discussing the importance of maintenance and set up to optimise pest and disease control.
Images Gabby Torpe



Figure 3 left : Demonstrations to assess coverage of citrus foliage after a range of speeds and delivery volumes, and with or without wetting agents. Mareeba Qld and Paringa SA. *Image G. Torpe*



Figure 4 above and below: Spraying specialists David Manktelow (ART, NZ) worked with Alison MacGregor (CA) and citrus growers to problem solve spray delivery. Sunraysia & Western Australia. *Images Good Fruit and Vegetables, and A. MacGregor*





FORUM PROGRAM

Time	Topic	Speaker
9:00 am	Welcome	Nathan Hancock, Citrus Australia, CEO
9:00 am	Spray demonstration in orchard	Alison MacGregor, Citrus Australia, Agrichemical Manager
9:40 am	NAQS update in orchard	Dave Britton, Northern Australia Quarantine Strategy, Senior Entomologist
9:55 am	What's in my orchard Part A	Ebony Faichney, DAF Qld, Development Horticulturist Emily Pattison, Total Grower Services, Agronomist
10:15 am	Orchard biosecurity practices and yellow trap procedure in orchard	Jeff Milne, Citrus Australia, National Citrus Surveillance Co-ordinator
10:30 am	BREAK - Head to shed for morning tea	
11:15 am	Citrus Australia update	Nathan Hancock, Citrus Australia, CEO
11:30 am	Freshcare FSQ4.2 standard update	Maria Miner, Citrus Australia, Market Information & Quality Officer
11:40 am	What's in my orchard Part B	Ebony Faichney, DAF Qld, Development Horticulturist Emily Pattison, Total Grower Services, Agronomist
11:50 am	Agrichemical update	Alison MacGregor, Citrus Australia, Agrichemical Manager
12:00 pm	Shed hygiene practices	John Golding, NSW DPI, Senior Research Scientist - Market access and postharvest
12:15 pm	BREAK	

1

Time	Topic	Speaker
12:25 pm	Chemical controls for FNQ pests of concern and pack-house sanitisers	Josh Gaverlock, Oro Agri, Business, Development Manager
12:40 pm	Draft import analysis for Mexican limes	Andrew Loch, DAWE, Director, Stakeholder Engagement
01:35 pm	Closing Remarks	Nathan Hancock, Citrus Australia CEO
1:10 pm	BREAK: BBQ lunch and drinks	

Thank you to our sponsors:



2



FORUM PROGRAM

Time	Topic	Speaker
9:00 am	Welcome	Nathan Hancock, Citrus Australia, CEO
9:00 am	Spray demonstration in orchard	Alison MacGregor, Citrus Australia, Agrichemical Manager
9:45 am	Orchard pests, present, emerging and exotic Biosecurity practices Yellow trap procedure in orchard	Jeff Milne, Citrus Australia, National Citrus Surveillance Co-ordinator Ebony Faichney, DAF Qld, Development Horticulturist Brian Gallagher, Citrus Monitoring Services, Director Dan Papacek, Bugs for Bugs, Entomologist and Director
10:30 am	BREAK - Head to Mundubbera Bowls Club for morning tea	
11:10 am	Citrus Australia update	Nathan Hancock, Citrus Australia, CEO
11:20 am	Citrus Australia policy and membership update	Kerry Thompson, Citrus Australia, Policy and Membership Project Officer
11:30 am	Export update	David Daniels, Citrus Australia, General Manager Market Development
11:40 am	Agrichemical update	Alison MacGregor, Citrus Australia, Agrichemical Manager
12:00 pm	NAQS update - Dial in	Dave Britton, Northern Australia Quarantine Strategy, Senior Entomologist
12:15 pm	BREAK	

1

Time	Topic	Speaker
12:25 pm	Shed hygiene practices	John Golding, NSW DPI, Senior Research Scientist - Market access and postharvest
12:40 pm	E.E. Muir & Sons what's new and packing shed agrichemical update	Craig Woolbridge, E.E. Muir & Sons, Postharvest consultant
12:55 pm	Update on Paradise Dam Class Action	Michael McMahon
1:10 pm	Closing remarks	Nathan Hancock, Citrus Australia, CEO
1:10 pm	End	

Thank you to our sponsors:



2

Figure 5 Programs for field days prior to regional forums in March 2021, Mareeba and Mundubbera, Qld

Appendix 4 – Social media

Three short videos were produced in collaboration with the communications project team (CT18000) to extend messages about baiting for Queensland fruit fly. Statistics from Facebook insights are summarized below.

Post Link	https://www.facebook.com/CitrusAustralia/videos/1122389431500434/				
Caption	Queensland fruit fly are active now that warmer weather has arrived. Take action NOW to avoid crop losses later Growers like Minter Magic show us how easy it is to protect your orchard with a simple spray rig. #showusyourrig Find more resources on our website at: https://citrusaustralia.com.au/fruit-fly/fruitfly				
Featured grower	Release date	Length	reach	engagement	Link clicks
Darren Minter	16 September 2021	2:12 minutes	6207	197	664

Post Link	https://www.facebook.com/CitrusAustralia/videos/2937840926470940/				
Caption	Take action NOW on Queensland fruit fly to avoid crop losses later. Warmer weather means this destructive pest is active in eastern Australia. See how Justin Kassulke fights fruit fly with a spray rig made out of "components we had lying around the shed". #showusyourrig Find more resources and videos on our website at: https://citrusaustralia.com.au/fruit-fly/fruitfly				
Featured grower	Release date	Length	reach	engagement	Link clicks
Justin Kassulke	20 September 2021	2:12 minutes	1280	59	245

Post Link	https://www.facebook.com/CitrusAustralia/videos/473025140356355/				
Caption	Caption: Queensland Fruit Fly become active with the arrival of warmer weather. Take action NOW to avoid crop losses later. Bridget might not be a trained biosecurity sniffer dog but she's doing what she can to control fruit fly on her orchard. "We bait every fortnight to make sure we keep within their cycles so when the females come out it goes to the bait rather than to the fruit." Find more resources and advice here on controlling fruit fly on your farm: https://citrusaustralia.com.au/fruit-fly/fruitfly				
Featured grower	Release date	Length	reach	engagement	Link clicks
Graham Lohmeyer (& Bridget)	27 September 2021	1:43 minutes	898	48	138

Appendix 5 – New resources posted to the Citrus Australia website

The Citrus Australia website offers links to a range of resources, to assist producers and service providers to use chemicals more strategically and responsibly.

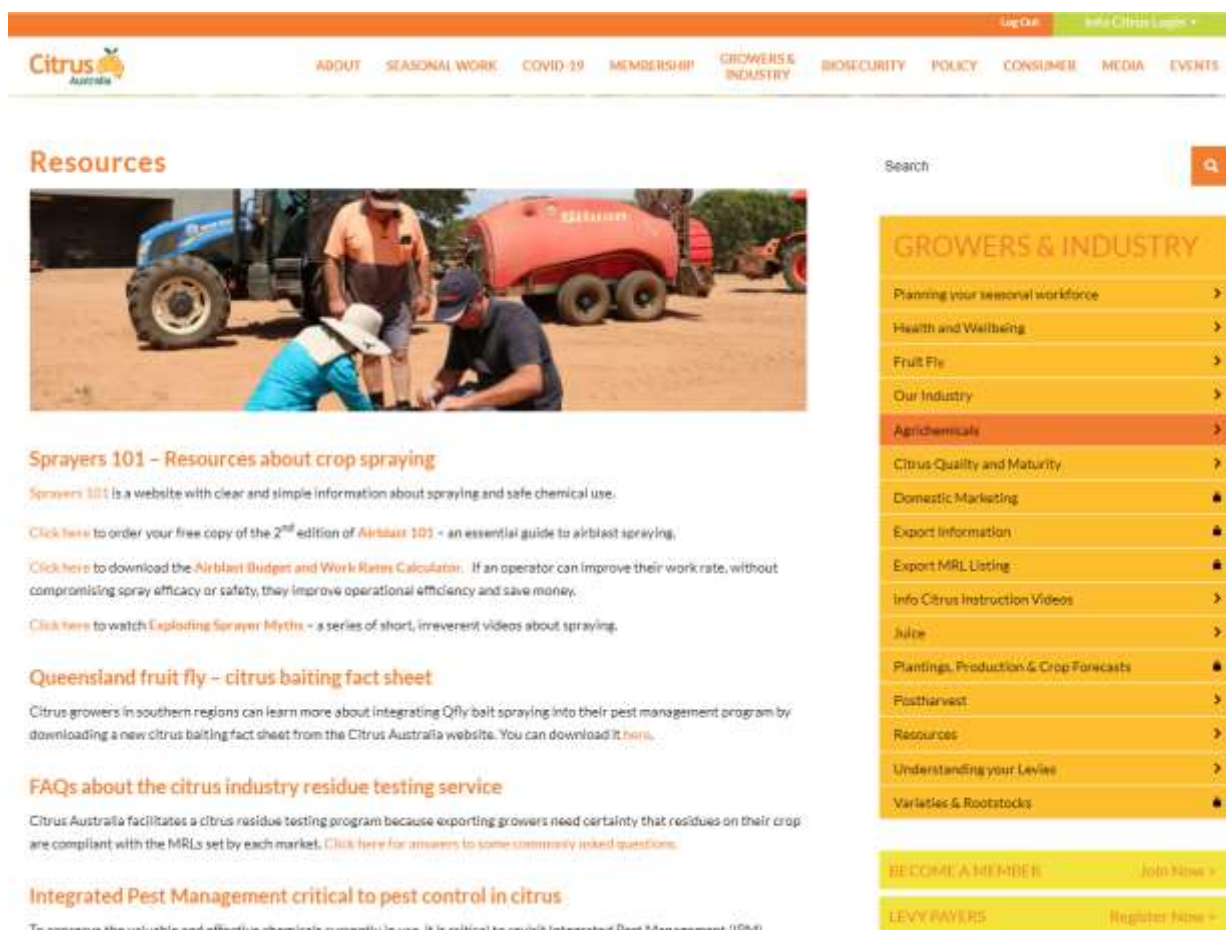


Figure 6: image of the Citrus Australia web page with links to resources for improving chemical use

Table 5: Reader statistics from Mail Chimp regarding Agrichemical Updates sent by Citrus Australia

Send Date	Deliveries	Open Rate	Total Opens	Unsubscribes
29/1/2020	762	49%	1045	2
20/2/2020	800	50%	1307	2
28/2/2020	799	48%	1193	2
19/3/2020	819	48%	1337	0
29/5/2020	810	49%	1198	1
17/11/2020	809	46%	1178	2
01/4/2021	803	44%	1004	0
22/11/2021	789	52%	977	5
23/11/2021	786	46%	883	1
Average	797	48%	1125	2

Appendix 6 – Communications – analysis of emails and enquiries

The Agrichemicals Manager fielded, on average, 1.6 enquires per day, or five enquiries or contacts regarding new topics/issues per week, based on 233 emails received during 2021 that related specifically to the agrichemical role.

Table 6: Sources of enquiries to the Agrichemicals Manager in 2021

Sources of contact	
Packers or growers	58
Chemical industry	45
State or Federal government	35
Agronomists/Consultants	34
Citrus Australia staff	18
Tertiary education (TAFE or Uni)	11
Companies with AI/robotics/sensors	9
Other Peak Industry Bodies	7
Scientists (Govt or Uni)	6
Laboratories	5
Spray equipment dealers	3
Greater Sunraysia Pest Free Area	1
Journalist	1
Total	233

Table 7: Nature of enquires made to the to the Agrichemicals Manager in 2021

Categories of enquiries	
MRLs	42
residue survey	29
new technology	22
diseases or pests/IPM/Qfly	22
New chemistry in the pipeline	20
Export Harvest Intervals	18
Spraying resources	18
Policy changes	11
New chemistry recently available	8
Stewardship	7
Biosecurity	6
Crop damage due to chemical	6
Extension	5
Chemical trials	5
Residue detected by market or lab	4
Trade situations/decision	4
Other	3
Chemical resources for auditors	2
Minor use process	1
Total	233

Appendix 7 – Citrus Export MRLs, updated January 2022

Citrus Export MRLs

January 2022



CITRUS MAXIMUM RESIDUE LIMITS

For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022

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Fungicides applied to orchards.....	9
Post-harvest fungicides	10
Herbicides	11
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Page 2 of 16

CITRUS MAXIMUM RESIDUE LIMITS

For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022

How to use the MRL Guide

1. Information in this document is provided to help industry comply with maximum residue limits (MRLs) in export markets.
2. The MRLs listed in this document have been developed using currently available information obtained from domestic and international regulatory authorities.
3. The MRL tables in this document relate to thirteen importing countries, plus European and Codex MRLs. If the country you are exporting to does not appear on this list, please contact Citrus Australia, as we may have some additional data.
4. Citrus Australia cannot guarantee the accuracy of the information, because MRL standards are subject to continual change. It is also possible that inadvertent transcription errors may have occurred.
5. We strongly recommend that this information be used in conjunction with residue monitoring, to avoid breaches of MRLs.
6. Examples of trade names does not signify product endorsement.
7. Yellow over text highlights most recent changes to MRLs.
8. MRLs followed with superscript T (for example 0.5^T) are temporary MRLs.
9. When the MRL is followed by a letter in parentheses (G, L, M or O), the MRL refers specifically to Grapefruit, or Lemons/Limes or Mandarins or Oranges. If the MRL for limes differs from the MRL for lemons, the lime MRL is indicated.
10. Where an MRL has not been set, the table shows a hyphen (-). In these cases, residues must not be detectable, unless a default or other commodities MRL exists or if Codex MRLs are recognized.
11. Where Codex MRLs are accepted by a country in event that they have not set an MRL, the hyphen is accompanied by superscript cdx (- ^{cdx}).
12. * Signifies that residues must be below the limit of quantification. This has typically been <0.01 mg/kg, but can be lower, eg <0.005 mg/kg.
13. Where more information is provided relating to a particular MRL, roman numerals next to the MRL identify a footnote in the section on page 15.
14. Note that farmers are required to maintain accurate and detailed records of all farm chemicals applied, according to State legislation.

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CITRUS MAXIMUM RESIDUE LIMITS

For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022

How to use the MRL Guide (continued):

Destination Country	What to do in absence of an MRL in that market		Comment
	Do I defer to a Codex MRL?	What if Codex also has no set MRL?	
Australia	× No. Only use the Australian citrus MRL		The registration status of the chemicals listed may vary for each commodity and in each State. Prior to using any chemical, consult the label and/or regulatory authority in your State
Canada	× No. Default to 0.1 mg/kg	Default to 0.1 mg/kg	In the absence of a set MRL, Canada defaults to MRL of 0.1 mg/kg for imports.
China	× No. While China may accept Codex they do not officially defer to any other system	Zero tolerance	MRLs are based on an unofficial translation of the Chinese MRLs (USDA, CH2021-0099, August 2021) and subsequent WTO SPS Notifications (most recently September 2021). The timeframes are uncertain for adoption of proposed MRL changes, so guidance should be sought from importers as to their status.
Codex		Zero tolerance	MRLs updated November 2021
EU	× EU only accept Codex under particular circumstances.	MRL defaults to 0.01 mg/kg	EU has recently been resisting MRLs proposed by Codex. For this reason, citrus producers are advised that residues should be below the limit of detection if the EU has not set an MRL
Hong Kong	× No. Hong Kong don't defer to Codex.	Zero tolerance unless exception is made after review	The Pesticide Residues in Food Regulation (Cap. 132CM) came into operation on 1 August 2014.
Indonesia	× No. Indonesia don't defer to Codex		As per Regulation No. 55/Permentan/KR.040/11/2016 -Food Safety Surveillance for Entry of Fresh Food of Plant Origin.
Japan	× No. MRL defaults to 0.01 mg/kg	MRL defaults to 0.01 mg/kg	Japan operates under a Positive List System. In the absence of a domestic MRL, the default level of 0.01 mg/kg applies.
Korea	× No.	MRL defaults to 0.01 mg/kg	Korea has a Positive List System: for chemicals not registered for use in Korea, residues must be below 0.01 mg/kg unless an import tolerance has been established. In 2021 all temporary (*) MRLs are being progressively revoked unless an import tolerance has been established.
Malaysia	✓ Yes, apply Codex MRL	MRL defaults to 0.01 mg/kg	In the absence of a set domestic MRL, Codex MRLs apply. In the absence of either Malaysian or Codex MRL a maximum residue limit of 0.01 mg/kg applies [Subs. P.U.(A) 160/2004.].
New Zealand	✓ Yes, apply Codex MRL or the Australian MRL	Use the Australian MRL	Compliance with Australian Food Standards Code recognised by NZ due to Trans-Tasman Mutual Recognition Arrangement for Australian exports.
Philippines	✓ Yes, apply Codex MRL	Australian MRL may apply (subject to evaluation)	In absence of a listed MRL, Codex MRLs shall apply. In absence of Codex MRL, the Australian MRL may apply subject to evaluation of competent authority.
Singapore	✓ Yes, apply Codex MRL		In the absence of a nationally set MRL, default to the Codex level (MRLs as per S493/2013 wef 01/08/2013). Updated November 2021.
Taiwan	× No. Residues must be undetectable. Zero tolerance	Zero tolerance	TAIWAN: Pesticides not listed, except for those import tolerances developed, shall not be detected (MRLs as per Food No. 1101301706 Amended, August 18, 2021).
Thailand	✓ Yes, apply Codex MRL	MRL defaults to 0.01 mg/kg	In the absence of a Thai standard, Codex MRLs apply unless the chemical is listed in Annex 1 (banned chemicals). Residues of banned chemicals (listed in Annex 1) must be below 0.01 mg/kg.
USA	× Yes & No. Conditions apply.	Zero tolerance	The US will only accept a Codex MRL if an import tolerance has also been established.

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CITRUS MAXIMUM RESIDUE LIMITS																
For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022																
Insecticides & miticides		Australia & NZ	Codex	Canada	China	EU	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	USA
Insecticides / Miticides / Nematicides																
abamectin (Vertimec) ⁱ	MRL	0.02	0.02	0.02 (GLO)	0.01 (GL) 0.02 (M)	0.04	0.01	0.01	0.1	0.02 (GLM), 0.05 (O), 0.01 (lime)	0.02 ⁱⁱ	0.01	- cadx	0.01	0.01	0.02
	WHP	7 days	7 days	7 days		7 days				7 days	7 days		7 days			7 days
acetamiprid (Trivior)	MRL	1	1	0.5	2 (G) 0.5 (OML ⁱⁱⁱ)	0.9	0.5	1	2	0.5	1	- cadx	- cadx	0.5	- cadx	1
	WHP	14 days	14 days					14 days	14 days		14 days	14 days	14 days		14 days	14 days
amitraz	MRL	*0.01	-	-	0.5	*0.05	0.5	-	0.5 (GL), 0.9 (O)	-	-	0.5	-	0.2	-	-
	WHP	Only use on non-bearing trees														
bifenthrin (Talstar) ^{iv}	MRL	*0.05	*0.05	-	0.05 (LMO)	0.05	0.05	0.05	2	0.5	- cadx	- cadx	0.05 (O)	0.5	0.05	0.05
	WHP	Withholding period not required when used according to label directions														
buprofezin (Applaud)	MRL	2	1	4 (OM)	0.5 (MLO)	*0.01	1	1	2 (O) 3 (GLM)	0.5 (GM) 2.5 (LO)	- cadx	0.5 (O)	- cadx	0.5	- cadx	4*
	WHP	28 days		28 days					28 days							28 days
cadusafos (Rugby)	MRL	*0.01	-	-	0.005	*0.01	0.005 (M)	-	0.01	0.01	-	-	-	*0.01	0.01	-
	WHP	Withholding period not required when used according to label directions														
carbaryl (Bugmaster)	MRL	3 (LO)	15	10	-	*0.01	15	15	5 (OG) 15 (other)	7 (O) 0.5 (GL)	- cadx	7	7	1	7	10
	WHP	3 days	3 days	3 days			3 days	3 days	3 days		3 days	3 days	3 days		3 days	3 days
chlorpyrifos (Lorsban)	MRL	0.05 ^{vi}	1	1	1 (M) 2 (OL)	0.01 ^{vii}	2	1	1	0.01 ^{viii}	- cadx	1	0.3	1	*0.01 ^{ix}	0.01 ^x
	WHP	14 days	14 days	14 days	14 days	avoid	14 days	14 days	14 days	avoid	14 days	14 days	14 days	14 days	avoid	avoid
clofentezine (Apollo) ^{xi}	MRL	0.02	0.5	<LOQ	0.5 (MLO)	0.5	0.5	0.5	0.5	0.5 [†]	- cadx	- cadx	- cadx	2	- cadx	-
	WHP	Withholding period not required when used according to label directions														

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CITRUS MAXIMUM RESIDUE LIMITS																
For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022																
Insecticides & Miticides (cont)		Australia & NZ	Codex	Canada	China	EU	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	USA
Insecticides / Miticides / Nematicides (continued)																
clothianidin (Samurai)	MRL	0.5	0.07	0.1	0.07 ^{xii}	0.06	0.07	0.07	2	1 (MG) ⁱ 0.3 ^{xiii} (LO)	- cdv	- cdv	- cdv	1	- cdv	0.07
	WHP	140 days							140 days							
cyantraniliprole (Exirel)	MRL	0.7	0.7	0.7	0.7 ^{xiv}	0.9	-	-	0.7	0.7 ^T (M)	- cdv	- cdv	- cdv	*0.01	- cdv	0.7
	WHP	Nil	Nil	Nil		Nil			Nil	Nil						Nil
dimethoate (Saboteur) ^{xv}	MRL	5	0.01 ^{xvi}	1.5	0.01 ^{xvii}	*0.01	5	5	2 (1 ^{xviii})	-	- cdv	2	2	0.02 ^{xix}	0.01 ^{xx}	2
	WHP	7 days	avoid		avoid	avoid	7 days	7 days		avoid	avoid			avoid	avoid	
etoxazole (Paramite)	MRL	0.5	0.1	-	0.5 (M)	0.1	0.1	0.1	0.7	1 (LTM)	- cdv	- cdv	- cdv	0.7	- cdv	0.1 (MO)
	WHP	7 days			7 days				7 days					7 days		
fenbutatin oxide (Torque)	MRL	5	5	2	1 (M) 5 (LO)	*0.01	5	5	5	-	- cdv	- cdv	5	2	- cdv	20
	WHP	7 days	7 days				7 days	7 days	7 days				7 days			7 days
imidacloprid (Trespass)	MRL	2	1	1	1 (M) ^{xii}	0.9 ^{xi}	2	1	0.7	0.7 ^T	- cdv	1	- cdv	1	1 (M)	0.7 (MO)
	WHP	140 days					140 days									
maldison (Fyfanon)	MRL	4	7	-	2 (M) 4 (LO)	2	7	7	7	0.5 ^T (GL), 4 (O)	- cdv	4	4	2	7 (MLO) 0.2 (G)	8
	WHP	3 days	3 days				3 days	3 days	3 days			3 days	3 days			3 days
mancozeb (Dithane)	MRL	7 ^{T xii}	10 (M) 2 (O)	-	3 (M) 2 (O) ^{xii}	5	4 (GLO) 10 (M)	2 (O) 10 (M)	2	2 ^T (O) 3 (L) 5 (G ^T M)	- cdv	2 (O)	- cdv	2	2	10 (M) ^{xiii}
	WHP	N/A					Exporters should test for dithiocarbamates to ensure that MRLs are met									
metaldehyde (Slugger)	MRL	1	-	-	-	*0.05	0.26	-	0.7	0.05 ^T (GLO)	-	-	-	-	0.01	0.26
	WHP	7 days														

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CITRUS MAXIMUM RESIDUE LIMITS																
For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022																
Insecticides & Miticides (cont)		Australia & NZ	Codex	Canada	China	EU	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	USA
Insecticides / Miticides / Nematicides (continued)																
methiocarb (Mesurol)	MRL	0.1	-	-	-	0.03 ^{xxiv}	-	-	0.05	0.05 ^T	-	-	0.05	*0.01	0.01	-
	WHP	7 days														
methomyl (Nudrin)	MRL	1	1	1	0.05 ^{xxv}	*0.01	1	1	10	-	- cdx	1	2	1	- cdx	2
	WHP	2 days	2 days	2 days			2 days	2 days	2 days		2 days	2 days	2 days	2 days	2 days	2 days
methoxyfenozide (Prodigy)	MRL	1 ^{xxvi}	2	10	2 ^{xii}	2	1	2	3	3 (LO) 1 (M)	- cdx	- cdx	- cdx	2	- cdx	3 (OMGL) 2 (lime)
	WHP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
permethrin ^{xxvii} (Zeeper)	MRL	*0.05	0.5	-	2	*0.05	2	0.5	5	-	- cdx	0.5	0.5	2	- cdx	-
	WHP	No WHP because the treatment is only applied to non-bearing trees														
piperonyl butoxide	MRL	8	5		-		5		5	0.2 ^T (GLO)	- cdx	- cdx	- cdx	5	- cdx	8
	WHP	1 day														
pirimicarb (Pirimor)	MRL	0.5	3	-	3	3	3	3	0.5 (O), 0.05 (GLM)	-	- cdx	- cdx	0.5 (O), 0.05 (GLM)	0.5 ^{xxviii}	- cdx	-
	WHP	2 days	2 days		2 days	2 days	2 days	2 days			2 days	2 days		2 days	2 days	2 days
propineb (Antracol)	MRL	7 ⁱ	10 (M) 2 (O)	-	2 (O) ^{xxix}	*0.05	4 (GLO) 10 (M)	2 (O) 10 (M)	2	2 ⁱ (O) 3 (L) 5 (GM)	- cdx	2 (O)	- cdx	2	2	-
	WHP	Exporters should test for dithiocarbamates to ensure that MRLs are met														
pyrethrins	MRL	1	0.05	1 (O)	(0.05 ^{xi})	1	0.05	0.05	1	1	- cdx	- cdx	1	0.05	- cdx	-
	WHP	Nil		Nil		Nil			Nil	Nil			Nil			

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CITRUS MAXIMUM RESIDUE LIMITS																
For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022																
Insecticides & Miticides (cont)		Australia & NZ	Codex	Canada	China	EU	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	USA
Insecticides / Miticides / Nematicides (continued)																
pyriproxyfen (Admiral)	MRL	0.5	0.5	0.5	0.5	0.6	0.5	0.5	2	0.7 (M) 0.7 ^T (GLO)	- cadx	- cadx	- cadx	0.3 (GL) 0.5 (MO)	- cadx	0.5
	WHP	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days	7 days		7 days	7 days
spinetoram (Success Neo)	MRL	0.2 ^{xxx}	0.15 (M) 0.07 (O)	0.3	0.15 ^{xxxi}	0.2	0.07 (O)	0.07 (O)	0.7	0.5 (M) 0.05 ^T (GLO)	- cadx	- cadx	0.15 (M) 0.07 (O)	0.2	- cadx	0.3
	WHP	1 day		1 day		1 day			1 day					1 day		1 day
spinosad (Success)	MRL	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3 ^T	0.3	- cadx	- cadx	0.3	- cadx	0.3
	WHP	Withholding period not required when used according to label directions														
spirotetramat (Movento)	MRL	1	0.5	0.6	1 (M) 0.5 (GLO)	0.5 ^{xxxi}	1	0.5	3	0.5 ^T (GMO), 2 (L)	- cadx	- cadx	- cadx	0.5	- cadx	0.6
	WHP	21 days					21 days		21 days							
sulfoxaflor (Transform)	MRL	0.7	0.4 (L) 0.8 (MO) 0.15 (G)	0.7	2 ^T (M), 0.4 ^T (L) 0.15 ^T (G)	0.15 (G) 0.4 (L) 0.8 (MO) 0.01 (Lime)	-	-	2	1 (M) 0.7 ^T (O) 0.6 ^T (L) 0.3 ^T (G)	- cadx	- cadx	- cadx	0.7	- cadx	0.7
	WHP	1 day		1 day					1 day					1 day		1 day
sulfur	MRL	Exempt	-	-	-	50	-	-	-	-	Exempt	-	-	Exempt	-	Exempt
	WHP	Withholding period not required when used according to label directions														
tebufenozide (Mimic)	MRL	1	2	-	2	2	2	2	2	1 (M) 1 ^T (GLO)	- cadx	- cadx	- cadx	1.5	- cadx	2
	WHP	1 day	1 day		1 day	1 day	1 day	1 day	1 day	1 day	1 day	1 day	1 day	1 day	1 day	1 day
thiamethoxam (Actara)	MRL	1	0.5	0.4	0.5 (GLO) ^{xii}	0.15	0.5	0.5	1	0.3	0.5	0.5 (O)	-	1 (OM) 0.4 (G) 0.5 (L)	- cadx	0.4
	WHP	49 days							49 days				154 days			

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CITRUS MAXIMUM RESIDUE LIMITS																
For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022																
Fungicides applied to orchards		Australia & NZ	Codex	Canada	China	EU	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	USA
Fungicides applied to orchards																
azoxystrobin (Amistar)	MRL	3 ^{xxxiii}	15	15 (GLO)	1 (M)	15	15	15	10	9 (M), 10 (GLO)	- cdx	- cdx	- cdx	10	- cdx	15
	WHP	N/A	N/A	N/A	Withholding period not required when used according to label directions											
captan (PER82043)	MRL	3 ^T (M), 0.1 (OLG)	-	0.1	5(M)	*0.03	-	-	*0.01	0.5 (M)	-	-	15	*0.01	0.01	-
	WHP	28 days		28 days	28 days					28 days			28 days			
copper	MRL	10	-	50	-	20	-	-	Exempt	-	Exempt	-	30	Exempt	-	Exempt
	WHP	1		1		1			1		1		1	1		1
iprodione (PER14772) ^{xxxiv}	MRL	5 ^T (M), 0.1 (OGL)	-	0.07	-	*0.01	5 (M)	-	10	^{xxxv}	-	-	-	*0.01 ^{xxxvi}	0.01	-
	WHP	56 days					56 days		56 days							
mancozeb (Dithane)	MRL	7 ^T ^{xxii}	10 (M), 2 (O)	-	3 (M), 2 (O) ^{xii}	5	4 (GLO), 10 (M)	2 (O), 10 (M)	2	2 ^T (O), 3 (L), 5 (G ^T M)	- cdx	2 (O)	- cdx	2	2	10 (M) ^{xxxvii}
	WHP	Exporters should test for dithiocarbamates to ensure that MRLs are met														
phosphorous acid ^{xxxviii}	MRL	100	50 (M), 20 (O) ^{xxxix}	-	-	75 ^{xxxix}	-	-	150 ^{xxxix}	- ^{xi}	5 ^{xii}	- cdx	- cdx	10 ^{xxxix}	- cdx	Exempt
	WHP	N/A														
propineb (Antracol)	MRL	7 ^T ^{xxii}	10 (M), 2 (O)	-	2 (O) ^{xiii}	*0.05	4 (GLO), 10 (M)	2 (O), 10 (M)	2	2 ^T (O), 3 (L), 5 (G ^T M)	- cdx	2 (O)	- cdx	2	2	-
	WHP	Exporters should test for dithiocarbamates to ensure that MRLs are met														
sulfur	MRL	Exempt	-	-	-	50	-	-	-	-	Exempt	-	-	Exempt	-	Exempt
	WHP															
zineb	MRL	7 ^T ^{xxii}	10 (M), 2 (O)	-	3(M), 2(O)	5	4 (GLO), 10 (M)	2 (O), 10 (M)	2	2 ^T (O), 3(L), 5(G ^T M)	- cdx	2(O)	- cdx	Prohibited	2	-
	WHP	Exporters should test for dithiocarbamates to ensure that MRLs are met														

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For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022																
Fungicides applied post-harvest		Australia & NZ	Codex	Canada	China	EU	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	USA
Post-harvest fungicides																
<i>Withholding periods do not apply to post-harvest treatments</i>																
2-phenylphenol (Preventol)	MRL	10	10	xiii	10	10	12	10	10	-	- cdx	- cdx	- cdx	10	- cdx	10
fludioxonil (Scholar)	MRL	10	10	10	10	10	10	10	10	10 ^T	- cdx	- cdx	- cdx	7, 5(G)	- cdx	10
guazatine (Panocrine)	MRL	5	5	-	3 ^T (M)	*0.05	-	5	-	-	- cdx	- cdx	- cdx	5	- cdx	-
imazalil (Fungaflor)	MRL	10	8 (O) 15 (LL) 5 (MG)	5	0.5 (G) 5 (MO)	5	10	5	5	15 ^{div}	- cdx	- cdx	5	5	- cdx	10 (MO)
propiconazole (Chairman)	MRL	7	10 (LLMO) 4 (G)	8	-	0.01 ^{xiv}	-	-	8	8	- cdx	- cdx	9 (O)	4	- cdx	8
pyrimethanil (Philabuster)	MRL	10 ^{xvi}	7	10	7	8	10	7	10	1 (M) 7 (GLO)	- cdx	- cdx	7 (O)	7	- cdx	10
thiabendazole (Tecto)	MRL	10	7	10	10	7	10	7	10	7 (GLO) 10 (M)	- cdx	- cdx	10	10	- cdx	10

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CITRUS MAXIMUM RESIDUE LIMITS																
For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022																
Herbicides		Australia & NZ	Codex	Canada	China	EU	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	USA
Herbicides																
2,2-DPA (Atlapon)	MRL	*0.1	-	-	-	*0.01	-	-	0.01	0.01	-	-	-	*0.01	0.01	-
	WHP	7 days														
amitrole (Amitrole T)	MRL	*0.01	-	-	-	*0.01 (GLO)	-	-	*0.01	0.01	-	-	-	*0.01	*0.01 ^{xvii}	-
	WHP	56 days				56 days			56 days	56 days				56 days	56 days	
bromacil (Hyvar)	MRL	*0.04	-	-	0.1 ^{xviii}	-	0.1	-	0.1	-	-	-	0.04	0.5	0.01	0.1
	WHP	Withholding period not required when used according to label directions							avoid							
carfentrazone (Hammer)	MRL	*0.05	-	-	-	0.02 ^{xix}	0.1	-	0.1	0.1 ⁱ (GLO)	-	-	-	0.1	0.01	0.1
	WHP	N/A					N/A		N/A	N/A				N/A		N/A
dichlobenil (Casoron G)	MRL	0.1	-	-	-	*0.01 ⁱ	-	-	0.01	0.15 [†]	-	-	-	*0.01	0.01	-
	WHP	N/A								N/A						
diquat (Reglone)	MRL	*0.05	*0.02	-	-	*0.02	-	-	0.03 (OM) 0.04 (GL)	0.02 [†] (GLO)	- adv	- adv	-	*0.01	0.01	0.05
	WHP	N/A														N/A
fluzifop-butyl (Fusilade)	MRL	*0.02	*0.01	0.03	0.01 ⁱⁱ	*0.01	-	-	0.05	0.05 (GLO)	- adv	- adv	-	*0.01	0.01	0.03
	WHP	N/A														
flumioxazin (Chateau)	MRL	*0.05	-	-	-	*0.02	-	-	0.1	0.1 (L [†] M)	-	-	-	*0.01	0.01	0.02
	WHP	98 days							98 days	98 days						
glufosinate (Basta)	MRL	0.1	0.05	0.1	- ⁱⁱⁱ	0.05	0.1	0.05	0.2	0.05 (GLO) 0.1 (M)	0.05	- adv	-	0.1	- adv	0.15
	WHP	N/A		N/A			N/A		N/A					N/A		N/A
glyphosate (Roundup)	MRL	0.5	-	-	0.1 (GLO) 0.5 (M)	*0.05 ⁱⁱⁱ	0.5	-	0.5	0.05 ^{iv}	0.2	-	-	0.1	*0.01	0.5
	WHP	N/A					N/A		N/A							N/A

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CITRUS MAXIMUM RESIDUE LIMITS																
For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022																
Herbicides		Australia & NZ	Codex	Canada	China	EU	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	USA
Herbicides (continued)																
haloxyfop (Exert 520)	MRL	*0.05	*0.02	-	-	*0.01	0.02	0.02	0.05	0.01	- cdx	- cdx	-	0.1	0.01	-
	WHP	N/A							N/A					N/A		
isoxaben (Gallery)	MRL	*0.01	-	-	-	*0.02	-	-	0.01	0.01	-	-	-	*0.01	0.01	-
	WHP															
WHP not required when used as directed																
norflurazon (Zoliar)	MRL	0.2	-	-	-	*0.01	0.2	-	0.2	0.1 ^T (GLO)	-	-	-	0.2	0.01	0.2
	WHP	N/A					N/A		avoid					N/A		N/A
Oryzalin (Surflan)	MRL	0.1	-	-	-	*0.01	0.05	-	0.08	0.05 ^T (GLO)	-	-	-	*0.01	0.01	0.05
	WHP	N/A														
paraquat (Gramoxone)	MRL	*0.05	0.02	-	0.02 (GLO) 0.2(M)	*0.02	0.02 (GLO) 0.2(M)	0.02	0.05	0.05 ^T (GLO)	- cdx	0.02	0.05	0.2	*0.01 ^{iv}	0.05
	WHP	N/A							N/A	N/A			N/A	N/A	avoid	N/A
pendimethalin (Stomp)	MRL	*0.05	0.03	-	0.03 ^{iv}	*0.05	-	0.01	0.05	0.05 ^T	- cdx	- cdx	-	*0.01	- cdx	0.1
	WHP	N/A				N/A			avoid	N/A						N/A
saflufenacil (Sharpen)	MRL	*0.03	*0.01	0.03	0.05 (O) ^{vi} 0.01 (M) ^{xii}	*0.03	-	0.01	0.03	0.03 ^T	- cdx	- cdx	-	0.03	0.01	0.03
	WHP	N/A		N/A		N/A			N/A	N/A				N/A		N/A
simazine (Gesatop)	MRL	0.25	-	-	-	0.01	0.25 (N/A GO)	-	0.1 (M) 0.2 (GOL)	0.25 ^T (GLO)	-	-	-	*0.01	0.01	0.25 (GOL)
	WHP	N/A							avoid	N/A						N/A
trifluralin (Treflan)	MRL	*0.05	-	-	-	0.01	0.05	-	0.05	0.05 ^T	-	-	-	0.05	0.01	0.05
	WHP	N/A					N/A		avoid	N/A				N/A		N/A

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Chemical - Plant Growth Regulators		Australia & NZ	Codex	Canada	China	EU	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand	USA
Plant Growth Regulators																
2,4 – D (Stop Drop)	MRL	5	1	2	0.05 ⁱⁱⁱ	1	1	1	2	0.15 1 (L)	- cod	1	2	2	- cod	3
	WHP															
dichlorprop-P (Corasil)	MRL	0.2	-	-	-	0.3	-	-	0.2	0.05 ^T (MO)	-	-	-	*0.01	0.01	-
	WHP															
ethephon (Ethrel)	MRL	2 (MO) 0.01 (GL)	-	0.1 ^{ix}	-	*0.05	-	-	2	2 ^T (L), 0.5 ^T (M)	-	-	-	*0.01	0.01	-
	WHP															
gibberellins (GA4/GA7)	MRL	Exempt	-	-	-	Exempt	-	-	0.2	-	-	-	-	*0.01	-	Exempt
	WHP															
triclopyr (Tops Plant Growth Regulator)	MRL	0.2	-	-	-	0.1 (MO) *0.01 (lime)	-	-	0.1	0.1 (M)	-	-	-	*0.01	0.01	-
	WHP															

Active ingredients removed from the Export MRL tables in 2021

Category	Active ingredient	Example trade name	Reason for removal from the Citrus Export MRL tables
Herbicide	oxyfluorfen	Goal	Label refers to other tree crops but not citrus
Insecticide	diazinon	-	The active is still approved but there are no available products. Do not use on citrus.
	cyhalothrin (lambda/gamma)	Unocaps Lambda cyhalothrin 250	Not registered for use in citrus.
	methidathion	-	The active is still approved but there are no available products. Do not use on citrus.
Miticide	dicofol	Kelthane	Removed – no longer registered

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CITRUS MAXIMUM RESIDUE LIMITS

For agricultural chemicals registered for use on Australian oranges, grapefruit, mandarins and lemons, for domestic and export markets. Updated 27 January 2022

Information sources and date of most recent updates

AUSTRALIA:	Agricultural and Veterinary Chemicals Code (MRL Standard) Instrument 2019 – Compilation No 21. Version F2021C01017 updated October 2021. https://www.legislation.gov.au/Details/F2021C01017 . Also refers to the Food Standard Schedule 20 of the FSANZ Food Standard Code Authorized Version F2021C01025 registered 18 Oct 2021. https://www.legislation.gov.au/Details/F2021C01025
CANADA:	http://pr-rp.hc-sc.gc.ca/mrl-lrm/index-eng.php 07-2020.
CHINA:	ICS 65.100 G25; GB 2763—2019, GB 2763—2016, GB 2763.1—2018 National food safety standard—Maximum residue limits for pesticides in food 2019-08-15 (2020—02—15 实施) 03-2020. ALSO Gain report CH2020-0099, August 2021. Updated June 2021.
CODEX:	http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/pesticides/en/ Updated November 2021.
EU:	https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=pesticide.residue.selection&language=EN June 2021.
HONG KONG:	https://www.cfs.gov.hk/english/mrl/mrl_select_pesticide.php October 2021.
INDONESIA:	Regulation of the Minister of Agriculture of The Republic of Indonesia; Number 55/permentan/kr.040/11/2016 Regarding food safety control on the importation of fresh food of plant origin (Permentan Nomor 55 Tahun 2016 Tentang Pengawasan Keamanan Pangan Terhadap Pemasukan Pangan Segar Asar Tumbuhan). 09-2019
JAPAN:	http://db.ffcr.or.jp/front/ Updated November 2021.
KOREA:	농산물의 농약 잔류허용기준 (Pesticide MRLs in Agricultural Commodities) https://www.foodsafetykorea.go.kr/foodcode/02_01.jsp Aug 2021
MALAYSIA:	http://fsq.moh.gov.my/v6/xs/page.php?id=72 September 2020
NEW ZEALAND:	Australia New Zealand Food Standards Code – Schedule 20 – Maximum residue limits. Version F2021C01025. 18 Oct 2021. https://www.legislation.gov.au/Details/F2021C01025 .
PHILIPPINES:	Philippines National Standards PNS/BAFS 292:2020 ICS 65.100.01 http://www.bafs.da.gov.ph/pesticides_commodities Updated Oct 2021.
SINGAPORE:	https://www.sfa.gov.sg/docs/default-source/default-document-library/food-regulations1.pdf . Updated Nov 2021.
TAIWAN:	Standards for Pesticide Residue Limits in Foods, 2020-05-20, Ministry of Health and Welfare 衛生福利部: Appendix tables 1-5. Updated Sept 2021.
THAILAND:	A) Thai Agricultural Standard: TAS 9002-2016. Pesticide Residues: Maximum Residue Limits. ICS 67.040. www.acfs.go.th Referred to February 2020. B) Unofficial Translation - Ministry of Public Health Notification No. 387 B.E. 2560 (2017) Re: Food Containing Pesticide Residues (Pesticide Residues in Food). 08-2020.
USA	Pesticide MRLs published by Bryant Christie https://bcglobal.bryantchristie.com/db#login , Updated November 2021.

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Footnotes to the MRL tables

- i Permit PER14932 allows abamectin bait spraying for Qld Fruit fly – expires 31st January 2023
- ii Gazetted in Peraturan-Peraturan Makanan (Pindaan) (No 3) 2020 — Food (Amendment) (No 3) Regulations 2020. 21 July 2020 [Subs PU(A)208/2020]
- iii China proposed a change to lemon MRL in G/SPS/CHN/1164, July 2020
- iv Soil treatment only.
- v USA MRL for buprofezin increased from 2.5 mg/kg to 4 mg/kg during 2021.
- vi APVMA reduced chlorpyrifos to a temporary MRL of 0.05 mg/kg in 2020 but the FSANZ MRL currently remains at 1 mg/kg.
- vii European Union reduced MRLs for chlorpyrifos in citrus to 0.01 mg/kg (Reg. (EU) 2020/1085) effective November 2020.
- viii Korea reduced the chlorpyrifos MRL in citrus to 0.01 in November 2021 after banning the use or sale of chlorpyrifos in Korea.
- ix Classified by Thailand as a Hazardous Substance Type 4 with zero tolerance for residues, effective from June 2020.
- x The USA has revoked all MRLs for chlorpyrifos. From 29 October 2021 residues must be below detection (G/SPS/N/USA/3270 – Sept 2021).
- xi Permit PER13059 for barerooted & nursery plants (NSW only) – expires 30th September 2025.
- xii China proposed MRL (G/SPS/N/CHN/1051 – August 2016).
- xiii Korea enforced a new MRL for oranges and lemons of 0.3 mg/kg from November 2020.
- xiv Proposed Nov 2020. Nchn_20_0540_00_x.pdf
- xv Dimethoate and its metabolite omethoate are often totaled into a single residue. The MRL listed reflects each country's definition of dimethoate and omethoate.
- xvi Codex MRL for dimethoate in this table reflects the nil tolerance of its major metabolite omethoate, which is likely to be detectable if dimethoate is detectable.
- xvii China dimethoate MRL reduced to 0.01 mg/kg, 8 October 2020. GAIN Report Number: CH2020-0136
- xviii Omethoate must not exceed 1 mg/kg in Japan
- xix Dimethoate is measured as the total of omethoate and dimethoate. Omethoate in Taiwan must not exceed 0.02 mg/kg
- xx The Thai MRL for dimethoate applied here reflects the low tolerance in Thailand of its metabolite omethoate, which Thailand classifies as an Annex 3 residue at 0.01 mg/kg.
- xxi European Union proposed reducing the MRL from 1 mg/kg to 0.9 mg/kg in March 2021. Not in effect yet but should be considered the target MRL
- xxii APVMA MRL for mancozeb, zineb and propineb is 0.2 mg/kg (F2021C00634.pdf, July 2021) but FSANZ still lists a temporary MRL of 7 for dithiocarbamates.
- xxiii USA MRL of 10 mg/kg for Tangerine is an import tolerance, as no registrations for mancozeb on tangerine.
- xxiv European Union enforced new MRL for methiocarb from August 2021 (G/SPS/N/EU/394 – July 2020)
- xxv China reduced methomyl MRL from 0.2 to 0.05 mg/kg in December 2021.
- xxvi FSANZ MRL is 3 mg/kg, APVMA MRL is 1 mg/kg. Residues should decay to the Australian MRL within the label WHP
- xxvii Treatment of nursery plants only.
- xxviii The MRL for pirimicarb applies to all citrus since 2020.
- xxix China proposed MRL for Shaddock (G/SPS/N/CHN/1051 – August 2016).
- xxx APVMA MRL Standard is shown in the table: The FSANZ MRL is 3 mg/kg.
- xxxi China proposed MRL in January 2020 (G/SPS/N/CHN/1149)
- xxxii European Union has proposed to reduce the MRL for spirotetramat in citrus from 1 mg/kg to 0.5 mg/kg potentially enforced late 2021.
- xxxiii APVMA MRL is 3 mg/kg. FSANZ MRL is 10 mg/kg. Residues should decay to the Australian MRL within the label WHP.
- xxxiv Permit PER14772 for control of Emperor Brown Spot in Mandarins - expires June 2023

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- xxv Korean MRL applies ONLY to mandarins. Oranges and lemons exported to Korea do not have an MRL Sept 2021
- xxvi Taiwan does not have a specific citrus MRL Default MRL of *0.01 mg/kg applies.
- xxvii MRL of 10 mg/kg for Tangerine is an Import Tolerance.
- xxviii Phosphorous acid residues are often measured the sum of fosetyl, phosphonic acid and their salts, expressed as phosphonic acid (phosphorous acid).
- xxix Sum of fosetyl, phosphonic acid and their salts, expressed as phosphonic acid (phosphorous acid).
- xl Korean MRL is for fosetyl-aluminium: 0.05 (GL) and 4 (O) – amendment notice of change 2020-04-04.
- xli Malaysian MRL for fosetyl- aluminium revised from 3 to 5 mg/kg in July 2020 <http://fsq.moh.gov.my/v6/xs/page.php?id=72>.
- xlii China proposed MRL for Shaddock G/SPS/N/CHN/1051 – August 2016.
- xliii 2-phenylphenol is an isomer of biphenyl. The Canadian MRL of 110 mg/kg for biphenyl in citrus may be an error. Citrus Australia recommends presuming an MRL of 10 mg/kg while this is clarified <https://pr-rp.hc-sc.gc.ca/mrl-lm/index-eng.php> 17 March 2020.
- xliv Korea proposed a new MRL for imazalil in August 2021 G/SPS/N/KOR/734
- xlv European Union has withdrawn propiconazole. Residues must be below limit of detection since March 2020.
- xlvi APVMA MRL increased from 7 to 10 mg/kg in July 2021. FSANZ MRL for lemons is 11 mg/kg and 10 mg/kg for citrus other than lemons.
- xlvii Classified as *Hazardous Substance Type 4* with zero tolerance for residues.
- xlviii MRL of 0.1 for mandarin and oranges announced October 08 2020 GAIN Report Number: CH2020-0136.
- xlix European Union increased the MRL for carfentrazone from <0.01 to 0.02 mg/kg G/SPS/N/EU/379/Add.1
- i European Union – Commission Decision 2011/234/EU – non-inclusion of dichlobenil in Annex I.
- ii China proposed MRL in WTO Notification G/SPS/N/CHN/1149 – 21st January 2020
- iii China proposed MRL of 0.1 mg/kg (G/SPS/N/CHN/600).
- iv European Union approved new MRL September 2019. EFSA Journal 2019;17(10):5862.
- v Korea proposed new MRL for glyphosate in July 2021
- vi Classified by Thailand as a Hazardous Substance Type 4 with zero tolerance for residues, taking effect June 2020.
- vii China proposed new MRL in January 2020 (G/SPS/N/CHN/1149)
- viii China proposed MRL in March 2014 (G/SPS/N/CHN/635).
- ix China revised MRL of 0.05 mg/kg now applicable to all citrus fruit - G/SPS/N/CHN/1242 – December 2021,.
- x Proposed MRL November 2020 <https://www.canada.ca/content/dam/hc-sc/documents/services/consumer-product-safety/pesticides-pest-management/public/consultations/proposed-maximum-residue-limit/2020/ethephon/ethephon-eng.pdf>

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