Expanding your export options

Modelling residue decay to extend withholding periods to meet export market MRLs

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The project consortium (Cherry Growers of Australia, Summerfruit Australia Limited and Australian Table Grape Association) acknowledge the support of Agriculture Victoria, in developing the *Extended Withholding Periods Methodology*, through funding from their Food to Market program.

The modelling methodology is based on work by Eurofins commissioned by Agriculture Victoria (Eurofins, 2021) and reviewed by DTS regulatory consulting.

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The information contained herein should not be relied on as advice specific to your particular situation or a recommendation that the chemicals or programs should be used by you. Always obtain specific advice from an appropriately qualified expert with respect to your own particular situation before any chemical use or before implementing any pest and disease control programs, particularly on products for export where requirements are subject to constant change.

In particular:

No absolute guarantee can be given that export MRLs will not be exceeded in all instances. It is therefore strongly recommended that this information be used in conjunction with residue monitoring to avoid violative residues.

The MRLs and withholding periods listed in this document have been developed on the basis of currently available information and scientific trials. The Consortium cannot guarantee the accuracy of the information as MRL standards are subject to continual change and as inadvertent transcription errors may have occurred.

Data providers may be happy to provide the data for the calculations in the OECD MRL Calculator, but they take no responsibility for the decisions that growers may take to operate outside the parameters of the registered label.

The control programs have also been designed based on the currently available information and based on our scientific trials. The Consortium cannot guarantee that there has been no human error or that the programs will be successful in all instances.

Withholding periods noted herein may not be accurate where you apply chemicals at a higher rate than specified.

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APVMA legislation provides a regulatory context to extended WHPs

There are some key differences between the withholding period (WHP) determined by the Australian Pesticides and Veterinary Medicines Authority (APVMA) and extended withholding periods as calculated using the methodology described in this document.

The APVMA is the Australian Government regulator of agricultural and veterinary (AgVet) chemical products. The APVMA is responsible for establishing legally binding MRLs and WHPs which apply to the sale of produce within Australia.

Extended withholding periods or export harvest intervals (XWHP or EHI), as calculated using the project methodology have been developed for the **purpose of facilitating export.**

Extended withholding periods or export harvest intervals are always **equal to or longer than** the WHP on the label and provide a guide as to the length of time it will take for a residue to decline to meet MRLs in export markets. It is not always feasible to establish a workable export harvest interval if the product is persistent or the MRL in the export market is low.

Acronyms and abbreviations

ac	active constituent = A.I.
ai, A.I.	active ingredient
APVMA	Australian Pesticides and Veterinary Medicines Authority, Australian Government regulator of agricultural and veterinary (AgVet) chemical products
AU	Australia
cGAP	Critical GAP
CAC	Codex Alimentarius Commission
CODEX	List of MRLs prescribed by the CAC in the Codex Alimentarius
DAT	Days After Treatment
DT50	Time required for the concentration to decline to 50% of the initial value
DT90	Time required for the concentration to decline to 90% of the initial value
EHI	Export Harvest Interval
EEHI	Extended Export Harvest Interval = XWHP = EHI
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organisation of the UN
GAP	Good Agricultural Practice (rate, timing, dilution volume and frequency according to the label)
GC	Gas chromatography
GLP	Good Laboratory Practice
HPLC	High-Pressure Liquid Chromatography or High-Performance Liquid Chromatography
HR	Highest residue – the maximum recorded residue value in a dataset
IPM	Integrated Pest Management
JMPR	Joint Meeting on Pesticide Residues
LC-MS/MS	Liquid chromatography, mass spectroscopy
LOD	Limit of Detection – level at which residues can be detected
LOQ	Limit of Quantitation – level at which residues can be quantified
MRL Calculator	OECD MRL Calculator
MRL	Maximum Residue Limit or Level
OCS	Office of Chemical Safety
OECD	Organisation for Economic Co-operation and Development
PRS	APVMA Public release summary
STMR	Supervised Trial Median Residue
T(0.5)	Half-life value = DT50
TAN	Trade advice notice
WHO	World Health Organisation
WHP	Withholding Period – the minimum number of days that must elapse between the last treatment and harvest. It is a legal requirement to observe the WHP on the product label.
XWHP	Extended WHP = EHI

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1 Background

In many overseas export markets, the maximum residue limits (MRLs) for horticultural produce will often be different to Australian MRLs as set by the Australian Pesticides and Veterinary Medicines Authority (APVMA).

Where an export market MRL for a specific chemical is equal to or higher than the Australian MRL, there are no issues with following the Directions for Use and WHP on the chemical label. For example, the MRL for mancozeb on plums is set at 3 mg/kg in Australia, but is higher (7 mg/kg) in Hong Kong, Malaysia, Saudi Arabia, Singapore, UAE, Thailand, Oman, Vietnam, Japan and the EU. Observing the WHP on the mancozeb chemical label ensures that, Australian growers comply with the MRL for these export destinations.

However, where an export market's MRL for a chemical is lower than that set by Australia, a grower has two options:

1. Do not use the chemical on produce destined to be exported to that particular overseas market, or
2. Extend the withholding period for that produce until residues of the chemical comply with the lower MRL of that market.

To date, many growers have gone for Option 1 above due to a lack of knowledge on how extended withholding periods (XWHPs) can help meet lower MRL requirements.

An example of the advantages of calculating XWHPs (Option 2) can be seen with Luna Sensation (fluopyram + trifloxystrobin) on summerfruit.

- Under option 1 above, the only summerfruit treated with Luna Sensation that can be exported are nectarines and apricots to Japan, as the MRLs of most other summerfruit markets are lower than the Australian MRL of 2 mg/kg for fluopyram.
- Under Option 2, modelling data from local and overseas trials shows that the lower MRLs set by most export markets can be met – in most cases within the Australian label WHP of 1 day, or other cases (e.g. plums, or other fruit to Taiwan), by extending the withholding period to 15 days (Table 1).

Table 1: Modelling of Luna Sensation on summerfruit opens up many markets to export

Fruit	Australia	China	Malaysia	Saudi Arabia	Singapore	UAE	Canada	Taiwan	Thailand	Oman	Vietnam	Japan	EU
Apricot	1 day	1 day	1 day	1 day	1 day	1 day	1 day	15 days	1 day	1 day	1 day	1 day	1 day
Nectarine	1 day	1 day	1 day	1 day	1 day	1 day	1 day	15 days	1 day	1 day	1 day	1 day	1 day
Peach	1 day	1 day	1 day	1 day	1 day	1 day	1 day	15 days	1 day	1 day	1 day	35 days	1 day
Plum	1 day	15 days	15 days	15 days	15 days	15 days	15 days	15 days	15 days	15 days	15 days	1 day	15 days

WHP (1 day) shown in green XWHP shown in orange

When the MRLs of export markets are lower than Australian MRLs, there is no simple way to determine an appropriate withholding period, as many factors relating to chemical decline and use need to be known.

To overcome this problem, Agriculture Victoria invested in a model that allows XWHPs to be determined for export markets using existing MRL decline data.

The model is based on the assumptions that:

1. Residues decline predictably
2. Residues decline predictably and can be modelled and
3. Residues decline predictably and can be modelled to interpolate extended export harvest intervals.

The methodology described can be used on any set of data relevant to any particular use of a chemical product, provided decline follows first order kinetics. An illustration of first-order decline kinetics is shown in Figure 1.

The model uses:

1. Decline data from registration field trials and registrant data (where available)
2. First-order decline kinetics/equations, and
3. OECD methods for MRL determination (OECD, 2020) to estimate the number of days required before chemical residues will reduce to a level accepted by an export market.

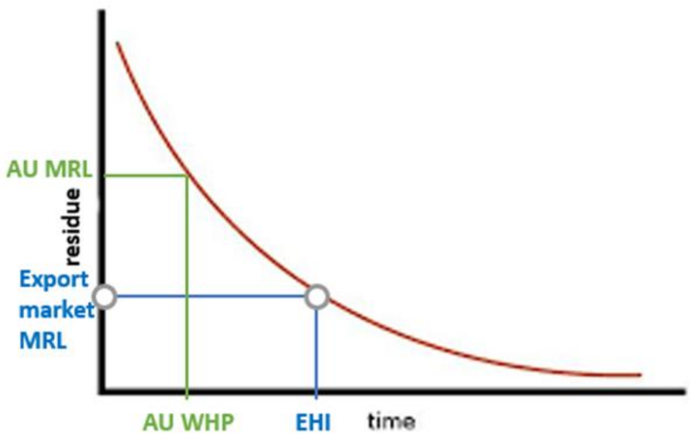

Figure 1: Illustration of first order residue decline, showing how an EHI can be estimated

The XWHP[1] (or EHI) estimated using this methodology must never be less than the WHP stated on the label. The WHP stated on a label is the minimum permitted interval (days) between treatment and harvest, and a legal requirement which must be observed. The described methodology must only be applied to derive an extended withholding period.

[1] The terms "export harvest interval" (EHI) and "eXtended withholding period" (XWHP) are used interchangeably in this document.

1.1 Selecting chemicals for modelling

Several criteria can help identify suitable chemicals for modelling extended WHPs (XWHPs). Prioritise chemicals with:

1. a slightly lower MRL than the Australian MRL (modelling is unlikely to be successful if target MRLs are close to zero).
2. label use permitted in the lead-up to harvest (relatively short WHPs). Most chemicals applied at or before bloom will have a zero residue at harvest as they do not come into contact with developing fruit.
3. a relatively short WHP (as described on the label).
4. ready availability and high popularity in industry. There is not much point in modelling a chemical that is rarely used, especially if it is based on old chemistry.
5. decline following first-order kinetics. This methodology is not suitable for other decline kinetics.
6. sufficient available data to satisfy minimal requirements for analysis.
    a. Check on availability of JMPR or other publicly available data for modelling.
    b. Ask the chemical industry if they can provide data (they will be most supportive if IP of the product is still protected, yet several or many markets have not yet established MRLs).
7. full registration in your industry. Products used under permit are only relevant until the permit expires.
8. likely availability in the long-term, e.g. avoid chemicals under review or where there are critical or significant concerns over its performance.
9. varying modes of action, so that they reflect a range of Resistance Management Groups.

The methodology developed by Agriculture Victoria by their contract research provider is not the only model that can be used. Other methodologies or scientific points of view could also be used to calculate XWHPs. An explanation of factors to consider when using the model follows.

2 Understanding residue data

The Agriculture Pesticides and Veterinary Medicines Authority (APVMA) typically only considers the worst-case scenario when determining withholding periods for label uses. As such, data produced to meet regulatory needs often only relates to the use situation with the highest application rate, most frequent treatments, shortest withholding period etc. Risk assessments quickly become very complicated once one starts considering all the possible use combinations.

2.1 Residue trial data consists of one of two forms

- **Decline data:** determination of residues in produce at successive dates (including the proposed WHP) after treatment at the GAP rate (or other). Half-life value can be easily estimated from the line of best fit. Most data used in this model must be decline data.
- **Data collected at a single point in time:** the determination of residues in treated produce only at the pre- determined WHP when following treatment according to GAP (This is often the highest treatment rate followed by collection of treated produce at the set WHP). Single point data can be used to supplement decline data, once the minimum 8-10 decline data points have been met.

OECD recommends caution regarding use of data sets, from a single point in time, in the OECD model.

It should be noted that distribution of single point residue data sets are usually asymmetric – with a long right tail - and often contains extreme values that appear different from the rest.

Figure 2 shows an example of the asymmetry in a typical data set of residues. This example shows the distribution of 20 independent MRL tests. The data set is left-skewed, with most values below 0.05mg/kg. However, one test returned a value of 1.7mg/kg. Occurrence of outliers is typical of residue data and not a cause for concern, but highlights why a margin of safety needs to be statistically calculated.

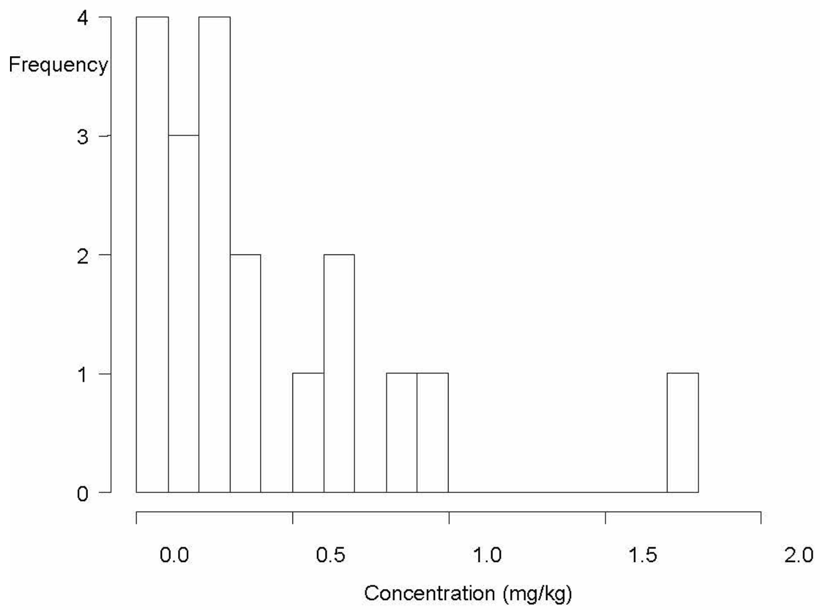

Figure 2: Example of the frequency of concentrations in a typical data set of single point residue samples (OECD, 2014)

2.2 Residue trials conducted outside Australia may not reflect the Australian GAP

Data obtained from international trials can often target a different treatment rate compared to the Australian label recommendations (GAP). In such instances, it may be acceptable to normalise results, i.e. mathematically adjust, based on differences in application rates. For example, if a trial consists of data following treatment at twice the GAP rate, then the resulting residue levels can be normalised by halving them. This normalised data can then be used in the combined dataset to improve the strength of the analysis. The FAO guidelines (FAO, 2016) describe this as the proportionality concept.

Normalising of data is only valid when quantifiable residues occur in the dataset. Values that are less than the limit of quantitation cannot be scaled up (normalised).

Data from trials where the application rate exceeds 4x or less than 0.3x the Australian GAP are considered unsuitable for normalising as they are too dissimilar from the GAP, and therefore must be excluded from the modelling.

2.3 Combining data from separate trials

Since a larger data set provides a more robust basis to derive MRL proposals, FAO and OECD guidelines recommend the merging of residue data sets, provided that trials were conducted according to the same GAPs.

It is appropriate to combine data sets, to increase the number of individual residue trial results, under the following conditions

- The chemical decay must follow first order kinetics. If it does not, the active cannot be modelled using this methodology[2].
- Trial data from different locations may be used providing that:
  - The trials are all representative of the Australian GAP with results >LOQ
  - The MRL proposals derived from each individual data set fall into the same or a neighbouring MRL class. MRL classes are automatically calculated by the OECD calculator.

2.4 Covered (indoor) production versus outdoor production

The European Food Safety Authority guidelines (EFSA, 2015) recommend that "When an active substance has been applied according to the same GAP on crops grown either under a greenhouse or field (outdoor) conditions, … the use on the protected crop leads to higher residue levels." …

Indoor (protected) crop residue data can be used to estimate MRLs outdoor production, providing the outdoor data confirms that outdoor residue levels are lower than, or similar to levels observed under indoor conditions. However, outdoor production dataset cannot be used to estimate indoor MRLs.

When the MRL is derived from trials conducted under indoor conditions, the following apply:

[2] Google the chemical active with the word "kinetics". If this does not yield adequate information, the chemical registrant may be consulted. A list of chemicals whose decline kinetics have already been determined may be found in Appendix B.

- The entire data set should be requested for indoor use; or
- A limited data set only (around 50%) is required for the outdoor use in order to confirm that the outdoor practice is less critical.

2.5 Combining residue trials performed on different crops:

In order to derive MRL proposals for a crop group, residue trials on different crops belonging to the same crop group can be combined in accordance with the provisions on extrapolation. In this case a higher variability of residue trials is expected. Hence, combining of residue trials is possible if the following conditions are fulfilled:

- The same GAP applies to the whole group
- The trials are representative of the GAP
- The number of trials is in line with the data requirements and the extrapolation rules.

For example, the APVMA allows extrapolation between cherries, plums, peaches and apricots as provided in "Representative Crops and Extrapolation Principles" for risk assessment and data waivers, unless "except cherries" is stated.

2.6 Number of data points required for each day after treatment (DAT) in the modelling

1. **A minimum of 8-10 data points for each day after treatment (DAT) is required to draw conclusions with any confidence**. Data from a shorter harvest interval may be used to supplement the number of data points at a particular (later) day (e.g. using results at 5 or 6 DAT to support results at 7 DAT).
2. **The number of applications.** For non-persistent compounds and when the critical GAP (cGAP) is defined with a large number of applications (≥3), the contribution of the first application(s) to the final residue levels can be considered negligible and trials conducted with a higher number of applications selected for MRL calculation. For instance, when residues at or close to the LOQ were measured in the samples collected just before the last application, trials conducted with more than 4 applications can be selected in support of a cGAP defined with a total of 4 applications.

Once data has been tabulated, the data are run through the OECD MRL calculator *to provide a safety factor.*

2.7 Use of a safety factor applied to the dataset to provide confidence that commodities harvested from treated crops will fall within the analysis outcome

The OECD MRL calculator (OECD, 2020) was developed to help the worldwide effort to harmonise MRLs and utilises a probabilistic model and is used by the APVMA and international agencies for MRL establishment purposes.

The statistical basis of the OECD MRL calculator is to produce an MRL proposal in the region of the 95th percentile of the underlying residue distribution (Croplife International, 2011)

Figure 3 illustrates the concept with respect to height, with a bell curve data set, where 95% of the people measured fall below the 95th percentile. Conversely, 5% of the population is expected to exceed this height

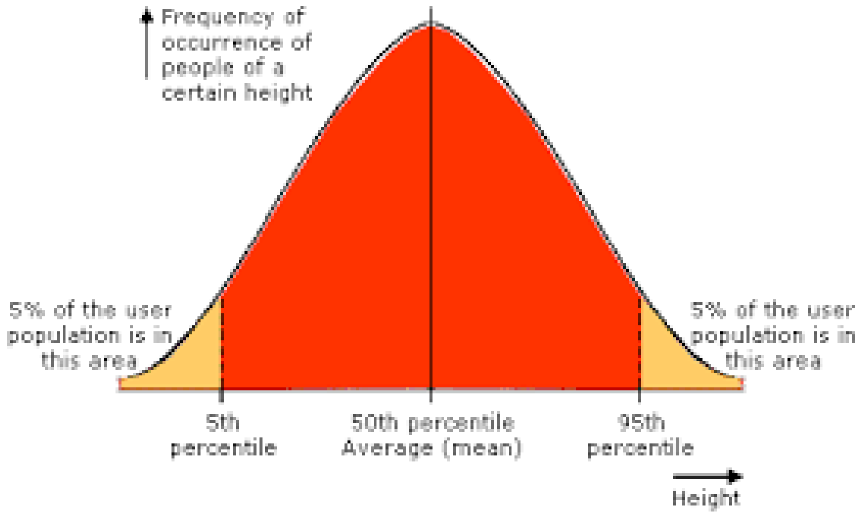

Figure 3: Example of the 95th percentile (Worthy, undated).

The model assesses the range of residue values observed in the dataset and, based upon the mean and standard deviation (SD), calculates an MRL value. The calculated MRL will be above the highest residue observed in the dataset, as the calculator allows for a statistical 'buffer'.

- **The highest residue (HR)** is used as a 'floor" to guarantee that the MRL proposal is always greater than or equal to the highest residue
- **The mean and the standard deviation** (SD) values of the dataset are computed; the "mean +4*SD" value is evaluated as the base proposal; … and
- The "3*Mean*correction factor (CF) (see next paragraph)

The "3*mean" value is computed to provide another "floor" to the calculation; in this case to guarantee that the sample coefficient of variance (CV = SD/Mean) used in the calculation is at least 0.5, a condition verified by most residue datasets. This is necessary given the tendency of small datasets to underestimate the standard deviation. A correction fact (CF) has been added because it was observed that the mean of a dataset is overestimated for censored datasets. The correction factor is equal to 1-2/3*fraction censored data in the dataset. This calculation is referred to as the "3*Mean*CF" method" (OECD, 2011).

The MRL calculator calculates the above statistics (HR, SD and CF) compares them and reports the statistic with highest value as the "unrounded MRL". This MRL is then rounded according to pre-determined rules. It may be rounded up or down, but in most cases, rounding results in an additional safety factor.

2.8 Values <LOQ

Care should be taken when inputting data into the spreadsheet which are below the level of detection (LOD). The value entered should be equal to that of the LOQ (e.g. 0.01, if reported as <0.01 mg/kg) (EFSA, 2015).

Of critical importance:

- The LOD (limit of detection) should not be reported and used for MRL calculations.
- The OECD calculator introduces a correction factor in the calculation in order to take into account the number of values below the LOQ (censored data). Data below the LOQ must therefore be identified in the calculator with a supplementary asterisk (*).

"For smaller datasets (less than 10 points), there is a possibility that the MRL proposal will exceed 2, or even rarely, 3 times the highest value of the residue data set. This is entirely justifiable considering the limited number of residue values and the inherent high variability found in residue data" (Croplife International, 2011).

"The OECD calculator distinguishes fully censored residue datasets (sample sets with all measurements below one or several limits of quantification) from not fully censored datasets (datasets with at least one measurement at or above the LOQ of the corresponding analytical method)" (OECD, 2011).

For non-chemists, the difference between LOQ and LOD can be confusing. The "limit of detection" (LOD) is the minimum detectable level, or the lowest concentration at which testing equipment can determine whether an element or compound is present in the sample or not (see middle curve in Figure 4) (Theodorsson, 2015).

The "limit of quantification" LOQ is also known as the "limit of reporting". This measure accounts for the variation between samples, that is the imprecision in replicate testing and sampling (Theodorsson, 2015). It combines data with statistical criteria to account for error in a sample. In Figure 4 over page, the LOQ curve is to the right of the LOD (e.g. the residue reported is higher and often with a "less than (<)" symbol before it to indicate that the true value is somewhere below the given value.

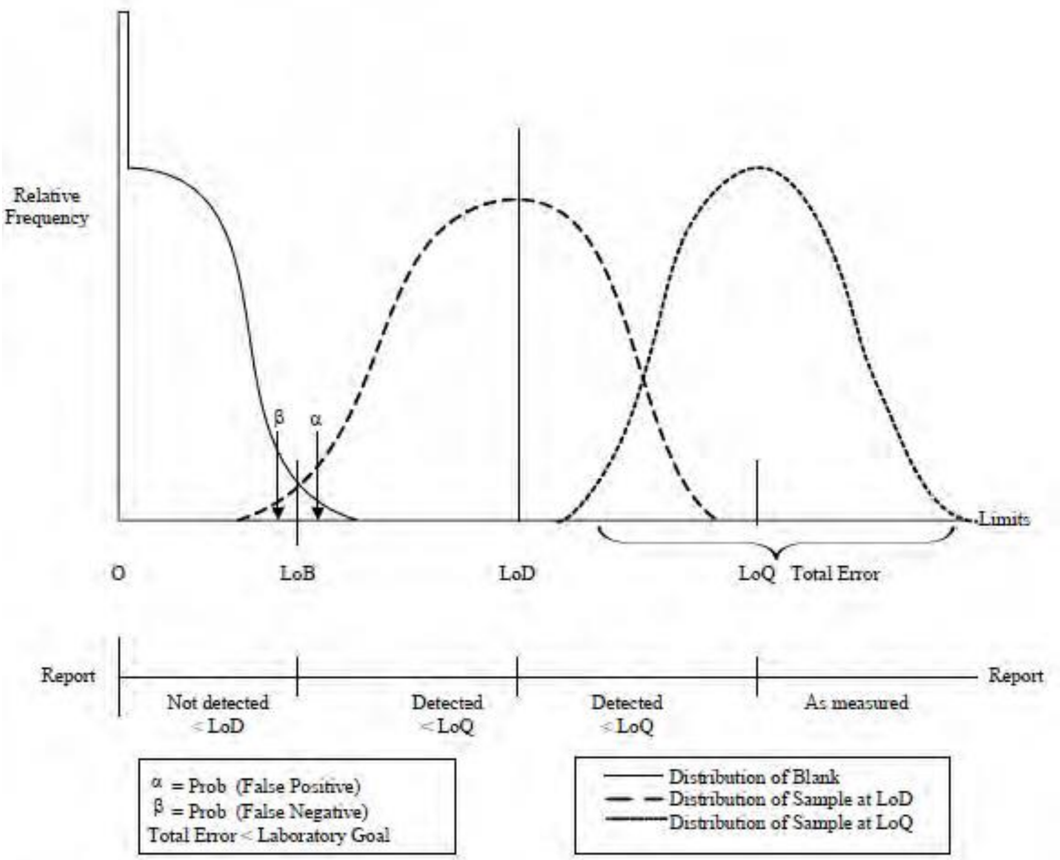

Figure 5. Distribution of Results for Blank, Low Positive at LoD, and Low Positive at LoQ (Report recommendations are shown for results at various points relative to limits.)

Figure 4: Graphical relationship between the concepts of LOD and LOQ (Theodorsson, 2015)

2.9 Fully censored datasets (all data below the LOQ)

When all data is below the LOQ (fully censored data sets), the MRL (will) be set at the level of the highest LOQ present in the dataset" (OECD, 2011).

2.10 Extrapolation

If the data set is of sufficient quality, a trendline can be extended to estimate longer withholding periods. However, care must be taken to ensure extrapolation is only used where the data set complies with the modelling guidelines (FAO, 2016).

2.11 General comments

The OECD MRL calculator is an acceptable method of establishing a limit, which is highly unlikely to be exceeded following use of a pesticide product as per label instructions.

Other methods, such as confidence limits can be employed where insufficient data points are available. However, the chance of exceeding the calculated limit is likely to be higher depending on the variation between results. **The upper 95% confidence limit used in this analysis is representing the point at which there is a 95% chance that the real mean will fall below.** It is not providing an upper limit of potential results.

The dataset available for each day after treatment (e.g., data from 7 days after treatment (DAT), 14 DAT or 21 DAT etc.) can be populated into the OECD MRL calculator if that data meets the criteria. Normally a minimum of 8 data points at each time point are required, however other options can deal with as few as 3.

It must be recognised that using fewer data points increases the chance that residues from actual use will exceed residues predicted by modelling.

It is suitable to use data from shorter harvest intervals to increase the number of data points at a particular day (e.g. using results at 5 or 6 DAT to support results at 7 DAT).

The use of a method other than the OECD MRL calculator requires the consideration of a knowledgeable statistician and understanding from the user industry regarding what level of risk is accepted with this method.

Even with the OECD MRL calculator, the accuracy of the resulting EHI is highly dependent on the data available. In addition, any EHI is not an absolute and there is always a (small) risk that residues may exceed the limits being considered.

It is quite possible that the resulting EHI required to meet the import MRL of the target country will be too great to be useful within existing crop management practices. Use of data from trials involving lower rates, fewer treatments or longer intervals between treatments may then be required to establish what set of use instructions (e.g. reduced rates or application frequencies) are required to meet the relevant import MRL. This may require the generating of new data.

It is the opinion of the project team that reliance on data that reflects reduced application rates could expose producers and Peak Industry Bodies to risk. For this reason it is preferable to only use the highest rates on the label for modelling.

3 Other considerations

3.1 Blossom or flowering applications

Summerfruit and Cherries – Chemicals applied at blossom are generally considered to leave no detectable residue by harvest, because the spray is applied before there is any fruit. Blossom applications may therefore be safe to use on fruit destined for export to countries where there is no tolerance (0 mg/kg), or a very low MRL (e.g. 0.01 mg/kg). However, residues may be detected if the spray is applied later than blossom, e.g. shuckfall, or for chemistry that is absorbed and remobilised within the plant.

Grapes – Chemicals applied to grapevines pre-flowering or before 80% capfall have in some circumstances resulted in detectable residues at harvest. Do not assume that pre-flowering applications will in all cases lead to undetectable residue at harvest.

3.2 Zero or very low MRLs

The likelihood of meeting very low MRLs will depend on the length of the growing season and the accuracy of testing. Caution should be used when interpreting results around the LOQ, as some markets adopt a lower LOQ than Australia. Please check the LOQ with your importer if the MRL you seek to meet is very low or zero.

3.3 BBCH scale

Some growth stages noted in MRL tables relate to specific fruit development stages, according to the BBCH scale or the Eichorn Lorenz (modified EL) scale. Copies of these scales are provided as Figure 6 and Figure 7 in Appendix D: Fruit development scales.

4 Summary of steps to calculate EHIs (XWHPs) for trade

4.1 Step 1: Define the target MRLs

Confirm the relevant import MRLs or tolerances from the countries receiving treated commodities from Australia.

Commodity	Export Destination Residue Limit (mg/kg)										
	Aust	Canada	China	EU	HK	Mal	Sin	Thai	UAE	USA	Codex (*)
Nectarine	3	0.8	0.2	0.15	0.2	0.2	0.2	0.2	0.2	0.8	0.2
Peach	3	0.8	0.2	0.15	0.2	0.2	0.2	0.2	0.2	0.8	0.2
Plum, Japanese	3	0.8	0.2	0.01	0.2	0.2	0.2	0.2	0.2	--	0.2

4.2 Step 2: Confirm whether the active is suited to modelling

Confirm that the selected chemical declines according to first-order kinetics and if any other metabolites need to be considered (information from registrant).

Some chemicals are known to cause cumulative/carry-over residues from applications in a previous season. While detectable residues may be very low, this is nonetheless important to consider if fruit is destined for countries with no MRLs.

4.3 Step 3: Identify Good Agricultural Practice (GAP)

Identify GAP of interest from APVMA label. The highest label rate/application frequency is linked to the WHP, but there are often other uses listed on the label. Also identify and note overseas patterns of use.

A worked example for Sumitomo Samurai Systemic Insecticide (500 g/kg Clothianidin) is shown below. Text in red shows the Australian key GAP of interest in stone fruit.

To manage risk, only modelling the highest label rate and frequency is recommended.

Use	Pest	Rate/Timing	Timing
Stone fruit	Queensland fruit fly (QFF), Mediterranean Fruit fly	40 g/100L =20 g ai/100 L	Three consecutive foliar sprays at 7 days interval
Peaches and Nectarines	Oriental fruit moth	40 g/100L =20 g ai/100 L	Two consecutive foliar sprays at 14 days interval.
	Green peach aphid	10 g/100L =5 g ai/100 L	Apply once per season

WHP: Do not harvest stone fruit for 7 days after last application.

4.4 Step 4: Collect residue decline data

The following sources may be useful:

- **Trade Advice Notices** (APVMA, 2023)**:** https://apvma.gov.au/node/11046#:~:text=The%20APVMA%20prepares%20Trade%20Advice,APVMA's%20residue%20and%20trade%20assessment)
- **Public Release Summaries** (APVMA, 2023) https://apvma.gov.au/node/11051#ag
- **European Food Safety Authority** (EFSA, 2023) http://registerofquestions.efsa.europa.eu/roqFrontend/wicket/page?18
- **Chemical registrants**
- **Grower data** may also be useful for analysis (MRL tests and spray diary information), but should be analysed separately as the quality may not be as good as registrant trials. If determined appropriate, it can be included in the analysis. Additional data increases the robustness of the results.

The bigger the dataset, the more robust the results and conclusions can be drawn with confidence.

To extract residue data from the JMPR database:

1. Go to http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/lpe/en/ (FAO, 2023)
2. Find the chemical (listed in alphabetical order)
3. Click on the evaluation files (will open as PDFs)
4. Use the **FIND** function on Adobe to find words relating to the crop of interest
5. Decline data may be listed in the tables or in the text.

Ensure that the residue tested in the trail data matches the residue definition for each analyte in your export markets. Residue definition may not be consistent between all markets.

4.5 Step 5: Consolidate available residue data

Combine all data into an Excel spreadsheet table to present a consolidation of all relevant data into one analysis:

- Rows representing individual trials
- Columns represent results for each day after treatment (or grouped days, e.g. 5, 6 & 7 DAT as explained above).

4.6 Step 6: Compile information on overseas patterns of use

Compile information on overseas patterns of use (overseas labels for each product) to confirm suitability of residues trials as being equivalent to the good agricultural practice (GAP) applied in Australia (i.e., relevant crops, application timing, maximum label application rates and frequencies), including following normalisation of results.

Refer to Section 2.6 page 13 for detail about selecting data.

4.7 Step 7: Normalise the data

Normalise the residue results from trials so they are equivalent to the good agricultural practice (GAP) applied in Australia. Apply the following rules:

1. Apply the proportionality concept to data from field trials conducted within a rate range of between 0.3× and 4× the GAP rate. This is only valid when quantifiable residues occur in the dataset.
2. Scaling is only acceptable if the application rate is the only deviation from critical GAP (cGAP). In agreement with JMPR practice, additional use of the ±25% rule for other parameters such as PHI is not acceptable. For additional uncertainties introduced, e.g., use of global residue data, these need to be considered on a case-by-case basis.
3. Residue data from an earlier DAT (e.g. Day 2) can be shifted to later DAT (e.g. Day 3) to increase the number of data points. Residue data from a later time period may not be moved to an earlier DAT.
4. Undertake checks to determine conformity to conditions. Save entire dataset for future use, but exclude all trials which do not conform to the GAP of interest, using filters.

Equation for normalising data:

Normalised data = (desired application rate) x (trial residue)/(trial application rate).

Application of this equation will result in zeros in the table when no applications were made. These must be removed before analysis.

A worked example table is shown in Appendix A and the excel spreadsheet.

4.8 Step 8: Determine (estimate) residues for each DAT using the OECD calculator

1. Open the OECD MRL calculator
    - https://www.oecd.org/env/ehs/pesticides-biocides/oecdmaximumresiduelimitcalculator.htm (OECD, 2020)
2. Determine the LOQ from previous MRL test reports. **If values are below the LOQ (e.g. <0.01 mg/kg), these must be entered as the LOQ (0.01) with an asterisk (*)** so that the OECD calculator can introduce a correction factor in the calculation.
3. Run trial data for each DAT through the calculator and copy and paste results into the table below the trial data.
4. Check the number of data points for each DAT. A minimum of 8 is desired.
5. Don't forget to add an asterix to any values below the LOQ

4.9 Step 9: Add a trendline (regression analysis)

1. Graph the predicted, rounded residues from the OECD MRL calculator output as a scatter plot. Use a separate chart for each analysis. The rounded residue data includes a safety factor and will therefore be the upper limit (e.g. maximum residue level).
    - Transpose results (flip) before graphing (column of DAT)

- X axis : time in days (DAT)
- Y axis : estimated residue
- Highlight the subset of cells to include in graph
- Insert scatter chart

2. Insert trendline
    - Right click on values in graph and insert an exponential trendline
3. Extend the trendline until such time as it falls below either the residue of concern (i.e. import country MRL) or the limit of quantitation for the analytical method employed.
    - Right click trendline you want to extend
    - In right “Format Trendline” panel look for the “Forecast” option
    - Insert how many extra days “Forward” and/or “Backward”

4.10 Step 10: Analysis

If the trendline falls below the unrounded MRLs, an additional safety factor could be considered by moving the trendline upwards (recommended). This should be considered on a case-by-case basis and may not be necessary, depending on the quality of the data, residues calculated and the GAP.

- Insert horizontal lines representing the MRLs of interest
- Read EHI values from graph for each export MRL of interest
- Compare predicted MRLs to export market MRLs and identify whether extending the WHP will allow use for a particular export market

4.11 Step 11: Mann-Whitney test (if required)

If there are unusual results, check that all data is from the same population using a Mann-Whitney test. Analyse only datasets from the same population. See Appendix C.

4.12 Step 12: Report results

A suggested reporting format appears in Appendix A. It is important to record sources and information relevant to the analysis to substantiate results and for future reference.

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6 Appendix A: Decline kinetics of selected agrichemicals

Chemical	First-order kinetics
Chlorothalonil (Barrack)	Yes
Chlorpyrifos	Yes (Fang, et al., 2008)
Clothianidin (Samurai)	Yes
Fenhexamid	Yes (Maheswari, Lamshoft, Sukul, Zuhlke, & Spiteller, 2010)
Fludioxonil	Yes (Cabras, Angioni, Garau, Melis, & et al, 1997)
Fluopyram (Luna Sensation)	Yes
Fluxapyroxad (Merivon)	No – First-order multi compartment (FOMC)
Mandestrobin (Intuity)	Yes
Mefentrifluconazole	Yes. (Health Canada, 2019)
Methomyl	Yes (Knaak, 1971)
Myclobutanil	Yes (Sun, et al., 2015 May;187(5):303. doi: 10.1007/s10661-01)
Penthiopyrad (Fontelis)	Yes
Propiconazole (Tilt)	Yes
Pyraclostrobin (Merivon)	Yes
Spinosad (Success)	Yes https://pubmed.ncbi.nlm.nih.gov/22262560/
Spinetoram (Delegate)	Yes
Spirotetremat (Movento)	No
Thiram	Yes
Trifloxystrobin (Luna Sensation)	Yes
Ziram	Yes

7 Appendix B: Worked example of calculations, analysis and reporting format

Table 2: Example of a spreadsheet with data compiled ready to run through the OECD calculator

AU GAP FOR MOTHS - 3.75 G AI /100L							DAT NORMALISED DATA -3.75 G ai/100L						
Fruit	Variety	Place	Form	Per app g ai/hL	Re treatment interval (RTI)	No app	0	1	3	7	14	21	28
Cherry	Stella	NZ	SC	2.5	14	4	0.04	0.03	< 0.01	< 0.01	< 0.01		
Cherry	Lapins	NZ	SC	2.5	14	4	0.05	0.04	0.03	0.03	< 0.01	< 0.01	< 0.01
Cherry	Van	Tas Au	WG	5	14	4	0.05			< 0.01	< 0.01	< 0.01	< 0.01
Cherry	Van	Tas Au	WG	7.5	14	4	0.06			0.01	< 0.01	< 0.01	< 0.01
Apricot	Francesco	VIC	WG	7.5	14	4	0.07						
Cherry	Stella	NZ	SC	5	14	4	0.07	0.05	0.03	0.01	< 0.01	< 0.01	
Apricot	Francesco	VIC	WG	7.5	14	4	0.07						
Apricot	Francesco	VIC	WG	5	3 applications at 5 day intervals at flowering then 4 applications at 14 days	7	0.07						
Cherry	Stella	NZ	SC	7.6	14	4	0.07	0.03	0.04	0.03	< 0.01	0.01	0.00
Cherry	Stella	NZ	SC	3.7	14	4	0.07	0.03	0.02	< 0.01	< 0.01	< 0.01	
Apricot	Castlebrig	NZ	SC	3.7	14	4	0.07						
Cherry	Stella	NZ	SC	5	14	4	0.07	0.09	0.04	0.02	0.02	< 0.01	< 0.01
Apricot	Castlebrig	NZ	SC	5	14	4	0.07						
Apricot	Francesco	VIC	WG	5	14	4	0.08						
Apricot	Castlebrig	NZ	SC	2.5	14	4	0.08						
Cherry	Lapins	NZ	SC	3.7	14	4	0.08	0.03	0.02	0.02	< 0.01	< 0.01	< 0.01
Cherry	Stella	NZ	SC	2.5	14	4	0.08	0.08	0.04	0.04	< 0.01	0.02	< 0.01
Apricot	Francesco	VIC	WG	5	3 applications at 5 day intervals at flowering then 4 applications at 14 days	7	0.08						
Apricot	Castlebrig	NZ	SC	2.5	14	4	0.08						
Cherry	Lapins	NZ	SC	7.6	14	4	0.08	0.06	0.03	0.04	0.01	0.01	< 0.01
Cherry	van	Tas Au	WG	7.5	3 applications at 5 day intervals at flowering then 4 applications at 14 days	7	0.09			0.01	< 0.01	< 0.01	< 0.01
Cherry	Stella	NZ	SC	7.6	14	4	0.09	0.06	0.01	0.02	0.01	< 0.01	
Cherry	Stella	NZ	SC	3.7	14	4	0.09	0.08	0.03	0.02	< 0.01	< 0.01	< 0.01
Apricot	Francesco	VIC	WG	5	14	4	0.09						
Apricot	Castlebrig	NZ	SC	3.7	14	4	0.09						
Apricot	Castlebrig	NZ	SC	5	14	4	0.09						
Cherry	Lapins	NZ	SC	5	14	4	0.10	0.06	0.04	0.05	0.01	0.01	< 0.01
Apricot	Sundrop	NZ	SC	5	14	4	0.10						
Apricot	Francesco	VIC	WG	7.5	3 applications at 5 day intervals at flowering then 4 applications at 14 days	7	0.10						
Apricot	Castlebrig	NZ	SC	7.6	14	4	0.11						
Apricot	Francesco	VIC	WG	7.5	3 applications at 5 day intervals at flowering then 4 applications at 14 days	7	0.12						
Apricot	Sundrop	NZ	SC	5	14	4	0.12						
Apricot	Castlebrig	NZ	SC	7.6	14	4	0.13						
Cherry	van	Tas Au	WG	5	3 applications at 5 day intervals at flowering then 4 applications at 14 days	7	0.14			0.02	0.01	< 0.01	< 0.01

Table 3: Estimated residue and statistics summary for each DAT, generated by the OECD model

DAYS AFTER LAST TREATMENT	0	1	3	7	14	21	28
Total number of data (n)	40	28	28	44	44	26	12
Percentage of censored data	0%	0%	4%	25%	55%	96%	92%
Number of non-censored data	40	28	27	33	20	1	1
Lowest residue	0.04	0.03	0.01	0.01	0.01	0.01	0.01
Highest residue	0.19	0.20	0.12	0.09	0.04	0.02	0.01
Median residue	0.08	0.08	0.04	0.03	0.01	0.01	0.01
Mean	0.09	0.09	0.06	0.03	0.02	0.01	0.01
Standard deviation (SD)	0.04	0.05	0.03	0.02	0.01	0.00	0.00
Correction factor for censoring (CF)	1.00	1.00	0.98	0.83	0.64	0.36	0.39
Proposed MRL estimate							
- Highest residue	0.19	0.20	0.12	0.09	0.04	0.02	0.01
- Mean + 4 SD	0.23	0.27	0.19	0.12	0.05	0.02	0.01
- CF x 3 Mean	0.28	0.26	0.16	0.08	0.03	0.01	0.01
Unrounded MRL	0.28	0.27	0.19	0.12	0.05	0.02	0.01
Rounded MRL	**0.3**	**0.3**	**0.2**	**0.15**	**0.05**	**0.03**	**0.015**

7.1 Example of reporting on Extended Withholding Periods for export of fruit

CONFIDENTIAL INFORMATION. Not to be disclosed to third parties.

Luna Sensation Fungicide is manufactured by Bayer and contains 250 g/L of each of FLUOPYRAM and TRIFLOXYSTROBIN.

Luna Sensation is used to treat blossom blight, brown rot and shothole in cherries (APVMA Product Number 65560).

Both actives follow first-order decline kinetics (Bayer, 2021).

7.2 International market targets

The top nine export markets for Victorian cherries, with their respective MRLs are shown below.

Country	Fluopyram MRL (mg/kg)	Trifloxystrobin MRL (mg/kg)
Australia	3	5
China	0.7	3
Hong Kong	-	3
Indonesia	0.7	-
Malaysia	2	3
Saudi Arabia	0.7	3
Singapore	2	3
South Korea	0.6	0.5
United Arab Emirates	2	3
Vietnam	0.7	3

All export MRLs of interest for fluopyram and tryfloxistrobin are below the Australian MRLs, severely limiting the use of both key chemicals.

For fluopyram, the MRL of interest are 2mg/kg, 0.7mg/kg, 0.6mg/kg and the limit of quanitification. Residues below the Australian LOQ (0.04 mg/kg) could potentially be detected by more sensitive instruments in overseas laboratories.

For trifloxystrobin, MRLs of interest are 3mg/kg, 0.5mg/kg and the limit of quantification. Residues below the Australian LOQ (0.04 mg/kg) could potentially be detected by more sensitive instruments in overseas

7.3 Summary of available residue data

Residue data for cherries and summerfruit was obtained from the following sources for **FLUOPYRAM** (Table 4).

Table 4: Sources of residue data for fluopyram in stone fruit and cherries

Studies available	50 AU studies: apricots (12), cherries (8), nectarines (12), and peaches (18)
Codex reports	Codex 2010, Codex 2012, Codex 2017: 109 trials – apricots, cherries, peaches, nectarines and plums (note there are duplicates reported at each assessment)
Other overseas reports	EU data: 45 selected trials on apricots, plums, and cherries (notemany of these trials were not reported in the Codex data)
APVMA references	APVMA TAN 2015: summary data were presented to support theMRLs
Summary	Total = 204 trials recorded in dataset (note there are duplicates reported, mostly from Codex data) + 2 replicates as part of this study

7.4 Australian GAP for fluopyram in stone fruit and cherries

Shothole and brown rot are both effectively treated by Luna Sensation close to harvest. They have slightly different GAPs – the application rate for shothole is higher than the rate for brown rot. Only shothole will be considered in this example analysis.

The AU GAP for TRIFLOXYSTROBIN is summarised in the following table: Text in red shows the GAPs of interest.

Use	Pest	Rate/Timing	Timing
Stone fruit (including cherries)	Blossom blight	40 mL/100L =10 g ai/100 L Fluopyram =10 g ai/100L trifloxystrobin	Apply during blossoming (as part of spray program)
	Shothole	40 mL/100L =10 g ai/100 L Fluopyram =10 g ai/100 L trifloxystrobin	Apply at interval of 10-14 days. Apply at early pink bud
	Brown rot	30 mL/100L =7.5 g ai/100 L Fluopyram =7.5 g ai/100L trifloxystrobin	Apply at interval of 7-10 days. Apply to fruit ripening to harvest

Label constraints:

- Apply a maximum of 2L product per season.
- Apply a maximum of 2 treatments per season.
- WHP: Do not harvest for 1 day after last application.

7.5 Data analysis

Data available from the APMVA TRADE ADVICE NOTICE on Fluopyram in the Product Luna Sensation Fungicide (APVMA Product Number P65560):

> *Sixteen Australian trials were conducted on stone fruit (peaches, nectarines, apricots and cherries), although the cherry trials did not match the proposed GAP. The local data is supported by data for stone fruit from the EU and USA.*
>
> *In the Australian trials, highest residues of fluopyram in stone fruit (except cherries) at 1 or more days after the last of 2 applications at 10 g ai/100 L were 0.12, 0.17, 0.18 (7 days), 0.20, 0.22, 0.24 (10 days), 0.25 (3 days), 0.27 (7 days) 0.29, 0.30 (9 days), 0.36, 0.37, 0.48 (3 days) and 0.49 mg/kg.*
>
> *Residues of fluopyram in peaches and plums at 0 - 1 day after the last of 2 applications at 208 - 250 g ai/ha (1.0× - 1.3×) in overseas trials were 0.02, 0.03 (3), 0.05 (2), 0.06, 0.07, 0.08 (3), 0.09, 0.12, 0.16, 0.17, 0.18, 0.19, 0.20, 0.23, 0.25, 0.27, 0.28, 0.29 (2), 0.30, 0.31 (5), 0.32 (2), 0.33, 0.35, 0.36, 0.38, 0.43, 0.45, 0.46, 0.46, 0.56, 0.59, 0.63 and 0.98 mg/kg.*
>
> *Residues of fluopyram in cherries at 0 days after the last of 2 applications at 250 g ai/ha (1.3×) in overseas trials were 0.07, 0.16, 0.22, 0.23, 0.31, 0.34, 0.36, 0.37, 0.55, 0.58, 0.60 (2), 0.64 (2), 0.66, 0.70, 0.71, 0.75, 0.79, 0.82, 1.2, 1.3 and 1.8 mg/kg.*
>
> *An MRL of 2 mg/kg is recommended for fluopyram on FS 0012 Stone fruits [except cherries] based on a highest residue of 0.49 mg/kg in apricots from Australian trials matching GAP and 0.98 mg/kg in peaches from overseas trials at ~1.3× the expected rate. Australian data for cherries matching the proposed GAP have not been provided. In the overseas trials at higher rates and shorter PHIs the HR was 1.8 mg/kg. An MRL of 3 mg/kg is recommended for fluopyram on FS 0013 Cherries.*

The Trade Advice Notice (TAN) provided context to the trial conditions and analysis, and rationale for proposing an MRL and WHP, and also clarified that the Australian trials on cherries and other stone fruit were applied according to the GAP for shothole.

The non-Australian trials reported in the TAN were either at GAP or in excess of GAP, but met the requirements for data to include in modelling and acceptable to normalise via the proportionality function.

7.6 Residues definition

Compound	Residue
Fluopyram	Fluopyram (commodities of plant origin)

7.7 Residue trial data compilation and transformation

Data which represented the GAPs of interest were chosen:

Shothole:

- 2 treatments with 7-14 day treatment intervals with rates that can be normalised to 10 g AC/ha. (NOTE: in some cases, the interval is shorter than the desired GAP).
- Test application rate within 0.3-4x GAP

Blossom blight:

- Apply as part of a blossom blight spray program. The critical application timings for blossom blight control are early (1-10%) blossom, full bloom and petal fall/shuck fall.
- Use of Luna Sensation at Bloom for blossom blight leaves no detectable residues (Eurofins, 2021).

NOTE: **Resistance Management**

This use is subject to a CropLife Australia fungicide resistance management strategy which limits the total number and consecutive number of applications of Luna Sensation and other Group 7 and 11 fungicides.

- **Apply a maximum of 2 applications of Luna Sensation per season.**
- **Apply a maximum of 2 litres of Luna Sensation per hectare per season**

Cherries have a separate fluopyram MRL to other stone fruit and as such have been investigated separately.

Results from trials and OECD calculator outputs are shown below for shothole ONLY.

Table 6 presents all the potential trial data for Fluopyram for cherries from Australia and other countries, that could be considered for this analysis. The results have been normalised at 10g ai/100L to account for differences in application rates. Data from DAT where there are less than 4 results have not been presented as they are too few to be useful. OECD MRL calculator outcomes are also presented.

Exclusions:

It should be noted that at DAT 1, 10 and 28 there were only 4 data points and these seem to underestimate the maximum residues at these intervals.

As there were insufficient data points to run the model for days 1 and 28, they were omitted from trendline modelling (unrounded data points included in Figure 5).

Table 5: Fluopyram data and results generated by the OECD calculator

				Fluopyram Cal. Normalised Data for Cherries @ 10 g ai/100L							
				DAYS AFTER TREATMENT							
COMMODITY	**Application No.**	**Rate, g a.i./100 L**	**Count**	**0**	**1 (AU GAP)**	**3**	**7**	**10**	**14**	**21**	**28**
Cherries	2 @7days	7.5	6	0.24	0.17		0.16		0.17	0.17	0.09
Cherries	2 @7days	7.5	6	0.12	0.16		0.08		0.08	0.05	0.07
Cherries	2 @7days	7.5	6	0.28	0.19		0.31		0.24	0.20	0.15
Cherries	2 @7days	7.5	6	0.40	0.24		0.09		0.23	0.17	0.13
Cherries	2	41	5	0.12		0.10	0.10	0.07	0.07		
Cherries	2	41	5	0.13		0.10	0.10	0.07	0.07		
Cherries	2	33.5	4	0.11		0.07	0.06		0.04		
Cherries	2	16.5	4	0.48		0.38	0.34		0.25		
Cherries	2	25	4	0.25		0.22	0.22		0.18		
Cherries	2	41.5	4	0.17		0.12	0.06		0.05		
Cherries	2	16.6	5	1.08		0.66	0.66		0.59	0.46	
Cherries	2	16.6	5	0.42		0.37	0.36		0.28	0.25	
Cherries	2	16.6	5	0.20		0.11	0.16		0.10	0.09	
Cherries	2	12.5	4	0.30		0.27	0.25		0.20		
Cherries	2	20.8	4	0.30		0.21	0.21		0.19		
Cherries	2	8.33	4	1.06		0.62	0.53		0.49		
Cherries	2	17.9	4	0.13		0.09	0.08		0.06		
Cherries	2	12.5	5	0.64		0.46	0.24		0.25	0.22	
Cherries	2	12.5	5	0.26		0.26	0.11		0.10	0.06	
Cherries	2	12.5	5	1.12		0.60	0.63		0.50	0.42	
Cherries	2	8.33	5	0.85		0.38	0.28		0.30	0.19	
Cherries	2	16.5	4	0.45		0.28	0.26		0.25		
Cherries	2	25	4	0.24		0.20	0.13		0.11		
Cherries	2	16.5	4	0.79		0.25	0.21		0.17		
Cherries	2	16.5	4	0.13		0.07	0.05		0.04		
Cherries	2	8.33	4	0.80		0.77	0.60		0.50		
Cherries	2	12.5	4	0.47		0.25	0.28		0.12		
Cherries	2	12.5	4	0.36		0.34	0.36		0.22		
Cherries	2	8.33	4	0.88		0.61	0.53		0.50		
Cherries	2	8.33	4	0.72		0.74	0.52		0.53		
Cherries	2	12.5	5	0.55		0.40	0.38		0.31	0.34	
Cherries	2	8.33	5	0.88		0.59	0.37		0.32	0.30	
Cherries	2	12.5	5	0.57		0.54	0.352		0.24	0.23	
Cherries	3 (1 at blossom)	7.5	5	0.08		0.13		0.04		0.05	
Cherries	3 (1 at blossom)	7.5	5	0.24		0.16		0.05		0.04	
Cherries	3 (1 at blossom)	7.5	from above data set							0.09	
Cherries	3 (1 at blossom)	7.5	from above data set							0.03	
Total number of data (n)				35	4	31	33	4	33	18	4
Percentage of censored data				0	0	0	0	0	0	0	0
Number of non-censored data				35.00	4.00	31.00	33.00	4.00	33.00	18.00	4.00
Lowest residue				0.08	0.16	0.07	0.05	0.04	0.04	0.03	0.07
Highest residue				1.12	0.24	0.77	0.66	0.07	0.59	0.46	0.15
Median residue				0.36	0.18	0.27	0.25	0.06	0.22	0.18	0.11
Mean				0.45	0.19	0.33	0.27	0.06	0.24	0.19	0.11
Standard deviation (SD)				0.31	0.04	0.21	0.18	0.01	0.16	0.13	0.04
Correction factor for censoring (CF)				1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Proposed MRL estimate											
- Highest residue				1.12	0.24	0.77	0.66	0.07	0.59	0.46	0.15
- Mean + 4 SD				1.70	0.33	1.19	0.99	0.11	0.87	0.71	0.26
- CF x 3 Mean				1.36	0.57	1.00	0.82	0.17	0.71	0.56	0.33
Unrounded MRL				**1.70**	**0.57**	**1.19**	**0.99**	**0.17**	**0.87**	**0.71**	**0.33**
Rounded MRL				**2.00**	**0.60**	**1.50**	**1.00**	**0.20**	**0.90**	**0.70**	**0.40**

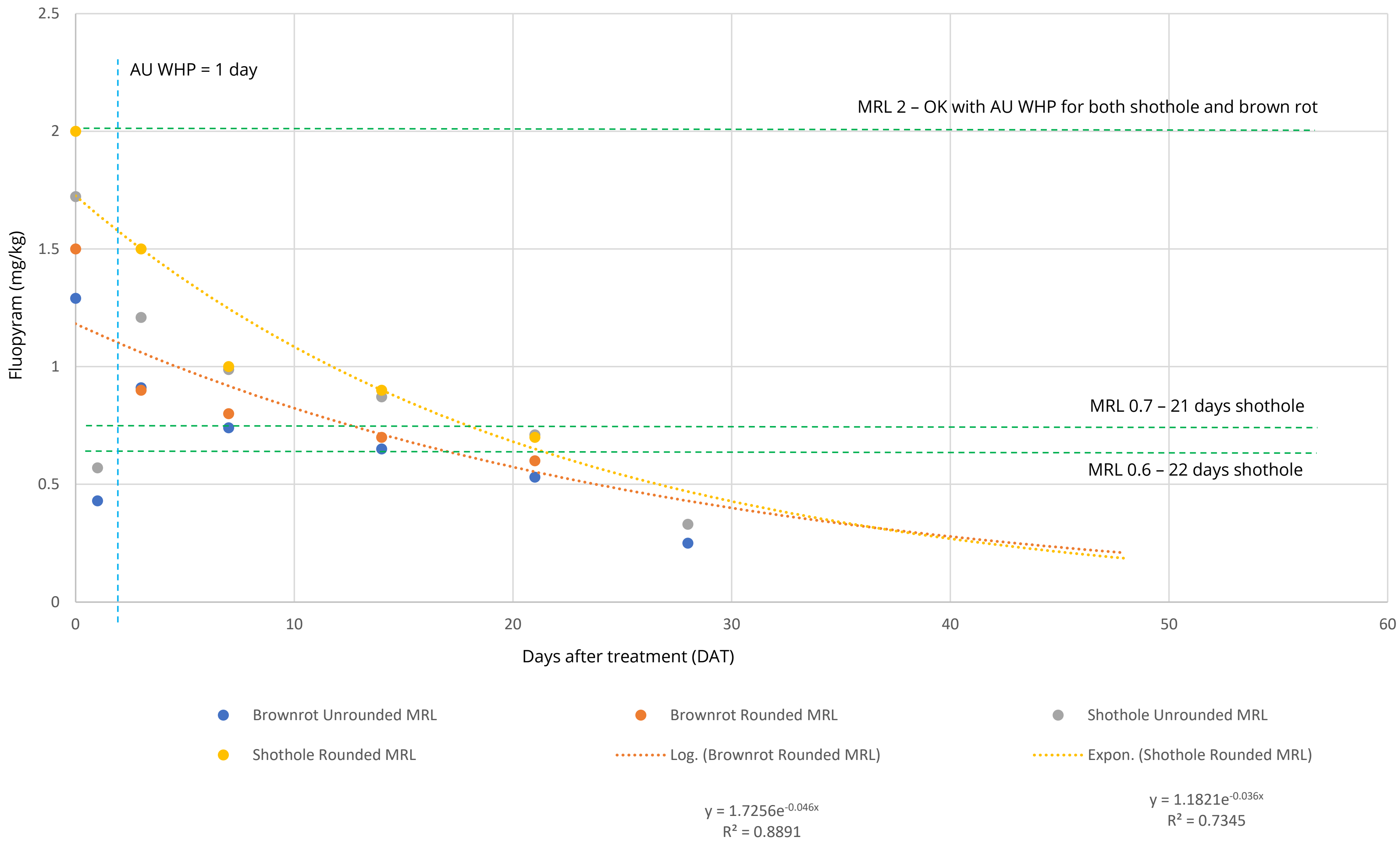

Figure 5: Fluopyram: estimates of rounded and unrounded residues on cherries after treatment according to shothole and brown rot GAP

7.8 Summary of estimated EHIs by country

Interpolated fluopyram EHIs by country are shown Table 6 and Figure 5.

Table 6: Summary of fluopyram MRLs and EHIs by country

Country	Fluopyram MRL (mg/kg)	Shothole WHP or EHIs (days)
Australia	3	1
China	0.7	21
Hong Kong	-	Blossom
Indonesia	0.7	21
Malaysia	2	1
Saudi Arabia	0.7	21
Singapore	2	1
South Korea	0.6	22
United Arab Emirates	2	1
Vietnam	0.7	21

An MRL of 2 and 3 mg/kg for export is already compliant with the Australian WHP. If the data and choice and transformation was correct then there is little chance that cherries treated according to GAP will exceed import MRLs established by other countries for fluopyram:

- An MRL of 0.7 mg/kg for export requires an extended harvest interval of 18 days for shothole.
- An MRL of 0.6mg/kg for export requires an extended export harvest interval of 22 days for shothole.

As there are two actives in Luna Sensation, the same analysis must occur for trifloxystrobin and an overall XWHP generated from combined results of both active ingredients. While the trifloxystrobin residue decline calculations are not shown in this summary, the combined results are presented below (Table 7).

The combined EHIs for Luna Sensation (trifloxystrobin and fluopyram) for shothole GAPs in selected export markets are shown in Table 7.

Table 7: EHIs for Luna Sensation (combining both actives trifloxystrobin and fluopyram)

Country	Combined EHIs for shothole
Australia	1
China	21
Hong Kong	Blossom
Indonesia	Blossom
Malaysia	1
Saudi Arabia	21
Singapore	1
South Korea	22
United Arab Emirates	1
Vietnam	21

8 Appendix C: Mann Whitney Test

If results are disordered, they may not belong to the same statistical population. This can be tested by using appropriate statistical tools (i.e., Mann-Whitney U-Test) to confirm that residue results are from the same distribution. The power of statistical tests is limited in case of small data sets (<5).

The following links provide support on conducting a Mann Whitney U-test:

Mann-Whitney U Test: Assumptions and Example.
Technology Networks Informatics.
https://www.technologynetworks.com/informatics/articles/mann-whitney-u-test-assumptions-and-example-363425 (McClenaghan, 2022)

Mann Whitney U Test (Wilcoxon Rank Sum Test).
https://sphweb.bumc.bu.edu/otlt/mph-modules/bs/bs704_nonparametric/bs704_nonparametric4.html (LaMorte, 2017)

9 Appendix D: Fruit development scales

9.1 The BBCH scale – a standardised scale for cherry development

Figure 6: BBCH Principle growth stages – flowering, fruit development, ripening or maturity, and senescence into dormancy of sweet cherry according to the extended BBCH scale (Fadon, Herrero, & Rodrigo, 2015)

9.2 Eichorn Lorenz grapevine development scale

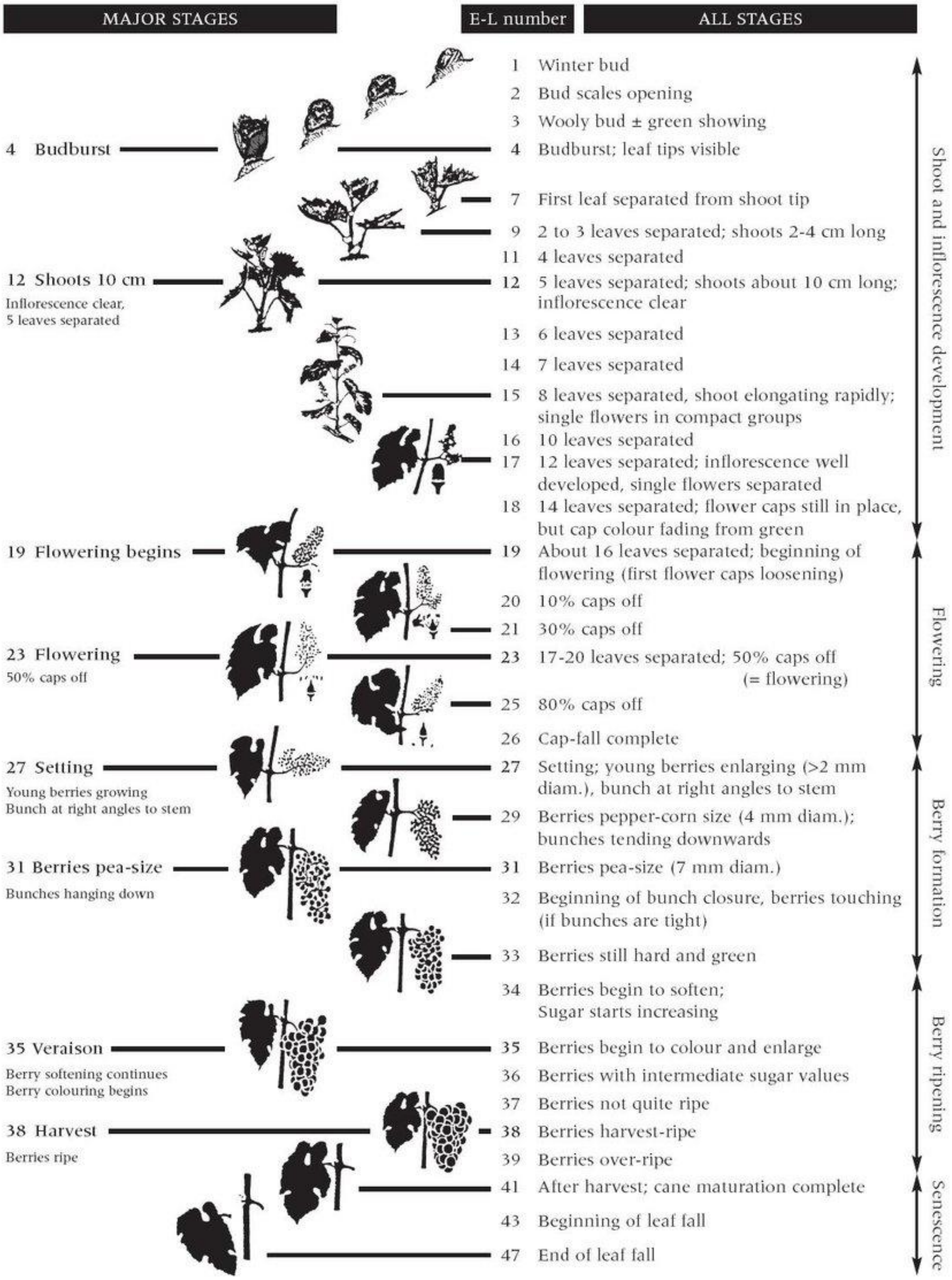

Figure 7: The Modified Eichorn Lorenz scale defines grape development stages (Coombe, 1995)

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