Australian Government

Australian Pesticides and Veterinary Medicines Authority

Fenitrothion

Final Review Technical Report

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Preface

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is an independent statutory authority with responsibility for the regulation of agricultural and veterinary chemicals in Australia. Its statutory powers are provided in the Agricultural and Veterinary Chemicals Code (the Code), which is scheduled to the *Agricultural and Veterinary Chemicals Code Act 1994*.

The APVMA has legislated powers to reconsider the approval of an active constituent, registration of a chemical product or approval of a label at any time after it has been registered. The Code provides for the suspension and cancellation of approvals and registrations if it appears to the APVMA that the criteria for approval or registration are not, or are no longer, satisfied (s 41 and s 44 of Part 2, Division 5).

About this document

This Final Review Technical Report is intended to provide an overview of the assessments that have been conducted by the APVMA and of the specialist advice received from its advisory agencies.

This document contains a summary of the assessment reports generated in the course of the chemical review of an active ingredient, including the registered product and approved labels. The document provides a summary of the APVMA's assessment of:

- the chemistry of the active constituent
- the toxicology of both the active constituent and product
- the residues and trade assessment
- occupational exposure aspects
- environmental fate, toxicity, potential exposure and hazard.

In addition, this report includes a summary of submissions received in response to public consultation on the Fenitrothion Review Technical Report (published on 9 April 2024), and the consideration of the information received.

Executive Summary

Fenitrothion is an organophosphate insecticide that is currently used in Australia to control:

- stored product pests in stored cereal grain
- stored product pests in grain storage areas and equipment
- litter beetle in poultry houses
- pasture pests in pasture
- locusts and grasshoppers in limited field, pasture and orchard crops
- sitona weevil in lucerne.

The reconsideration of fenitrothion commenced in 1996, with interim action taken in 2000–01, and a proposed regulatory decision (PRD) published in the APVMA Special Gazette on 9 April 2024.

The PRD was based on contemporary health, environment, residues and trade assessments which found that the ongoing use of fenitrothion products on stored cereal grain was considered acceptable, but all other use patterns were unacceptable based on risks to human health (workers and residues) and/or the environment. The PRD proposed cancellation of the sole ultra-low volume (UL) product as it only included uses that posed an unacceptable risk to the environment.

Nine submissions were received during the public consultation period. These submissions included concerns about the accuracy of daily work rates for structural uses, and the environmental modelling used (see Table 40 in Appendix A). New data provided in these responses allowed refinement of some environmental risk parameters and limited uses of fenitrothion emulsifiable concentrates (EC) products on cereal grain crops and grazing sorghum. These uses were considered acceptable with appropriate restraints to protect the environment and workers using the products. Despite the submission of new information, the uses of the fenitrothion UL product could not be supported based on unacceptable spray drift buffer zones. Submissions received on daily work rates for structural/surface spray uses did not change the position of the APVMA, that the exposure to workers would exceed safe levels, and as such these uses remain unsupported. A summary of the assessment outcomes, including the input from specific areas is presented below in Table 1. For additional detail on overall assessment outcomes, including specific restrictions and restraints recommended for labels, refer to Table 41 in Appendix B.

Table 1: Summary of assessment outcomes for fenitrothion uses.

Situation	Assessment area				Overall Outcome
	Environment	Worker Health and Safety	Residues	Spray drift	
Stored cereal grains (stored product insect pests)	No safety concerns	No safety concerns	No safety concerns	n/a	**Acceptable**

Situation	Assessment area				Overall Outcome
	Environment	Worker Health and Safety	Residues	Spray drift	
Cereal crops and grazing sorghum (locusts and grasshoppers) ***EC formulation ONLY***	**Risk to birds and mammals** (limit application rate and timing; additional instructions required)	**Risk to workers** that can be mitigated (closed M&L, daily work rate restrictions and re-entry restrictions required)	No safety concerns	**Risk to sensitive areas** (limit rate to 330 g ac/ha, no aerial, buffer zones required)	**Acceptable** with restrictions
Cereal crops and grazing sorghum (locusts and grasshoppers) ***UL formulation ONLY***	**Risk to birds and mammals** (limit application rate and timing; additional instructions required)	**Risk to workers** that can be mitigated (closed M&L, daily work rate restrictions and re-entry restrictions required)	No safety concerns	**Unacceptable risk** to aquatic areas	**NOT** acceptable-risk to environment (spray drift)
Grain storage facilities and equipment (stored product insect pests)	No safety concerns	**Unacceptable risk** to workers	No safety concerns	n/a	**NOT** acceptable-risk to human health (WHS)
Poultry houses (Darkling beetle)	**Risk to poultry**(can be mitigated with label statements)	**Unacceptable risk** to workers	No safety concerns	n/a	**NOT** acceptable-risk to human health (WHS)
Lucerne (Sitona weevil)	**Unacceptable risk** to birds and mammals	**Risk to workers** that can be mitigated (closed M&L, daily work rate restrictions and re-entry restrictions required)	**Safety risk** that can be mitigated (yearly application restraint)	Not assessed	**NOT** acceptable-risk to environmental safety
Fodder and forage crops, lucerne (excluding grazing sorghum and cereal crops; locusts and grasshoppers)	**Unacceptable risk** to birds and mammals	**Risk to workers** that can be mitigated (closed M&L, daily work rate restrictions and re-entry restrictions required)	No safety concerns	Not assessed	**NOT** acceptable-risk to environmental safety
Pastures (pasture pests)	**Unacceptable risk** to birds and mammals	**Risk to workers** that can be mitigated (closed M&L, daily work rate restrictions and re-entry restrictions required)	**Unacceptable risk** as residues safety data not available	Not assessed	**NOT** acceptable-risk to human health (residues) and environmental safety

Situation	Assessment area				Overall Outcome
	Environment	Worker Health and Safety	Residues	Spray drift	
Cabbage, lettuce, tomatoes, soybeans (locusts and grasshoppers)	**Unacceptable risk** to birds and mammals	**Risk to workers** that can be mitigated (closed M&L, daily work rate restrictions and re-entry restrictions required)	**Unacceptable risk** as residues safety data not available	Not assessed	**NOT** acceptable-risk to human health (residues) and environmental safety
Apples, grapes, cherries (locusts and grasshoppers)	**Unacceptable risk** to birds and mammals	**Risk to workers** that can be mitigated (closed M&L, daily work rate restrictions and re-entry restrictions required)	**Unacceptable risk** as resides safety data not available	Not assessed	**NOT** acceptable-risk to human health (residues) and environmental safety

1 Introduction

Fenitrothion is a broad-spectrum, non-systemic organophosphorus insecticide that was first introduced to Australia in 1959 (British Crop Production Council, 2016). Fenitrothion is used in Australian agriculture for the control of certain insect pests in broadacre and horticultural crops, in stored grain, in grain storage facilities and in poultry houses. Fenitrothion was nominated for review in response to an invitation to the public by the APVMA (then the NRA) in 1994. The APVMA began its reconsideration of fenitrothion active constituent approvals, product registrations and associated label approvals in 1996 because of concerns relating to chemistry, toxicology, occupational health and safety, efficacy, residues, trade, and the environment.

The APVMA took interim regulatory action on fenitrothion products in 2000–01, following publication of component assessment reports (residues, environmental impact, toxicology, chemistry and occupational health and safety) in 1999. These interim actions were to:

- reduce the label rate for locust and grasshopper control and include buffer zones
- reduce the label rate for control of Sitona weevil in lucerne and include buffer zones
- delete the tobacco use pattern
- limit the number of yearly applications that can be made.

A number of fenitrothion product registrations were voluntarily ceased or cancelled in 2001. These included a range of formulations (liquefied gas, pressurised gas, powder and aerosol) and products intended for home and garden use.

This report only includes the assessment of fenitrothion active constituent approvals, chemical products registrations and label approvals that were placed under review and remain approved or registered.

1.1 Purpose of review

The scope of the fenitrothion chemical review includes the following aspects of active constituent approvals, product registrations and label approvals for fenitrothion:

- Chemistry:
  - Level of impurities of toxicological concern in fenitrothion active constituents and products.
- Toxicology:
  - Consideration of toxicological endpoints, health-based guidance values and poisons scheduling.
- Worker health and safety:
  - Risks to professional workers arising from exposure during handling and application.
  - Risks to professional workers who re-enter treated areas.
  - Determination of appropriate personal protective clothing and engineering control requirements.
  - Establishment of appropriate first aid instructions and safety directions for fenitrothion products.

- Residues and trade:
  - Residues in treated food and animal feeds arising from application in accordance with label instructions.
  - Establishment of appropriate maximum residue limits (MRLs) for supported uses of fenitrothion.
  - Determination of dietary exposure resulting from the consumption of produce treated with fenitrothion.
  - Risks to international trade resulting from the use of fenitrothion on major export commodities.
- Environment:
  - Risks to terrestrial vertebrates, aquatic species, bees, other non-target arthropods, soil organisms and terrestrial plants resulting from application in accordance with label instructions.

In addition to the above assessments, fenitrothion labels are reviewed for consistency with current APVMA policies and guidelines, including the Agricultural Labelling Code and APVMA Spray Drift Policy July 2019.

1.2 Mode of action, product claims and use patterns

Fenitrothion is a group 1B (organophosphorus) insecticide that acts via acetylcholinesterase inhibition and is registered for use in agricultural situations for the control of chewing and sucking insects. It is available in both emulsifiable concentrates (EC) and ultra-low volume (UL) formulations. In Australia, fenitrothion is used in the following situations:

- Cereal grain protection, either alone or in combination with S-methoprene
- Structural protection of grain storage areas and poultry houses
- Control of pests (coleopteran, lepidopteran) in pasture
- Control of Sitona weevil in lucerne
- Control of locusts and grasshoppers in pasture, cereal and horticultural crops

1.3 International regulatory status

Fenitrothion has been reviewed by several international regulators, including the US Environmental Protection Agency (USEPA) in 1995, the European Food Safety Authority (EFSA) in 2007, the Joint Meeting on Pesticide Regulators (JMPR) in 2007, the Canadian Pest Management Regulatory Agency (PMRA) in 2004 and the New Zealand Environmental Protection Authority (NZ EPA) in 2013. It is not listed under the Basel, Rotterdam, or Stockholm conventions.

1.3.1 United States

The USEPA issued a re-evaluation decision in 1995, which cancelled most uses other than ant and cockroach baits in child-resistant packaging. By June 2020 the remaining fenitrothion technical active was cancelled.

1.3.2 European Union

The authorisation for the use of fenitrothion was withdrawn in the EU in 2007 based on human health and environmental concerns. Exposure to workers was unacceptable in most outdoor scenarios and there was an identified risk to consumers of residues in grapes. Environmental risks to birds, mammals, bees, and aquatic species were also identified.

1.3.3 Canada

The Health Canada Pest Management Regulatory Agency restricted fenitrothion to limited forestry uses in their 2004 reconsideration and it was subsequently voluntarily discontinued.

1.3.4 New Zealand

A reassessment of fenitrothion was completed in July 2013 and its use phased out by July 2016. Overall, the risks to workers, bystanders and the environment ranged from negligible to medium, however as there were no critical uses identified, the benefit of retaining fenitrothion was considered low.

1.3.5 India

The use of fenitrothion was restricted in 2007 to public health applications (for example, mosquito control) and restricted locust control in desert areas.

1.4 Public consultation

The APVMA published the draft Fenitrothion Review Technical Report on 9 April 2024, in conjunction with the Fenitrothion Proposed Regulatory Decision, and conducted a 3 month public consultation. The APVMA received 9 submissions to the public consultation. Where consent to publish the submissions was provided, the submissions have been published on the APVMA website.

This document includes a summary of the APVMA's chemistry, toxicology, worker health and safety, residues and trade and environment assessments, which have been amended based on the consideration of the submissions received in the public consultation.

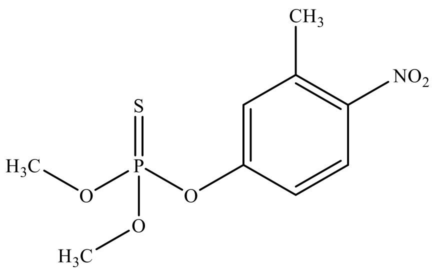
A summary of the submissions received by the APVMA in this public consultation, and the APVMA's response to the matters raised in these submissions, is listed in Table 40, Appendix A of this report.

2 Chemistry

2.1 Active constituent

The nomenclature and structural formula of the active constituent fenitrothion are provided in Table 2.

Table 2: Nomenclature and structural formula of the active constituent fenitrothion

Parameter	Nomenclature and structure
Common name (ISO):	Fenitrothion
IUPAC name:	*O,O*-dimethyl *O*-(3-methyl-4-nitrophenyl) phosphorothioate
CAS registry number:	122-14-5
Molecular formula:	$C_9H_{12}NO_5PS$
Molecular weight:	277.2 $gmol^{-1}$
Structural formula:	

Fenitrothion is a liquid at room temperature (colourless in the case of the pure active ingredient, and yellow-brown in the case of the technical active ingredient). It is practically insoluble in water, while being soluble in aliphatic hydrocarbons, and highly soluble in alcohols, esters, ketones, aromatic hydrocarbons, and chlorinated hydrocarbons. Fenitrothion is relatively more stable to hydrolysis under acidic and neutral conditions (half-life of 180 to 200 days), and less stable under alkaline conditions (half-life of ~100 days). It is rapidly photolysed, with a half-life of approximately 3 days. Further details of the physicochemical properties of fenitrothion are tabulated in Table 3 below (JMPR 2003).

Table 3: Key physicochemical properties of the active constituent fenitrothion

Parameter	Physicochemical property
Appearance	Colourless, viscous liquid (pure active ingredient, 99% purity) Yellow-brown liquid with a faint characteristic odour (technical active ingredient)
Melting point	0.3 °C
Boiling point	140–145 °C (0.1 mm Hg, decomposes)
Specific gravity	1.328 (25 °C)

Parameter	Physicochemical property
Solubility in water	19 mg/L (20 °C)
Organic solvent solubility (g/L, 20 °C)	Hexane: 24 Isopropanol: 138 Readily soluble in alcohols, esters, ketones, aromatic hydrocarbons and chlorinated hydrocarbons.
Octanol/water partition coefficient (Log K_{ow})	3.43 (20 °C)
Vapour pressure	1.48×10^{-4} Pa (10 °C) 6.76×10^{-4} Pa (20 °C) 1.57×10^{-3} Pa (25 °C, interpolated) 3.39×10^{-3} Pa (30 °C)
Henry's law constant (calculated)	0.0099 Pa.m^{3}mol^{-1} (20 °C)
Hydrolysis (DT50, 25 °C)	pH 5: 191–200 days pH 7: 180–186 days pH 9: 100–101 days
Aqueous photolysis (DT50, 25 °C)	pH 5: 3.3–3.7 days (2 kW xenon lamp, ≥ 290 nm, 10 hours light/14 hours darkness cycle)

There is currently only one active constituent approval for fenitrothion (Table 4).

Table 4: Current active approvals for fenitrothion

Approval number	Holder
44499	Sumitomo Chemical Australia Pty Ltd

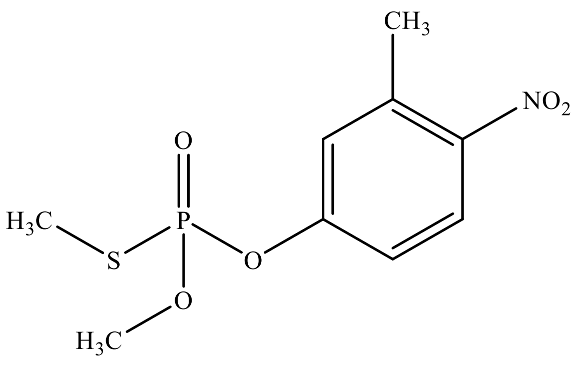
The Agricultural and Veterinary Chemicals Code (Agricultural Active Constituents) Standards 2022 (Agricultural Active Constituents Standard 2022) for fenitrothion, as excerpted in Table 5 below, and the Food and Agriculture Organization of the United Nations (FAO) specification for fenitrothion technical material (TC) (FAO 2010) specify a minimum purity of 930 g/kg, with maximum levels for 2 toxicologically significant impurities of 5 g/kg for S-methyl fenitrothion and 3 g/kg for tetramethyl pyrophosphorothioate (TMPP).

Table 5: Agricultural Active Constituents Standard 2022 for fenitrothion

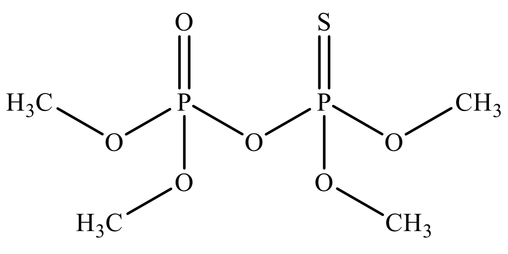
Identity	Description	Minimum purity	Maximum impurity
Common Name: Fenitrothion Chemical Name: Dimethoxy-(3-methyl-4-nitrophenoxy)-sulfanylidene-λ5-phosphane CAS Number: 122-14-5	The material shall consist of fenitrothion together with related manufacturing impurities and shall be a yellow to brown liquid free from extraneous matter and added modifying agents.	930 g/kg minimum	S-methyl fenitrothion: 5 g/kg maximum Tetramethyl pyrophosphorothioate (TMPP): 3 g/kg maximum

Both S-methyl fenitrothion and tetramethyl pyrophosphorothioate (Figure 1) have higher acute toxicity than fenitrothion itself, as reported by the Joint Meeting on Pesticide Specifications (JMPS) in 2009 (FAO 2010).

Figure 1: Structures of toxicologically significant impurities in fenitrothion



S-methyl fenitrothion (*O,S*-dimethyl *O*-(3-methyl-4-nitrophenyl) phosphorothioate), CAS number 3344-14-7



Tetramethyl pyrophosphorothioate (TMPP), CAS number 18764-12-0000

The APVMA has considered batch analysis results and certificates of analysis for the currently approved source of fenitrothion active constituent, and confirmed compliance with the manufacturer's own specifications (Declaration of Composition), the Agricultural Active Constituents Standard 2022 for fenitrothion and the FAO specification for fenitrothion technical active constituent (TC). The APVMA has also considered real time and accelerated stability information for this active constituent approval, which confirmed that technical fenitrothion is expected to remain in compliance with the Agricultural Active Constituents Standard 2022 for fenitrothion and the FAO specification for fenitrothion TC when stored for at least 2 years under normal conditions.

2.2 Formulated products

There are currently 8 registered chemical products containing fenitrothion, formulated as 3 different formulation types: 4 emulsifiable concentrate (EC) formulations containing 1,000 g/L fenitrothion, one ultra-low volume liquid (UL) product containing 1,230 g/L fenitrothion, and 3 EC formulations containing 600 g/L fenitrothion in combination with 60 g/L (S)-methoprene.

Table 6: Currently registered products containing fenitrothion

Registration number	Holder	Product name
Emulsifiable concentrate (EC) formulation containing 1,000 g/L fenitrothion		
46127	Babolna Bioenvironmental Centre Ltd	Methograin Fenitrothion 1000 Insecticide
50775	Sumitomo Chemical Australia Pty Ltd	Sumithion 1000 EC Insecticide
56170	Kendon Plant Care Pty Ltd	Kendon Fenitrothion 1000 EC Insecticide
67186	Freezone Public Health Pty Ltd	Freezone Fenitrothion Insecticide
Ultra-low volume liquid (UL) formulation containing 1,230 g/L fenitrothion		
50774	Sumitomo Chemical Australia Pty Ltd	Sumitomo Sumithion ULV Premium Grade Insecticide
Emulsifiable concentrate (EC) formulation containing 600 g/L fenitrothion and 60 g/L (S)-methoprene		
66520	Sumitomo Chemical Australia Pty Ltd	Grain-Guard Duo Insecticide
67567	Freezone Public Health Pty Ltd	Freezone Smart Grain Dual Insecticide
91551	Freezone Public Health Pty Ltd	Titan Dual Grain Treatment

The APVMA has not established any standards under section 6E of the Agvet Code for chemical products containing the active constituent fenitrothion. The FAO specification for fenitrothion includes specifications for chemical products with EC and UL formulations, with maximum limits specified for both of the toxicologically significant impurities S-methyl fenitrothion and tetramethyl pyrophosphorothioate (TMPP).

It was noted by JMPS in the 2009 evaluation accompanying the FAO specification that levels of S-methyl fenitrothion can increase on storage in both technical fenitrothion and in fenitrothion formulations, particularly at elevated temperatures, or in the presence of other formulation ingredients (notably, anionic surfactants, which are commonly used as emulsifiers in EC formulations) (FAO 2010). Therefore, limits for S-methyl fenitrothion, allowing for possible increases during storage, were included the FAO specifications for fenitrothion EC and UL formulations.

TMPP on the other hand, can be formed during the manufacture of fenitrothion, but is not likely to increase in technical fenitrothion or formulated products during storage. Therefore, while maximum limits for TMPP were included in the FAO specification for fenitrothion EC and UL formulations, it was not necessary to allow for increases in TMPP levels during storage, and the maximum limits were set at 0.3% of the fenitrothion content, i.e.

allowing only for TMPP carried over as an impurity formed during the manufacture of fenitrothion technical active constituent.

It was further noted by JMPS that water is a relevant impurity in EC and UL formulations, as it can contribute to the degradation of fenitrothion, and that pH likewise, is a relevant physicochemical property. Maximum limits for water in EC and UL formulations were recommended, along with a required pH range (to prevent degradation of fenitrothion at low pH or hydrolysis at high pH).

It is recommended that APVMA product standards be established under section 6E of the Agvet Code for fenitrothion EC and UL formulations, and for the fenitrothion and S-methoprene combination EC formulation, based on the FAO specifications. It is further recommended that holders be required to provide batch analyses and stability data for the formulated products to confirm compliance with the relevant FAO specification and the proposed APVMA s6E standard.

2.3 Chemistry recommendations

The APVMA is satisfied of the chemistry and manufacturing aspects of the safety and efficacy criteria for fenitrothion active constituent and formulated products, noting the following:

- The APVMA proposes to establish a standard under section 6E of the Agvet Code for fenitrothion EC and UL formulations, harmonised with the FAO specifications as appropriate and incorporating limits for active content, S-methyl fenitrothion, tetramethyl pyrophosphorothioate, water and pH. The specifications proposed to be included in this section 6E standard are included in Table 7 below.
- It is proposed that the APVMA apply a condition on all product holders to provide batch results and stability data within 12 months of the final regulatory decision for the fenitrothion chemical review to confirm compliance with the proposed specifications for fenitrothion chemical products as set out in Table 7.

Table 7: The proposed specifications for fenitrothion chemical products

Chemical	Formulation type	
	EC	UL
Fenitrothion[1]	Above 250 g/L up to 500 g/L: ±5% of the declared content Above 500 g/L: ±25 g/L	Above 250 g/L up to 500 g/L: ±5% of the declared content Above 500 g/L: ±25 g/L
(S)-methoprene[1] (where applicable)	Up to 25 g/L: ±15% of the declared content Above 25 g/L up to 100 g/L: ±10% of the declared content Above 100 g/L up to 250 g/L: ±6% of the declared content Above 250 g/L up to 500 g/L: ±5% of the declared content Above 500 g/L: ±25 g/L	N/A

Chemical	Formulation type	
	EC	UL
S-methyl fenitrothion[2]	Max. 2.0% of the fenitrothion content	Max. 2.5% of the fenitrothion content
Tetramethyl pyrophosphorothioate (TMPP)[2]	Max. 0.3% of the fenitrothion content	Max. 0.3% of the fenitrothion content
Water	Max. 2 g/L	Max. 2 g/L
pH (CIPAC MT75.3)	3–6	3–6

[1]Allowable ranges of fenitrothion concentrations in products are as specified in the *Agricultural and Veterinary Chemicals Code (Allowable Variations in Concentrations of Constituents in Agricultural Chemical Products) Standard 2022*.

[2]Concentration percentages for all impurities in products are relative to the concentration of active in the product.

3 Toxicology

3.1 Evaluation of toxicology

Fenitrothion is an organophosphorus (OP) insecticide. It functions via inhibition of acetylcholinesterase (AChE) activity, which results in an excess of acetylcholine (ACh) in the synaptic cleft, causing hyperstimulation of ACh receptors and impaired transmission of nerve impulses. Symptoms of acute poisoning from OPs include agitation, muscle weakness and/or twitching, pupil constriction, excess salivation, and sweating. Severe poisonings may cause respiratory failure, unconsciousness, confusion, convulsions and/or death.

In 1999, the APVMA (then the NRA) published a detailed assessment of the mammalian toxicology of fenitrothion (APVMA 1999d) and an assessment of the occupational health and safety of the products and associated uses that were registered at that time (APVMA 1999b). The toxicology database for fenitrothion is complete and there is high confidence in the regulatory quality of the information contained therein.

Since the 1999 publications, several reports related to possible adverse effects that may result from exposure to fenitrothion have been published in a variety of scientific publications. These more recent investigations sought to examine endpoints and markers for reproductive and developmental toxicity, to include androgenic, anti-androgenic, oestrogenic, or anti-oestrogenic effects. Other endpoints, such as hepatotoxicity, cognitive deficiencies and ChE inhibition were identified as being characterised previously for fenitrothion and for OP pesticides in general. None of the identified studies report a No Observed Adverse Effect Level (NOAEL) that is more sensitive than those already relied-on for health-based guidance values for fenitrothion. The doses tested in these studies were generally limited, in some cases designed to administer doses already known to cause cholinesterase (ChE) inhibition or toxicity. The new studies build upon the toxicological database, and do not introduce any endpoints that would alter the existing hazard assessment of fenitrothion.

In addition, more recent acute toxicity studies were submitted and evaluated by the APVMA. The results of the assessment of this data indicate that fenitrothion is moderately toxic via the oral route of exposure (Moon 2010a), of low toxicity via the dermal route of exposure (Moon 2010b), is not irritating to the skin of rabbits (Ota 2010a), slightly irritating to rabbit eyes (Ota 2010b) and is not a skin sensitiser in guinea pigs (Kawabe 2010) when tested according to the Buehler method. These results are consistent with existing data on file for fenitrothion.

3.2 Health based guidance values

3.2.1 Acceptable daily intake

The acceptable daily intake (ADI) for fenitrothion is 0.002 mg/kg bw/day based on a 1 year dietary study in dogs (Griggs *et al*., 1984). The NOAEL for this study was based on the absence of plasma cholinesterase inhibition at 0.2 mg/kg bw/day (5ppm), with plasma cholinesterase inhibition seen in female beagles at the next highest dose (10 ppm). A total uncertainty factor of 100 was used (x10 for interspecies variation and x10 for intraspecies variation).

3.2.2 Acute reference dose

The acute reference dose (ARfD) of 0.03 mg/kg bw is based on a single dose study using human volunteers (Nosál M & Hladká A, 1968). The NOAEL of 0.33 mg/kg bw was based on the absence of inhibition of plasma and erythrocyte cholinesterase activity at the highest tested dose. As the study was conducted in human subjects, a 10-fold uncertainty factor for intraspecies variation was applied.

3.3 Poisons scheduling

The Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) classifies fenitrothion as Schedule 6, with no cut-offs or exceptions.

There are no proposed changes to the poisoning scheduling of fenitrothion.

4 Worker health and safety

4.1 Previous assessments

In 1999, the APVMA (then the NRA) published an interim occupational health and safety (OHS) assessment for fenitrothion (APVMA 1999b). A Margin of Exposure (MOE) approach was used that involved a calculation of the ratio between estimated exposure and a relevant NOAEL(s) as established in the interim toxicology report (APVMA 1999d).

The APVMA has substantially changed its approach to exposure assessment since the publication of its interim OHS assessment on fenitrothion in 1999. This necessitated a re-evaluation of exposures and risk characterisations associated with the uses of fenitrothion.

4.2 Worker exposure assessment

Professional use involves repeated occupational exposure to fenitrothion, principally via the dermal route. Most of the registered uses include limited applications to the treated crops (e.g., 1–3 per season, although some may be higher). Accordingly, the most appropriate point of departure (POD) for occupational risk characterisation is 3 mg/kg bw/day. This POD is the no observed adverse effect level (NOAEL) for inhibition of blood cholinesterases in rabbits following dermal exposure to fenitrothion for 21 days (Suetake *et al*.,1991). A margin of exposure (MOE) of 100 was applied to account for inter- and intra-species uncertainties. The point of departure for incidental oral exposure and inhalation exposure is 0.2 mg/kg bw/day, which is the NOAEL from a one-year dietary toxicity study in dogs (Griggs *et al*., 1984).

For exposure during mixing, loading and application the current assessment has utilised the US EPA Office of Pesticide Programs Occupational Handler Exposure Calculator (OPHEC; US EPA 2020a). For exposure associated with re-entry into pesticide treated area, the current assessment has utilised the US EPA Occupational Pesticide Re-entry Exposure Calculator (OPREC; US EPA 2020b). For exposure associated with the on-farm handling of fenitrothion treated seed grain the current assessment has utilised the US EPA seed treatment calculator (US EPA 2022).

The following assumptions have been used in the exposure modelling (see Table 8):

Table 8: Assumptions used in modelling exposure for professional use of fenitrothion

Parameter	Value(s)/model(s)
POD for risk assessment (dermal exposure)	3 mg/kg bw/day
POD for risk assessment (oral and inhalation exposure)	0.2 mg/kg bw/day
Acceptable margin of exposure (MOE)	100*
Body weight (adult)	80 kg

Parameter	Value(s)/model(s)
Body weight (child)	1–2 y = 11 kg 2–3 y = 15 kg
Dermal absorption factor	Not required (dermal study for POD)
Inhalation absorption factor	100%
Airblast foliar application (orchard/vineyard)	30 ha/day
Groundboom inter-row application (orchard/vineyard)	30 ha/day
Groundboom field application (typical crops)	50 ha/day
Groundboom field application (broadacre uses)	600 ha/day
Aerial application	Baseline 600 ha/day Upper limit 1,000 ha/day
Backpack application (mixer, loader, applicator)	10 x 15 L refills = 150 L/day
Manually pressurized hand wand application	150 L/day
Mechanically pressurized handgun application	Structural components (e.g. walls, framing, voids, slabs, beams, lumber, etc.) = 4,000 L/day default, 1,500 L/day after consultation. Poultry house (whole-house treatment of litter, walls, etc.) = 0.8 ha/day (2 acres)
Exposure modelling	Professional agricultural operators and commercial and on-farm grain protectant uses: A. Mixing, loading and application for agricultural and structural/surface treatment uses: US EPA Occupational Handler Exposure Calculator (OPHEC) B. Commercial and on-farm seed treatment uses: US EPA Seed treatment exposure calculator Agricultural re-entry workers: Post-application exposure: US EPA Occupational Pesticide Re-entry Exposure Calculator (OPREC)

* As a NOAEL from an animal study was used to estimate risks, a MOE ≥ 100 was considered acceptable. This value is based on a 10-fold uncertainty factor (UF) for intra-species variability and 10-fold UF for inter-species differences in response.

The exposure assessments and risk characterisations for fenitrothion also rely upon a further set of reasonable assumptions, notably that:

- mixing, loading and application is performed by trained, professional operators

- professional operators using fenitrothion wear a long-sleeved shirt, long pants, shoes and socks or an equivalent single layer of clothing as a baseline
- professional operators are capable of accurately measuring, dispensing, and applying products according to the directions specified on product labels, and are trained in and are competent and experienced users of personal protective equipment (PPE), and relevant application techniques and equipment
- professional operators comply with the PPE specified on product labels and comply with label-specific application rates
- professional operators perform only one type of use or activity per day (e.g. the same operator would not undertake groundboom fenitrothion treatment of horticultural crop(s) and performing grain protectant application of fenitrothion on the same day)
- for ground application, a single operator performs all steps in the use of fenitrothion products that are applied by ground application methods, i.e. a single operator mixes, loads and applies the pesticide during product use
- for aerial application, mixing and loading activities are performed by someone other than the pilot.

The exposure assessments and risk characterisations also assume that there are no concurrent co-exposures to other anticholinesterase substances (the effects of which are likely to be at least additive to those of fenitrothion due to their common mode of action).

4.2.1 Grain protectant treatment for bulk storage

Modelling for the use of fenitrothion as a grain protectant in bulk storage facilities was undertaken using a reverse exposure approach. It was assumed that exposure to fenitrothion during the application process is negligible as specialized equipment is used to treat the grain/seed using nozzles integrated into the auger or using a shielded sprayer on the conveyor belt that transfers the grain into the storage silos. Therefore, the calculation to determine the quantity of fenitrothion that could be handled in a single day was based on unit exposures for open mixing/loading of a liquid in an outdoor environment and assumed that the PPE currently recommended on product labels was worn by individuals performing that task (that is: cotton overalls, buttoned to the neck and wrist and washable hat, elbow-length chemical resistant gloves and face shield). The label rate for that use is 6–12 g ac/tonne of grain treated.

Using the above assumptions, a single operator would reach the threshold of acceptable risk at 28.5 kg product handled in a single day. This equates to treating 4,750 tonnes of grain at the low application rate (6 ppm) or 2,375 tonnes of grain at the high application rate (12 ppm). It is expected that a single operator would be unlikely to reach these daily rates and that the use of fenitrothion on grains entering bulk storage, according to existing label directions, remains acceptable.

Seed treatment with fenitrothion is not specifically mentioned on labels; however, treated stored seed grains could conceivably be used as seed. The US EPA seed treatment calculator (US EPA 2022) was used to determine occupational exposure and risk estimates for commercial and on-farm application of fenitrothion to lucerne, barley, canola, corn, flax, lentil, millet, oats, okra, rice, rye, safflower, sorghum, soybean, triticale and wheat at 6 and 12 ppm, assuming operator PPE was used as currently prescribed on registered product labels (i.e. single layer of clothing buttoned to the neck and wrist and elbow-length chemical resistant gloves). Risk estimates were derived for short-term and intermediate term exposure durations, and included the following activities: treating seed, packaging seed, loading, and planting treated seed, and cleaning seed treatment equipment. The exposure estimates yielded acceptable MOEs for all the crops noted above, hence on-farm treatment of seed grains with fenitrothion according to existing label directions remains acceptable.

4.2.2 Surface treatment for bulk stored cereal grains, structural treatments for grain storage and use in poultry sheds

Fenitrothion is used as a structural and surface spray in a limited number of scenarios. The dilution rate for all these uses is 1 L product per 100 L water. As a surface spray for grain storage and associated structural treatments, the diluted solution is applied at a rate of 1 L per 20 m^2 (or to the point of runoff). In poultry sheds, 1 L of dilute spray treats 7 m^2.

It is assumed that the product could be applied in these scenarios using a variety of application methods, including backpack sprayers, manually pressurized hand wands or mechanically pressurized handguns. Risk estimates were determined for a single mixer/loader/applicator for each of these application methods, using the default volumes in OPHEC. Feedback provided during the consultation process suggested that default volumes overestimated daily use, and therefore risk, so additional consultation was undertaken. Consultation with grain handling stakeholders provided daily use rate estimates of up to 144 L for backpack sprayer and 1500 L for mechanically pressurised handgun. Modelling using these values increase the MOE in comparison to default values, but not to an acceptable level. The results are presented in Table 9 below, which shows that no structural or surface treatments for grain protection are acceptable, nor is the use of fenitrothion in poultry sheds.

Table 9: Risk estimates for the use of fenitrothion as a structural or surface treatment for grain protection and as a structural treatment in poultry sheds

Application method	Scenario	Amount handled/ area treated	MOE[1] with modelled PPE[2]
Backpack sprayer	Structural/surface[3]	150 L	45
Manually pressurized hand wand	Structural/surface[3]	150 L	11
Mechanically pressurized handgun	Structural/surface[3]	4,000 L (default)	7
Mechanically pressurized handgun	Structural/surface[3]	1,500 L (daily rate based on consultation)	19
Mechanically pressurized handgun	Poultry shed (including litter, walls and roof)	0.8 ha	25

[1] Acceptable MOE>100

[2] Double layer of clothing, chemical resistant gloves and PF50 (full face) respirator. OPHEC does not include data for exposure mitigation with chemical resistant hat, and there is no engineering control available to mitigate risk for these application methods.

[3] Structural treatments include cereal grain storage on farms, produce stores, feed and flour mills, warehouses and processing plants, transport equipment and animal feed bins, and surface treatment includes bulk stored cereal grain (surface application) and stacks of grain bags.

4.2.3 Field crops

4.2.3.1. Ground-based application

4.2.3.1.1. Groundboom application

The basic assumptions for groundboom application to field crops is a default area treated per day of 50 ha, as noted in Table 8. It is however recognised, that modern groundboom equipment can cover a significantly greater area in a single workday, with boom widths approaching 50 m and typical speeds of application of approximately 20 km/hr. It is considered reasonable that a single operator could treat up to a maximum of 600 ha in one day.

The outcomes for the exposure risk assessment for the use of fenitrothion in field crops and pasture are outlined in Table 10. The field crops that are covered by these risk estimates below include those listed on the registered product labels: horticultural crops including cabbage, lettuce and tomatoes as well as pasture, pasture seed forage and cereal crops (including sorghum, lucerne, soybean, wheat, barley, oats, rice, millet, rye, triticale, and corn).

It is recognised that the implementation of additional risk mitigation measures will decrease individual exposure, translating to a higher margin of exposure. Therefore, Table 10 includes both the minimum PPE and/or engineering control requirements for the various product application rates at the default area treated rate of 50 ha/day, and the maximum daily work rates permitted when fully closed mixing and loading and closed cab application is used.

The use of closed mixing and loading systems (for example, addition of sealed, lockable valves resulting in closed transfer of the product from its packaging to the spray tank) minimises operational exposure, therefore the use of closed mixing and loading as an engineering control would reduce fenitrothion exposure during mixing and loading.

Table 10: Risk estimates for the use of fenitrothion in field crops using groundboom application

Crop	Application rate (g ac/ha)	Area treated/day (ha)	Minimum PPE and/or engineering controls required in modelled scenario	Mixer/ loader MOE	Applicator MOE	Total MOE[1]
Lucerne	250	50	Single layer, gloves	210	400	137
		450 (max)[2]	Closed mixing/loading, closed cab application	230	180	101
Pasture, pasture seed, forage (including lucerne), cereal crops, cabbage, lettuce and tomato	270	50	Single layer, gloves	190	380	126
		400 (max)[2]	Closed mixing/loading, closed cab application	240	180	103
Pasture, pasture seed, forage (including lucerne), cereal crops, cabbage, lettuce and tomato	300	50	Single layer, gloves	170	340	113
		350 (max)[2]	Closed mixing/loading, closed cab application	240	190	106

Crop	Application rate (g ac/ha)	Area treated/day (ha)	Minimum PPE and/or engineering controls required in modelled scenario	Mixer/ loader MOE	Applicator MOE	Total MOE[1]
Pasture, pasture seed, forage (including lucerne), cereal crops, cabbage, lettuce and tomato	330	50	Single layer, gloves	160	310	105
		320 (max)[2]	Closed mixing/loading, closed cab application	240	190	106
Pasture, pasture seed, forage (including lucerne), cereal crops, cabbage, lettuce and tomato	350	50	Double layer, gloves	190	350	123
		300 (max)[2]	Closed mixing/loading, closed cab application	240	190	106
Pasture, pasture seed, forage (including lucerne), cereal crops, cabbage, lettuce and tomato	400	50	Double layer, gloves	160	310	105
		250 (max)[2]	Closed mixing/loading, closed cab application	260	200	113
Pasture	480	50	Double layer, gloves, half facepiece respirator	150	350	105
		200 (max)[2]	Closed mixing/loading, closed cab application	270	210	118
Pasture, pasture seed, cereal crops, grazing sorghum and lucerne	492 (UL)	50	Double layer, gloves, half facepiece respirator	150	340	104
		200 (max)	Closed mixing/loading, closed cab application	260	200	113
Pasture	500	50	Double layer, gloves, half facepiece respirator	150	330	103
		200 (max)[2]	Closed mixing/loading, closed cab application	260	200	113
Pasture	550	50	Double layer, gloves, closed cab application	120	730	103
		50	Closed mixing and loading, gloves, single layer for application	930	180	150
		200 (max)[2]	Closed mixing/loading, closed cab application	230	180	101
Lucerne	650	50	Closed mixing/loading, gloves, single layer for application	790	160	133

Crop	Application rate (g ac/ha)	Area treated/day (ha)	Minimum PPE and/or engineering controls required in modelled scenario	Mixer/ loader MOE	Applicator MOE	Total MOE[1]
		150 (max)[2]	Closed mixing/loading, closed cab application	270	210	118
Pasture	700	50	Closed mixing/loading, gloves, single layer for application	730	140	117
		150 (max)[2]	Closed mixing/loading, closed cab application	240	190	106
Pasture	800	50	Closed mixing/loading, gloves, single layer for application	640	130	108
		130 (max)[2]	Closed mixing/loading, closed cab application	250	190	108
Pasture	1,000	50	Closed mixing/loading, gloves, single layer and half facepiece respirator for application	520	130	104
		110 (max)[2]	Closed mixing/loading, closed cab application	230	180	101
Pasture	1,200	50	Closed mixing/loading, closed cab application	430	330	186
		90 (max)[2]	Closed mixing/loading, closed cab application	240	180	102
Pasture	1,300	50	Closed mixing/loading, closed cab application	390	300	170
		80 (max)[2]	Closed mixing/loading, closed cab application	250	190	108

[1] Acceptable MOE>100

[2] The maximum daily work rate that is supported in scenario modelled.

4.2.3.1.2. Misting application

There is one UL product (1,230 g/L) and multiple EC products (1,000 g/L) that include instructions for ground-based misting application, in addition to air-assisted, electrostatic, and boom spray applications. Exposures from mixing and loading for application by mister is identical to that for groundboom application. While exposures to applicators resulting from misting applications may be slightly higher than those resulting from ground boom applications, overall MOEs are acceptable.

4.2.3.2. Aerial application

For aerial application, it is assumed that the individual undertaking the mixing/loading activities is someone other than the pilot. Therefore, separate exposure and risk estimates were determined for mixing/loading and application of products containing fenitrothion. Where aerial application is indicated on currently registered product labels, a maximum application rate has been specified. For the 1,000 g/L EC products (APVMA registration numbers 50775, 56170 and 67186), the upper limit for aerial application on current labels is 350 g ac/ha. For the UL product (APVMA registration number 50774), aerial application is recommended for rates up to 492 g ac/ha (the maximum label rate.

The risk estimates presented in Table 11 assume that operators are using closed mixing/loading systems and are wearing gloves, and that pilots are in enclosed cockpits wearing gloves (consistent with the data that supports OPHEC unit exposure values for those activities). Current labels include a restraint for human flaggers in aerial applications whereby they must be protected by engineering controls such as enclosed cabs. It is expected that the use of human flaggers is no longer practiced by aerial applicators, hence the restraint may not be necessary. However, exposure modelling using OPHEC includes estimates of exposure to flaggers, and without engineering controls, the risk is unacceptable. Therefore, if the practice of using human flaggers is undertaken, the restraint must remain on any registered product labels.

Table 11: Risk estimates for the use of fenitrothion in field crops using aerial application

Crop	Application rate (g ac/ha)	Area treated/day (ha)	Mixer/loader MOE[1]	Pilot MOE[2]
Lucerne	250	600	170	330
		1,000 (max)[3]	110	200
Pasture, pasture seed, forage (including lucerne), cereal crops, cabbage, lettuce and tomato	270	600	160	310
		900 (max)[3]	110	200
Pasture, pasture seed, forage (including lucerne), cereal crops, cabbage, lettuce and tomato	300	600	140	280
		800 (max)[3]	110	210
Pasture, pasture seed, forage (including lucerne), cereal crops, cabbage, lettuce and tomato	350	600	120	240
		700 (max)[3]	110	200
Pasture, pasture seed, forage (including lucerne), cereal crops, cabbage, lettuce and tomato	492 (UL)	500 (max)[3]	110	200

[1] Acceptable MOE>100, assumes closed mixing/loading systems are used.

[2] Acceptable MOE>100, assumes gloves and enclosed cockpit.

[3] The maximum daily work rate that is supported in scenario modelled.

4.2.4 Orchard and vineyard crops

Orchard and vineyard uses of fenitrothion are limited to use in apples, cherries, and grapes to control grasshoppers and locusts. The default area treated per day is 30 ha, and modelling larger areas was not performed.

4.2.4.1. Groundboom application

As a ground directed spray, exposure modelling was performed for broadcast application using ground boom spraying equipment. Exposure estimates in these scenarios are for a single operator performing mixing, loading and application activities, wearing the recommended PPE on registered product labels (that is, cotton overalls, buttoned to the neck and wrist and washable hat, elbow-length chemical resistant gloves and face shield).

Table 12: Risk estimates for the use of fenitrothion in orchard and vineyard crops using groundboom application

Crop	Application rate (g ac/ha)	Area treated/day (ha)	Minimum PPE and/or engineering controls required in modelled scenario	Mixer/ loader MOE	Applicator MOE	Total MOE[1]
Apples, cherries and grapes	270	30	Single layer, gloves	320	620	211
	300	30	Single layer, gloves	290	560	191
	400	30	Single layer, gloves	220	430	145
	550	30	Single layer, gloves	160	310	105

[1] Acceptable MOE>100

4.2.4.2. Airblast application

While it is expected that the application of fenitrothion in these scenarios is a ground directed spray, and that it is not applied to the foliage of these commodities, there is no restraint specified on current label to prevent foliar application to these crops. If airblast application is conducted in the limited orchard and vineyard scenarios above, closed cab application equipment is mandatory to achieve acceptable margins of exposure. The total MOEs for mixer/loaders/applicators using closed cab application remains acceptable.

4.2.4.3. Misting application

There is one UL product (1,230 g/L) and multiple EC products (1,000 g/L) that include instructions for ground-based misting application, in addition to air-assisted, electrostatic, and boom spray applications. Exposures resulting from mixing and loading for misting applications are identical to those for mixing and loading for airblast. In the limited application scenarios set out above, the total MOEs for mixer/loader/applicators using closed cab application remains acceptable.

4.3 Re-entry and re-handling exposure assessments and risk characterisations

Re-entry interval modelling was performed using OPREC with the baseline assumptions in Table 8 and the following additional assumptions about re-entry exposure:

- Re-entry exposure occurs principally via the dermal route with inhalation exposure considered negligible.
- Re-entry exposure assessments and risk characterisations assume that there were no concurrent co-exposures to other anticholinesterase products.

While orchard and vineyard use of fenitrothion is expected to be ground application to control grasshoppers and locusts, the product labels do not preclude foliar application. Therefore, post-application exposure and risk assessments were determined for various activities in the relevant crops (that is, apples, cherries and grapes).

Existing product labels do not include re-entry statements. Unless otherwise specified, a standard re-entry period should be respected. All labels[1] should include at least the following re-entry statement:

> **DO NOT enter treated areas until the spray has dried. If prior entry is necessary, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow-length chemical resistant gloves. Clothing must be laundered after each day's use.**

In addition to the general re-entry restraint, the following specific re-entry intervals outlined in Table 13 must be added to the relevant product labels and respected by re-entry workers. As set out in Table 13, the use of fenitrothion on corn at rates greater than or equal to 400 g ac/ha and use of fenitrothion on grapes at rates greater than or equal to 300 g ac/ha have re-entry periods of more than 30 days, which is considered impractical from a risk management perspective. On this basis, these uses of fenitrothion are not supported.

Table 13: Minimum re-entry intervals for post-application activities by crop and application rate

Application rate (g ac/ha)	Crop	Activity	Minimum re-entry interval (days)
250	Lucerne	Scouting	8
		Irrigation (handset)	14
270	Lucerne, barley, forage crops, rice, soybean, wheat	Scouting	9
		Irrigation (handset)	14
	Apples, cherries	Scouting, hand pruning, training	4
		Hand harvesting	11
		Fruit thinning	20

[1] excluding bulk stored grain uses where re-entry is not relevant

Application rate (g ac/ha)	Crop	Activity	Minimum re-entry interval (days)
	Cabbage	Scouting, harvesting, hand and mechanically assisted	11
		Irrigation (handset)	14
		Hand weeding	22
	Corn	Scouting	9
		Irrigation (handset)	14
		Detasseling, hand harvesting	29
	Lettuce	Hand harvesting	9
		Irrigation (handset)	14
	Grapes	Scouting, propagating, hand pruning, hand weeding, bird control, trellis repair	5
		Tying/training, hand harvesting, leaf pulling	30
		Irrigation (handset)	14
	Tomato	Hand harvesting, tying/training	9
		Irrigation (handset)	14
300	Lucerne, barley, forage crops, rice, soybean, wheat	Scouting	10
		Irrigation (handset)	15
	Apples, cherries	Scouting, hand pruning, training	4
		Hand harvesting	12
		Fruit thinning	21
	Cabbage	Scouting, harvesting, hand and mechanically assisted	12
		Irrigation (handset)	15
		Hand weeding	23
	Corn	Scouting	10
		Irrigation (handset)	15
		Detasseling, hand harvesting	30

Application rate (g ac/ha)	Crop	Activity	Minimum re-entry interval (days)
	Lettuce	Hand harvesting	10
		Irrigation (handset)	15
	Grapes	Scouting, propagating, hand pruning, hand weeding, bird control, trellis repair	5
		Tying/training, hand harvesting, leaf pulling	**>30 (impractical)**
		Irrigation (handset)	15
	Tomato	Hand harvesting, tying/training	10
		Irrigation (handset)	15
330	Lucerne, barley, forage crops, rice, soybean, wheat	Scouting	11
		Irrigation (handset)	16
400	Lucerne, barley, forage crops, rice, soybean, wheat	Scouting	13
		Irrigation (handset)	18
	Apples, cherries	Scouting, hand pruning, training	7
		Hand harvesting	15
		Fruit thinning	24
	Cabbage	Thinning plants	1
		Scouting, harvesting, hand and mechanically assisted	15
		Irrigation (handset)	18
		Hand weeding	26
	Corn	Scouting	13
		Irrigation (handset)	18
		Detasseling, hand harvesting	**>30 (impractical)**
	Lettuce	Hand harvesting	13
		Irrigation (handset)	18

Application rate (g ac/ha)	Crop	Activity	Minimum re-entry interval (days)
	Grapes	Scouting, propagating, hand pruning, hand weeding, bird control, trellis repair	8
		Tying/training, hand harvesting, leaf pulling	**>30 (impractical)**
		Irrigation (handset)	18
	Tomato	Hand harvesting, tying/training	13
		Irrigation (handset)	18
492 (UL)	Lucerne, barley, forage crops, rice, soybean, wheat	Scouting	15
		Irrigation (handset)	20
	Apples, cherries	Scouting, hand pruning, training	9
		Hand harvesting	17
		Fruit thinning	26
	Cabbage	Thinning plants	3
		Scouting, harvesting, hand and mechanically assisted	17
		Irrigation (handset)	20
		Hand weeding	27
	Corn	Scouting	15
		Irrigation (handset)	20
		Detasseling, hand harvesting	**>30 (impractical)**
	Lettuce	Hand harvesting	15
		Irrigation (handset)	20
	Grapes	Scouting, propagating, hand pruning, hand weeding, bird control, trellis repair	10
		Tying/training, hand harvesting, leaf pulling	**>30 (impractical)**
		Irrigation (handset)	20
	Tomato	Hand harvesting, tying/training	15

Application rate (g ac/ha)	Crop	Activity	Minimum re-entry interval (days)
		Irrigation (handset)	20
550	Lucerne, barley, forage crops, rice, soybean, wheat	Scouting	16
		Irrigation (handset)	21
	Apples, cherries	Transplanting	1
		Scouting, hand pruning, training	10
		Hand harvesting	18
	Cabbage	Transplanting	1
		Thinning plants	5
		Scouting, harvesting, hand and mechanically assisted	18
		Irrigation (handset)	21
		Hand weeding	29
	Corn	Scouting	16
		Irrigation (handset)	21
		Detasseling, hand harvesting	**>30 (impractical)**
	Lettuce	Transplanting	1
		Hand harvesting	16
		Irrigation (handset)	21
	Grapes	Transplanting	1
		Scouting, propagating, hand pruning, hand weeding, bird control, trellis repair	11
		Irrigation (handset)	21
		Tying/training, hand harvesting, leaf pulling	**>30 (impractical)**
	Tomato	Hand harvesting, tying/training	13
650	Lucerne	Scouting	17
		Irrigation (handset)	23

Application rate (g ac/ha)	Crop	Activity	Minimum re-entry interval (days)
480	Pasture/forage crops	Scouting	15
		Irrigation (handset)	20
700	Pasture/forage crops	Scouting	18
		Irrigation (handset)	23
800	Pasture/forage crops	Scouting	19
		Irrigation (handset)	25
1,000	Pasture/forage crops	Scouting	21
		Irrigation (handset)	27
1,200	Pasture/forage crops	Scouting	23
		Irrigation (handset)	28
1,300	Pasture/forage crops	Scouting	24
		Irrigation (handset)	29

4.4 First aid instructions

The existing FAISD Handbook entry for fenitrothion remains adequate and is presented in Table 14:

Table 14: First aid instructions (FAI) for fenitrothion

Status	Substance	Concentration	FAI	Warning Statement
Existing entry	Fenitrothion		m	

The code 'm' above refers to the following first aid instructions in Table 15:

Table 15: Translation of first aid instructions (FAI) code for fenitrothion

Code	Instruction
m	If swallowed, splashed on skin or in eyes, or inhaled, contact a Poisons Information Centre (Phone Australia 13 11 26, New Zealand 0800 764 766) or a doctor at once. Remove any contaminated clothing and wash skin thoroughly. If swallowed, activated charcoal may be advised. Give atropine if instructed.

4.5 Safety directions

The FAI, safety directions, warning statements and general safety precautions for Agricultural and Veterinary Chemicals (the FAISD Handbook) currently includes safety directions for 6 different types of products containing fenitrothion. The following are the only product types that remain on the market currently in Australia:

- EC, 1000 g/L
- EC, 600 g/L with S-methoprene, 60 g/L
- UL, 1230 g/L

The remainder of the safety directions have not been considered as they related to products no longer available for use. These instructions will be deleted at the next publication of the FAISD handbook.

A number of fenitrothion use patterns supported from a worker health and safety perspective could not be supported from a residues, trade and/or environment perspective. The safety directions for fenitrothion products have been evaluated based on uses supported by all assessment areas. The safety directions listed in Table 17 are required on product labels.

Table 16: FAISD Handbook entries – fenitrothion products

Substance	Formulation	Statement codes
Fenitrothion	EC 1,000 g/L or less	130 131 132 133 190 210 211 220 223 279 280 281 282 290 292 294 296 279 284 290 297 300 303 340 342 350 360 361 362 363 364 366
Fenitrothion	EC 600g/L plus S-methoprene 60g/L	130 131 132 133 190 210 211 220 223 279 280 281 282 290 292 294 296 279 284 290 297 300 303 340 342 350 360 361 362 363 364 366
Fenitrothion ULV*	ULV* 1280 g/L or less	130 131 132 133 190 210 211 220 223 279 280 281 282 290 292 294 296 279 284 290 297 300 303 340 342 350 360 361 362 363 364 366

*ULV is the code currently used for UL formulations in the FAISD Handbook.

The above statement codes translate into the following safety directions in Table 17.

Table 17: FAISD Handbook – fenitrothion products, translation of statement codes to safety directions

Safety directions	Code
Hazards	
Poisonous if absorbed by skin contact, inhaled or swallowed	130 131 132 133
Repeated minor exposure may have a cumulative poisoning effect	190
Precautions	
Avoid contact with eyes and skin	210 211
Do not inhale spray mist	220 223

Safety directions	Code
Mixing or using	
When opening the container, preparing spray, and using the prepared spray, wear cotton overalls buttoned to the neck and wrist and washable hat, elbow-length chemical resistant gloves and face shield. When using in enclosed areas, wear goggles and half-facepiece respirator with combined dust and gas cartridge. If product on skin, immediately wash area with soap and water.	279 280 281 282 290 292 294 296 279 284 290 297 300 303 340 342
After use	
After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash contaminated clothing, gloves, face shield, goggles and respirator and if rubber wash with detergent and warm water	350 360 361 362 363 364 366

4.6 Worker health and safety recommendations

The uses of fenitrothion that present an unacceptable risk to worker health and safety are listed in Table 18.

Table 18: Uses not supported from the viewpoint of worker health and safety

Situation	Basis
Grain structural and surface treatment Poultry shed (including litter, walls and roof)	Unacceptable risk to occupational handlers
Corn, application rates ≥ 300 g ac/ha Grapes, application rates ≥ 300 g ac/ha	Impractical re-entry period (>30 days)

The use of fenitrothion on stored cereal grain is considered acceptable from a worker health and safety perspective, noting that worker exposure to fenitrothion during the application process is negligible as specialized equipment with nozzles integrated into the auger or using a shielded sprayer on the conveyor belt that transfers the grain into the storage silos is used to treat the grain/seed.

The worker health and safety risks for the use of fenitrothion in field crops and orchard and vineyard crop, other than the situations listed in Table 18, can be mitigated through the implementation of PPE requirements, engineering control requirements, daily work rate restrictions (ha/day) and/or re-entry period requirements, as set out in Table 10 to Table 13. It is noted that closed mixing and loading is required to mitigate the risks to the mixer/loaders or mixer/loaders/applicators in many of the assessed scenarios, and that at the time of the proposed regulatory decision, the APVMA did not have evidence that the use of this engineering control could be feasibly implemented and managed by industry.

During the consultation period on the proposed regulatory decision, new data was submitted that allowed a limited field use for fenitrothion in cereal crops and grazing sorghum at a maximum rate of 330 g ac/ha. Further consultation with industry indicated that use restrictions mandating closed mixing and loading, specific to the field use, would be feasible for relevant fenitrothion products.

The following label statements are recommended for the fenitrothion products that include the use in cereal crops and grazing sorghum:

> **A single operator MUST NOT mix and apply more than 110 L of neat product per day (equivalent to spraying an area of no more than 320 ha per day at the maximum rate of 330 mL/ha or no more than 400 ha per day at the minimum rate of 270 mL/ha.**
>
> **DO NOT use open mixing/loading equipment. Closed mixing and loading must be used.**
>
> **DO NOT apply using open cab equipment. Enclosed cab application MUST be used.**

The first aid instructions listed in Table 14 and the safety directions listed in Table 16 are reflective of use patterns supported by all assessment areas and should be included on all relevant product labels.

5 Residues and trade

5.1 Previous assessments

In 1999, the APVMA (then the NRA) published an interim residues report (APVMA 1999a). The APVMA also published a draft review report in 2004 (APVMA 2004). No new residues data has been submitted to the APVMA following the publication of the 2004 draft review report. This current residues and trade assessment combines the findings of the 1999 interim and 2004 draft review reports and includes a contemporary residues and trade risk assessment for currently approved label use patterns.

5.2 Metabolism and residues definition

The metabolism of fenitrothion in plants and animals was evaluated in the 1999 interim report. No additional metabolism studies were submitted following the 1999 interim report, and it is concluded that the current Australian residue definition of parent fenitrothion is appropriate. It is noted that the current Codex residue definition is parent fenitrothion and this was recommended by the FAO/WHO Joint Meeting on Pesticide Residues (JMPR) in 2004, which concluded that the fenitrothion S-isomer, fenitrooxon and aminofenitrothion were not required for inclusion as they were expected to occur in foods in only small amounts (JMPR 2004).

5.3 Analytical methods

Analytical methods for the determination of fenitrothion in plant and animal commodities were evaluated in the 1999 interim report. GLC was the method of choice for the quantitation of fenitrothion and metabolites in the submitted residue trials. Separation of fenitrothion and its polar metabolites can also be achieved using liquid column chromatography. For most substrates, the limit of detection is 0.005 mg/kg; limit of quantitation = 0.02 mg/kg, however lower limits of quantitation of 0.004 mg/kg have been reported with detection at 0.001–0.002 mg/kg.

5.4 Residues in food and animal feeds

Use patterns will be supported from a residues and trade perspective in this assessment where there is sufficient relevant residues data for the use pattern(s) to set a Maximum Residue Limit (MRL) for the relevant commodities, where there are no dietary exposure concerns and where an undue risk to international trade is not expected.

5.4.1 Post harvest storage treatment of cereal grains

Registered fenitrothion products may be used as a post-harvest treatment on cereal grains for control of weevils, flour beetles, saw-toothed grain beetles, tropical warehouse moth borers, Indian meal moths and, with the addition of an insect growth regulator, lesser grain borer. Fenitrothion is registered in Queensland, NSW, Victoria, SA and Tasmania as an admixture for cereal grains stored less than 3 months at a treatment rate of 6 ppm. It is also registered in all states as an admixture treatment for cereal grains stored 3–6 months, with a treatment rate of 12 ppm fenitrothion. When treated at 12 ppm, there is a '90 day' storage interval, where the grain must be withheld from use as a human food or animal feed.

In the 1999 interim report, the post-harvest use of fenitrothion on stored cereal grains were supported as data provided showed that the existing fenitrothion MRL of 10 mg/kg for cereal grains was appropriate for post-harvest storage treatments of cereals. Residues in processed commodities such as wheat bran and germ were also found to be below the existing MRLs for those commodities at 20 mg/kg. The Australia Wheat Board 1984 data observed maximum residues in wheat, bran and germ at 5.0 mg/kg (mean 2.9 mg/kg), 22.6 mg/kg (mean 12.8 mg/kg) and 19.8 mg/kg (mean 11.1 mg/kg) respectively. Data from the Flour Millers' Council observed residues in raw bran between <10–23 mg/kg and data on rice from a Japanese processing study showed that when treated at 15 mg/kg residues in polished rice, husked rice and rice bran at 1.02 mg/kg, 9.38 mg/kg and 65 mg/kg respectively.

The 1999 interim report highlighted concerns regarding fenitrothion residues in rice bran. The 2004 draft review report considered additional rice processing data, which were adequate to calculate maximum residue levels in rice bran and in rice hulls. The maximum residue level of 6.3 mg/kg found in the trial was well within the established TMRL of 20 mg/kg for unprocessed rice bran indicating that a rice bran MRL at 20 mg/kg was appropriate. The data also showed that the maximum rice hull residue was 54 mg/kg, at 2 weeks after treatment of 12 ppm fenitrothion. As rice treated under the Australia GAP at 12 ppm should not be processed for a minimum of 90 days (~13 weeks) after treatment, this result is not consistent with label instructions. Residues in hulls at 10–12 weeks after 12 ppm treatment were ~30–42 mg/kg. Residues on hulls processed from rice treated at 6 ppm did not exceed 26 mg/kg. Hence, an MRL at 50 mg/kg level can be established for rice hulls as an animal feed commodity MRL in Table 4 of the MRL standard.

Based on the available data, the existing fenitrothion MRLs for GC 0080 Cereal grains at 10 mg/kg, CM 0654 Wheat bran, unprocessed and Wheat germ at 20 mg/kg remain appropriate for the post-harvest use on stored cereal grains. MRLs for rice bran at 20 mg/kg and hulls at 50 mg/kg are recommended to cover the potential residues from the post-harvest use on stored rice.

The withholding period (WHP) of 90 days for the 12 ppm grain protection use is considered appropriate, but should be expressed as 13 weeks, in accordance with the APVMA Labelling Code.

A WHP is not required for the 6 ppm grain protection use, as fenitrothion residues in stored grain will be below the current MRL at 10 mg/kg (ppm). Most labels do not state a WHP for the 6 ppm grain protection use with the exception of the 3 products containing a co-formulation of 600 g/L fenitrothion and 60 g/L S-methoprene (66520, 67567 and 91551), which have a WHP of one day that was determined as appropriate based on the available one-day data. Product 46127 has a WHP of 'Not required when used as directed'. As it is considered implausible the cereal grain will be treated as it is placed into storage, transported and consumed by either human or animal within 24 hours of treatment, a WHP of 'Not required when use as directed' is considered appropriate and should be applied to all products containing the 6 ppm grain protection use pattern.

The post-harvest uses of fenitrothion for the storage treatment of cereal grains are supported from a residues perspective.

5.4.2 Treatment of grain storage facilities and equipment

The registered structural treatment use involves cereal grain storage on farm, produce stores, feed and flour mills, warehouses and processing plants, transport equipment and animal feed bins. 1 L of products containing 1,000 g/L fenitrothion are added to 100 L of water, which is then applied at 1 L of spray over 20 square metres, or to the point of runoff, applied at 2 monthly intervals in warm weather and at 3 monthly intervals in winter months (46127) or without specified retreatment intervals (50775, 56170 and 67186).

The grain surface treatment use involves treatment of bulk stored cereal grain and stacks of bags etc. 1 L of products containing 1,000 g/L fenitrothion are added to 100L of water, which is then applied at 1 L of spray over 20 square metres of exposed grain surface, or to the point of runoff on bags. Depending on the product the retreatment interval is either 2 months (46127) or applied at 1 month intervals during summer and 2 or 3 month intervals in winter (50775, 56170, and 67186).

For the structural treatment use, the intention of the use on all labels is for application to structures, as the use name suggests. However, only product 46127 has a critical comment to avoid contamination to the grain. It is recommended that the critical comment *‘Precautions should be taken to prevent surface contamination of grain’* should be added to the ‘Structural treatment’ use on all relevant labels.

Structural treatment and grain surface treatment uses may result in lower residues in grain than the 12 ppm grain protection use. However, due to a lack of data to specifically assess these uses, the 13 week withholding period applied to the 12 ppm grain protection use is considered appropriate. It is recommended that the WHP of *‘DO NOT use for processing into food for human consumption or stock food within 13 weeks of treatment’*, present on some labels and silent on others, should be added for all products where this WHP is not clearly stated, including for the 10 ppm grain surface treatment use.

Fenitrothion can be transferred to oilseeds and pulses following structural treatment of grain handling and storage equipment and potentially from storage in structures previously used for treated cereal grains. Storage and supply chains for cereal grains and other grains/seeds are not segregated. The MRLs for oilseeds and pulses at 0.1 mg/kg were established as permanent MRLs in 2014 based on NRS monitoring data in canola, sunflower, chickpea, faba bean, field pea, lentils, lupins, mung bean and soybean seeds for the period of 1 July 2007 to 8 February 2012. It is recommended that the existing MRLs for SO 0088 Oilseeds at 0.1 mg/kg and VD 0070 Pulses at 0.1 mg/kg continue to remain appropriate.

The use patterns for cereal storage facilities and equipment are supported from a residues perspective.

5.4.3 Treatment of broiler poultry houses

The 1999 interim report found that the exposure to chickens from fenitrothion treatment of poultry houses is unlikely to result in residues greater than the existing poultry MRLs and that the use is considered to be of negligible risk from a residues perspective.

The fenitrothion concentration used for treatment of poultry housing and feed-sheds is 10 ppm. Residue trials with poultry, feeding up to 100 ppm, resulted in no poultry products exceeding existing MRLs at *0.05 mg/kg. In addition, current label instructions recommend that if litter is treated, it is covered by fresh untreated litter and that birds are not to be placed in recently treated sheds. In practice, this is at least one to 2 days after treatment, allowing some aeration of treated sheds and some natural breakdown of fenitrothion on treated surfaces. Any uptake by birds would be further reduced by the 10 weeks of growth of the broiler chickens prior to slaughter for human consumption.

Based on the reasoning provided above, the potential uptake of fenitrothion residues by poultry from the use is considered to be low. The use patterns for the treatment of poultry housing, feed sheds and litter are supported from a residues perspective.

5.4.4 Cereal crops (pre-harvest)

The 1999 interim report considered a study conducted in 1996 on sorghum. Sorghum treated at 768 g a.i./ha (~1.4× locust control rate of 550 g ai/ha), with a previous application at least one month before, contained maximum fenitrothion residues in sorghum grain of 4.4 mg/kg at 4 days after last application (DALA) and 0.6 mg/kg at 14 DALA. Residues in sorghum forage were 4.8 mg/kg (dry weight basis) at 14 DALA.

The 2004 draft review report considered a supplementary residues study conducted in 2001 on winter cereals (Litzow 2002), which was also considered in 2003 by JMPR. Four trials were conducted in Australia during 2001 (2× winter wheat, 1× triticale and 1× barley). Each trial received 3 applications of fenitrothion at 550 g ai/ha (1× the maximum locust rate), residues of 0.21, 0.10, 0.08 and <0.06 mg/kg were observed in wheat, triticale and barley grain, at the registered harvest WHP of 14 days. Residues were 4.1, 2.0, 1.2 and 0.41 mg/kg (fresh weight) in wheat, triticale and barley straw at the registered grazing WHP of 14 days.

The 2004 draft review report concluded the available data for sorghum grain, wheat, triticale and barley grain was sufficient to confirm that the current GC 0080 Cereal grains MRL at 10 mg/kg would cover expected residues of fenitrothion in cereal grains in conjunction with the WHP of 14 days. The 2004 draft review report also concluded that the Australian straw data on winter cereals was sufficient to confirm the fenitrothion MRL at 10 mg/kg for cereal straw, fodder (dry) and hay of cereal grains in conjunction with the grazing WHP of 14 days.

It is noted that based on the sorghum, lucerne and pasture forage data, a fenitrothion MRL at 10 mg/kg would also be sufficient to cover potential residues in cereal forage at the 14 day grazing WHP. The use patterns for cereal grains for control of locust pests are supported from a residues perspective (up to 550 g ai/ha). The harvest and grazing WHPs of 14 days are considered appropriate.

5.4.5 Lucerne

The 1999 interim report considered data produced following one treatment of fenitrothion on lucerne at 1120 g ai/ha (~1.7× the Sitona weevil control rate (650 g ai/ha)). Residues of fenitrothion 7 days after treatment were 2 mg/kg for forage (dry weight, based upon 35% dry matter) and 1.1 mg/kg for hay (dry weight). Similarly, residues 14 days after treatment were 1.4 mg/kg for forage and 0.7 mg/kg for hay (both on a dry weight basis).

The lucerne data is sufficient to confirm that the lucerne forage and lucerne fodder MRLs at 5 mg/kg each are appropriate, when the existing grazing intervals of 7 days, or cutting for stockfeed of 14 days, or slaughter interval of 14 days are observed. The 14-day slaughter interval applies in situations where the grazing WHP cannot be observed or where grazing stock have been oversprayed, as instructed on product labels.

The use patterns for lucerne up to 650 g ai/ha are supported from a residues perspective. As the relevant residues data for lucerne was for a single application, label use for lucerne should be restricted to one application per year.

5.4.6 Pastures

The 1999 interim report considered data for fenitrothion use on pastures. In one trial (HR-81-0156) fenitrothion was applied once to pasture at 125 g ai/ha or 375 g ai/ha. When applied at 125 g ai/ha, residues of fenitrothion were 2.88 and 0.52 mg/kg (fresh weight basis) at one and 7 days after application (DAA) respectively. When applied at 375 g ai/ha residues were 6.59, 1.84 and 1.04 mg/kg (fresh weight basis) at 1, 7 and 10 DAA respectively.

The 1977 JMPR reviewed a supervised residue trial conducted in New Zealand, prior to 1974. In this trial fenitrothion was applied once to grass at 1,680 g ai/ha and residues of 74.2, 37.7, 9.0 and 3.25 mg/kg (as received) were measured at a 0, 2, 7 and 14 day WHP respectively.

Six residues studies on grass were provided by the Australian Plague Locust Commission (APLC) in support of an off label permit granted in October 1997 for control of locusts. Fenitrothion was applied at a rate of 210 mL (267 g ai/ha according to the APLC, assumed to be older UL formulation at 1270 g/L) with residues of fenitrothion on grass after a 0-day WHP reported at up to 50 mg/kg. Fenitrothion could not be detected in grass 600 m downwind when applied with winds up to 6 m/s.

Eight other studies with varying application rates between 267–1,680 g ai/ha were also supplied by the APLC. At a zero-day WHP the highest fenitrothion residues were up to 50 mg/kg declining to up to 5 mg/kg at a 7 day WHP (assumed to be reported as fresh weight but not specified).

In February 1998, NSW Agriculture and APLC conducted a residues study to determine if the 14 days WHP from slaughter period was appropriate. The trial assessed the occurrence and depletion of fenitrothion in pasture, soil and animal commodities. The registered UL formulation of fenitrothion was applied to pasture aerially once at a rate of 508 g ai/ha (~1× the locust rate) on which 28 cattle were grazing (oversprayed livestock). A further 38 cattle were allowed to graze the pasture immediately after the treatment was applied. The study duration was 21 days with samplings of pasture at 3 day before treatment (DBT) and 0, 1, 2, 4, 7, 10, 14 and 21 days after treatment (DAT) to establish a residues decline pattern. Soil samples were also taken at the same time points as the pasture samples, at a depth of 25 mm and an area of 100 mm × 100 mm. Animals were slaughtered at 2, 4, 7, 14 or 21 days after overspraying and/or grazing on treated pasture. Some cattle were withdrawn from the treated pasture for 2, 4 or 7 days prior to slaughter, representing grazing durations of between 3–13 days in the treated area. Subcutaneous fat, renal fat, muscle and liver samples were taken for analysis. Results from the decline study in pastures showed that average fenitrothion residues of 81 mg/kg on day 0 had declined to 50% of initial levels within 24 hours and declined to <10% of initial levels (2.5 mg/kg) within 7 days. The residue decline profile was similar in soil, with residues declining within 7 days of treatment. Fenitrothion residues below the limit of determination (0.02 mg/kg) in all muscle or liver samples (16 samples). Residues of fenitrothion were detected in subcutaneous fat and renal fat samples at levels of between 0.020 and 0.064 mg/kg with no obvious decline observed between 2 and 7 days after being withdrawn from the treated pasture (and noting that the 0.064 mg/kg in subcutaneous fat was detected in a control animal).

For the registered locust control rate of 550 g ai/ha, based on the data for pastures, grass, cereals and Lucerne, residues of fenitrothion in pastures are expected below the MRL for AS 0161 Straw, fodder (dry) and hay of cereal grains and other grass-like plants at 10 mg/kg when the following current grazing WHPs are observed:

Pasture and lucerne where stock have not been oversprayed:

DO NOT graze for 7 days after application or withhold stock from slaughter for 14 days after application, whichever is appropriate. DO NOT cut for stockfeed for 14 days after application.

Pasture (including lucerne) where stock have been oversprayed:

DO NOT slaughter for 14 days after application.

These WHPs are considered appropriate for the supported use on pastures for control of locust pests.

The use patterns for pastures for control of spur-throated locust, migratory locust, wingless grasshopper and Australian plague locust on pastures and pasture seed crops are supported from a residues perspective. The registered uses on pasture for control of pasture cockchafer, corbie, winter corbie, underground grass grub and oxycanus grub at up to 1,300 g ai/ha were not supported by the 1999 interim or 2004 draft review reports. The interim report required Australian data for other grass-like pasture situations and other forage crops where non-locust pests are to be controlled. Since 1999, no Australian data has provided for pasture situations. In the absence of further data, the non-locust uses on pasture should not continue. Therefore, the uses on pasture for control of pasture cockchafer, corbie, winter corbie, underground grass grub and oxycanus grub should be removed from the approved labels.

5.4.7 Soybean

The 1999 interim report noted that limited residues data was available for soybean forage, and the 2004 draft review report noted no Australian data had been generated in support of the soybean use. Both reports referred to soybean data reviewed by the 1974 JMPR which showed that when fenitrothion is applied at 710 g ai/ha (~1.3× the maximum locust control rate), consisting of 3 applications at 14 day intervals, the maximum residue level encountered at 9–15 days after treatment was 0.01 mg/kg in the harvested grain. There was no residues data available for forage. The 2004 draft review report confirmed that, in the absence of Australian generated data in support of the soybean use, the existing MRL and use should not continue.

Soybean residues data for fenitrothion was considered in the 2004 and 2007 JMPR, but it is noted that these soybean trials have not been submitted in full to the APVMA. In the Japanese trials considered by the 2004 JMPR, young immature green soya beans received 2–3 applications of fenitrothion at 10–13 day intervals at rates of 0.7 kg ai/ha (~1.3× the maximum locust rate), residues in green seeds were 0.002 (n=2), 0.006 and 0.01 mg/kg at 11–14 DALA (n=4). When 4 applications at 1.25 kg ai/ha (~2.3× the maximum locust rate) were applied at 7 day intervals, residues in the green soya bean (in the pod) were <0.01, 0.12 and 0.18 mg/kg at 21-30 DALA (n=3). The remaining applicable Japanese trials received 2–4 applications at 6–47 day intervals with rates of 0.7–1.25 kg ai/ha resulted in residues in soybeans (dry) of 0.001, 0.002 (n=2), 0.004 (4), <0.005 (n=4), <0.01 (n=3), 0.013, 0.022, 0.026 and 0.12 mg/kg at 11–56 DALA (n=15). The highest residue of 0.12 mg/kg was recorded 38 days after the final of 3 applications at 0.75 kg ai/ha (~1.4× the maximum locust rate) with a 12–13-day re-treatment interval. The 2007 JMPR considered Brazilian trials conducted on soybeans. The trials involved 2 applications at 10 day intervals at rates of 0.28 or 0.56 kg ai/ha (~0.5–1× the maximum locust control rate), with residues in soybeans (dry) reported as <0.1 mg/kg at 14 DALA (n=6). The analytical method was not validated below 0.1 mg/kg; however, it was reported that no peaks were visible after 3 DALA in the 2 Brazilian trials that included decline data. No forage data was available for JMPR consideration.

The use patterns for soybeans are not supported from a residues perspective. It is recommended that these uses be removed from approved labels as there is not sufficient relevant residues data to enable for a robust assessment of the fenitrothion residue profile in soybeans (particularly in forage).

5.4.8 Fruits and vegetables

Registered fenitrothion products contain a use for locust/ grasshopper control (spur-throated locust, migratory locust, wingless grasshopper, Australian plague locust, yellow winged locust and small plague grasshopper) on the following fruit and vegetables: apples, cabbages, cherries, grapes, lettuce and tomatoes. There are currently 4 products registered with these uses: 50774, 50775, 56170 and 67186. Three of these products are an EC formulation containing 1,000 g ai/L and the other a UL formulation (50774), which contains 1,230 g ai/L of fenitrothion. Treatment rates are ~246–550 g ai/ha. Generally, the labels do not specify the number of applications and the minimum re-treatment interval. The UL product (50774) label states a retreatment interval of not less than 14 days. All approved labels state the WHP associated with these uses is 14 days.

The 1999 interim report recommended the then existing fruit MRLs (apple, cherries, grapes, and fruits except cherries and grapes) and vegetable commodity MRLs (head cabbages, head and leaf lettuce, tomato, and vegetables except head cabbages, head and leaf lettuce, tomato) be deleted, and a fruit MRL of 1 mg/kg and vegetable MRL of 0.5 mg/kg be established. The intention of these MRLs were to cover residues in fruit and vegetables resulting from emergency use situations only, presumably as plague locust situations arose. Consequently, the use patterns for fruits and vegetables remained on the approved labels.

In the 2004 draft review report, no suitable Australian data supporting the fruit and vegetable MRLs was supplied. Without this data, the APVMA could not be satisfied that the existing fruit and vegetable MRLs were acceptable from a dietary exposure and human health perspective. Accordingly, all fruit and vegetable MRLs were recommended for deletion, and the fruit and vegetable use patterns were recommended for removal from approved labels.

No new data has been provided to the APVMA since 2004 and consequently the recommendations of the 2004 draft review report still apply. The fruits and vegetable uses are not supported and all fruit and vegetables MRLs should be deleted. The fenitrothion uses on apples, cabbages, cherries, grapes, lettuce and tomatoes, are not supported, with respect to residues, as there is insufficient data to enable for a robust assessment of the fenitrothion residue profile in these crops.

5.5 Animal exposure to fenitrothion

The 1999 interim report considered animal transfer studies in hens, broilers and lactating cattle. Feed levels in the studies ranged from 10 to 100 ppm, and fenitrothion and metabolites were determined in eggs, milk and tissues. The data from the hen and cattle feeding studies showed that following feeding at levels up to 100 ppm for 28 days, fenitrothion residues above the limit of determination of 0.05 mg/kg were not observed in any tissues or eggs or above 0.01 mg/kg in milk and cream. Based on the feeding studies, the 1999 interim report determined that Maximum feeding levels (MFLs) of 100 ppm were required to meet the current MRLs at the LOQ of *0.05 mg/kg for both livestock and poultry.

The studies considered for animal feeds adequately covered the possible exposure levels resulting from post-harvest treatment of cereal grains and from pastures/forages treated during locust control. Based on the data received, the existing MRLs for eggs and poultry commodities at *0.05 mg/kg were confirmed to be appropriate and therefore remained unamended. The 1999 interim report requested Australian data for lucerne, other grass-like situations, and other forage crops (e.g., pasture and sorghum) where non-locust pests are to be controlled, in order to establish appropriate grazing restraints and withholding periods. As there were outstanding data requirements for forage and fodder of cereals, pastures and sorghum for treatments other than locust control, the existing MRLs for milk, meat and edible offal were removed and established as temporary MRLs until appropriate animal feed commodity data was received.

The 2004 draft review report considered a processing study conducted on rice (Ricegrowers Co-operative Ltd, 2002) and a study conducted on winter cereals (Litzow, 2002). The report recommended that the animal commodity MRLs for meat (mammalian), edible offal (mammalian) and milks at T*0.05 mg/kg should be confirmed as permanent and are considered appropriate for the supported uses.

Cereal grains and pulses can form up to 100% of the diet in livestock and poultry. Processed grain fractions can form up to 40% and 20% of the diet in livestock and poultry respectively. Pasture and forage and fodder crops can also form up to 100% of the diet in livestock. Using the MRL for forage at 10 mg/kg as a worst case scenario, the estimated maximum dietary burden is expected to be 40 ppm for beef and dairy cattle, assuming 100% of the diet comprises grass forage at 25% dry matter content. Using the MRLs for cereal grains at 10 mg/kg, the estimated maximum dietary burden is expected to be 10 ppm for poultry or livestock fed a grain diet.

Livestock exposure to fenitrothion from feeding of treated cereals and pastures (for locust control situations), lucerne fodder and forage (for sitona weevil or locust control situations), or other feed substances, including rice hulls and bran, are unlikely to result in detectable residues in animal commodities. Therefore, the current limit of quantification (LOQ) MRLs for meat (mammalian) [in the fat] and edible offal of *0.05 mg/kg are appropriate. The lactating cow feeding study reported a LOQ of 0.01 mg/kg for milk and cream, with no residues of fenitrothion in milk or cream after feeding at 100 ppm, therefore it is recommended that the milks [in the fat] MRL be established as a permanent MRL at *0.01 mg/kg.

Poultry MRLs for eggs, edible offal and meat were confirmed as permanent at *0.05 mg/kg by the 1999 interim report. However, as fenitrothion MRLs in meat (mammalian) and milks are being confirmed in the fat it is also recommended that the poultry meat MRL be changed to in the fat.

5.6 Spray drift

From the cattle feeding study, after feeding at levels up to 100 ppm for 28 days, fenitrothion residues above the LOQ of 0.05 mg/kg for tissues of 0.01 mg/kg for milk and cream were not observed. A Regulatory Acceptable Level (RAL) of 100 mg/kg will result in residues in meat, edible offal and milk below the current LOQ animal commodity MRLs and therefore should prevent and undue risk to international trade to markets which do not have fenitrothion MRLs established in animal commodities.

5.7 Dietary exposure assessment

The chronic dietary exposure to fenitrothion is estimated by the National Estimated Daily Intake (NEDI) calculation encompassing all registered/temporary uses of the chemical and the mean daily dietary consumption data derived primarily from the 2011–12 National Nutritional and Physical Activity Survey. The NEDI calculation is made in accordance with WHO Guidelines and is a conservative estimate of dietary exposure to chemical residues in food. The NEDI for fenitrothion is equivalent to <10% of the ADI. It is concluded that the chronic dietary exposure to fenitrothion is acceptable.

The acute dietary exposure is estimated by the National Estimated Short Term Intake (NESTI) calculation. The NESTI calculations are made in accordance with the deterministic method used by the JMPR with 97.5th percentile food consumption data derived primarily from the 2011–12 National Nutritional and Physical Activity Survey. NESTI calculations are conservative estimates of short-term exposure (24 hour period) to chemical residues in food. Based on the supported uses the highest acute dietary intake was estimated at 27% of the ARfD for children (2–6 years) and 22% of the ARfD for the general population (2+ years). It is concluded that the acute dietary exposure is acceptable.

5.8 Trade risk assessment

Cereal grains, oilseeds, pulses and oaten hay are considered major trade commodities, as are the animal commodities associated with the feeding of treated produce to livestock and poultry. Residues in these commodities resulting from the use of fenitrothion may have the potential to unduly prejudice trade.

5.8.1 Comparison of Australian MRLs with Codex and overseas MRLs

The Codex Alimentarius Commission (Codex) is responsible for establishing Codex Maximum Residue Limits (CXLs) for pesticides. Codex CXLs are primarily intended to facilitate international trade and accommodate differences in Good Agricultural Practice (GAP) employed by various countries. Some countries may accept Codex CXLs when importing foods. The following relevant Codex CXLs and/or international MRLs have been established for the uses and MRLs for fenitrothion which are supported from a residues and trade perspective.

The US has had no registered uses on food commodities since 1987. The only US tolerance is for wheat gluten at 3.0 mg/kg and relates specifically to the postharvest application of the insecticide to stored wheat in Australia (US Electronic Code of Federal Regulations).

Table 19: Australian and overseas MRLs/tolerances for fenitrothion

Commodity	Australia[1]	Codex[2]	EU[3]	China[4]	Japan[5]	Korea[6]	Taiwan[7]
Residue definition	Fenitrothion	Fenitrothion	Fenitrothion	Fenitrothion	Fenitrothion	–	–
Barley	–	–	*0.05	–	6	–	0.3
Broad beans				–	0.2	–	–
Buckwheat	–	–	*0.05	–	6	–	–
Cereal grains	10	6	*0.05	5	6 (other cereal grains)	–	0.2 Other cereals and crops (except sorghum)
Edible offal (mammalian)	*0.05	*0.05	*0.01	0.05	0.05	–	–

Commodity	Australia[1]	Codex[2]	EU[3]	China[4]	Japan[5]	Korea[6]	Taiwan[7]
Eggs	*0.05	*0.05	*0.01	0.05	0.05	0.05	–
Maize/corn	–	–	*0.05	–	0.2		–
Meat (mammalian)	*0.05 (in fat)	*0.05	*0.01	0.05	0.05 in muscle and fat	0.05 (fat)	0.05 (fat)
Milks	*0.01	0.01	*0.01	0.01	0.01	0.002	0.002
Millet	–	–	*0.05	–	–	0.3	–
Oats	–	–	*0.05	–	–	–	–
Oilseeds	0.1	–	*0.02	0.1 (cotton seed only)	7 (sesame seeds) 7 (other oilseeds)	–	–
Poultry meat	*0.05	*0.05	*0.01	0.05	0.05 in muscle and 0.4 in fat	0.05	–
Poultry offal	*0.05	–	*0.01	–	0.05	–	–
Pulses	0.1	–	*0.01	–	0.3 Beans, dried, peas 0.3 (other pulses)	0.05 (mung bean, cowpea, pea)	0.05 Dry beans
Rice	–	–	*0.05	1 and 5 (both listed as Rice)	0.2 (brown rice)	0.2	0.2
Rice bran, unprocessed	20	40	–	–	–	–	–
Rye	–	–	*0.05	–	6	–	–
Sorghum	–	–	*0.05	–	–	–	0.5
Wheat	–	–	*0.05	5 (Wheats and Whole wheat flour) 1 (Wheat flour)	1		0.5
Wheat bran, unprocessed	20	25	–	–	–	–	–
Wheat germ	20	–	–	–	–	–	–

[1] Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023 (Cited 28/10/2023)

[2] FAO Codex Alimentarius International Food Standards (Cited 28/10/2023)

[3] European Commission Pesticide Residue (s) and maximum residue limits (Cited 28/10/2023)

[4] USDA Gain report: National Standard of the People's Republic of China, National Food Safety Standard Maximum Residue Limits for Pesticides in Food, implemented 03-09-2021 (Cited 28/10/2023)

[5] Japanese Food Chemical Research Foundation Table of MRLs for Agricultural Chemicals (Cited 28/10/2023)

[6] Food Safety Korea Pesticide MRLs for agricultural commodities (Cited 28/10/2023)

[7] Food and Drug Administration Taiwan Standards for Pesticide Residue Limits in Foods (Cited 28/10/2023)

5.8.2 Potential risk to trade

Export of treated produce containing finite (measurable) residues of fenitrothion may pose a risk to Australian trade in situations where either no residue tolerance (import tolerance) is established in the importing country, or where residues in Australian produce are likely to exceed a residue tolerance (import tolerance) established in the importing country.

For animal commodities Australian MRLs are established or recommended at the LOQ of *0.05 mg/kg for tissue and eggs and *0.01 mg/kg for milks. Good international MRL coverage exists in all markets at the LOQs noting that the EU has MRLs at *0.01 mg/kg in all animal commodities, Korea has a lower MRL for milks at 0.002 mg/kg and there are no established tolerances in the US. Given that the maximum dietary burdens associated with the uses supported from a residues perspective for livestock and poultry are 40 ppm and 10 ppm respectively and residues were below <0.05 mg/kg in tissues and eggs and <0.01 mg/kg in milk and cream after feeding at 100 ppm, it is likely that residues of fenitrothion in animal commodities would meet the requirements of all overseas markets when the registered withholding periods and export intervals are observed. The potential risk to Australian trade is not considered undue for animal commodities.

The Australian fenitrothion MRL for cereal grains at 10 mg/kg is higher than that established in all other markets. Codex and Japan have cereal grains MRLs at 6 mg/kg and the European Union at *0.05 mg/kg. In China, cereal grains MRLs are established at 5 mg/kg for wheats, rice, upland crops and coarse cereals, noting the MRL for wheat flour and the other rice MRL at 1 mg/kg. In Korea there is limited coverage for cereal grains except for coverage in millet at 0.3 mg/kg and rice at 0.2 mg/kg. The US has had no registered uses on food commodities since 1987. The US wheat gluten tolerance relates specifically to the postharvest application of the insecticide to stored wheat in Australia. The potential risk to trade of cereal grains has existed for many years and has been well managed by industry. The grains industry has well established practices to manage the risks of fenitrothion residues in exported grains and process fractions including the Australian Grains Industry Post Harvest Chemical Usage Recommendations and Outturn Tolerances, which provides specific recommendations for fenitrothion residues in grains for individual export markets and defines an industry outturn target of half the established Australian MRL.

For oilseeds and pulses international MRL coverage is limited; however, as described above the potential risk to trade is not considered undue. The risks have been managed for many years and industry has well established practices for mitigating the risks. It is noted that the Australian Grains Industry Post Harvest Chemical Usage Recommendations and Outturn Tolerances also includes specific recommendations for fenitrothion residues in oilseeds and pulses.

As the potential trade risk associated with fenitrothion residues expected in cereal grains, pulses and oilseeds have been effectively managed by industry, and because international standards for fenitrothion have not significantly changed in recent years, it is currently considered that the trade risk associated with the uses of fenitrothion in cereal grains and grain storage facilities and equipment is not undue. However, as the Australian MRL is higher than those set by Codex or major export destinations, it is recommended that the following trade advice statement should be added to the labels of products containing uses on stored cereal grains (including grain storage facilities and equipment):

> **EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain or grain storage facilities or equipment using this product.**

As the Australian MRL for cereal grains is higher than those set by Codex and major export destinations, the APVMA sought comment from members of the grain industry on their ability to manage the risk to international trade associated with fenitrothion. This occurred via the 3 month public consultation on the proposed regulatory decision for the reconsideration of fenitrothion. The National Working Party on Grain Protection (NWPGP) provided an extensive submission outlining an array of management strategies used by the industry, including independent monitoring data demonstrating a high level of compliance with major market requirements such as MRLs/tolerances. The APVMA therefore concludes that the risks to trade caused by the use of fenitrothion on stored grain are being effectively managed, and that the risk is not considered to be undue.

5.9 Consideration of overall risk assessment outcomes for fenitrothion

No field uses for fenitrothion were supported in the Draft Fenitrothion Review Technical Report due to unacceptable risks to birds and mammals that could not be mitigated. The APVMA's risk assessment for environmental exposure to fenitrothion was revised upon consideration of the submissions received in response to the public consultation on the Proposed Regulatory Decision for the fenitrothion reconsideration.

The majority of field uses were not supported by the environmental remodelling completed, however the use of fenitrothion EC on cereal crops and grazing sorghum, up to a maximum rate of 330 g ac/ha and within BBCH ranges 40–69 could be used in the control of locusts and grasshoppers. This use was also acceptable from a worker health and safety and spray drift perspective, when closed mixing, loading and application, daily work rate limits, and spray drift restraints and mandated buffer zones were included on the label.

The use of fenitrothion to a maximum rate of 550 g ac/ha was supported in the proposed regulatory decision in sorghum and winter cereals and could continue to be supported at the new maximum rate of 330 g ac/ha, based on the proportionality concept for adjusting crop field trial values relative to application rates. This guidance, prepared by the Organization for Economic Co-operation and Development (OECD),considers that the proportionality concept can be applied within a range of 0.3 – 4.0 x the maximum rate according to good agricultural practice, and the studies below fall within this range (OECD, 2016).

Sorghum treated at 768 g ai./ha (~2.3× the new maximum rate of 330 g ai/ha), with a previous application at least one month before, contained maximum fenitrothion residues in sorghum forage of 4.8 mg/kg (dry weight basis) at

14 days after last treatment (DALA). Scaled to the maximum rate of 330 g ai/ha residues of fenitrothion in sorghum forage would be expected to be 2.1 mg/kg (dry weight basis) at the registered grazing WHP of 14 days.

For cereal grains, 4 trials were conducted in Australia during 2001 (2× winter wheat, 1× triticale and 1× barley). Each trial received 3 applications of fenitrothion at 550 g ai/ha (~1.7× the new maximum rate of 330 g ai/ha), residues of <0.06, 0.08, 0.10 and 0.21 mg/kg were observed in wheat, triticale and barley grain, at the registered harvest WHP of 14 days. Residues were 0.41, 1.2, 2.0 and 4.1 mg/kg (fresh weight) in wheat, triticale and barley straw at the registered grazing WHP of 14 days. At the new maximum rate of 330 g ai/ha residues of fenitrothion in wheat, triticale and barley straw would be expected to be 0.3, 0.8, 1.3 and 2.7 mg/kg (dry weight basis) at harvest.

5.10 Residues and trade recommendations

The outcomes of the residues and trade assessment of fenitrothion is summarised in Table 20. This assessment supports the post-harvest uses on cereal grains, the cereal storage facilities and equipment uses, and the uses for poultry housing. The broadacre uses for cereals, pastures and pasture seed crops for control of locust pests at up to 550 g ai/ha, and also at the lower rate of 330 g ac/ha supported by other risk areas, for lucerne for control of Sitona weevil at up to 650 g ai/ha are also supported. Sufficient data has been available to support the establishment of permanent MRLs for mammalian offal, meat and milks, rice bran, rice hulls, alfalfa [lucerne] forage and fodder and to recommend other appropriate animal feed MRLs for the supported uses. There was insufficient data to support the continued uses on apples, cherries, cabbages, grapes, lettuce, soybeans, tomatoes. There was insufficient data to support the uses on pasture above 550 g ai/ha, these are essentially the non-locust pest uses on pastures.

Table 20: Summary of residue assessment outcomes for fenitrothion use patterns

Use pattern	Use supported	Outcomes of the residues assessment
Stored cereal grains 6 ppm	Yes	Add WHP statement to all labels *'Not required when used as directed'*. Add trade advice statement: *EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain or grain storage facilities or equipment using this product.*
Stored cereal grain 6 ppm plus addition of S-methoprene	Yes	Add WHP statement to all labels *'Not required when used as directed'*. Add trade advice statement: *EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain or grain storage facilities or equipment using this product.*

Use pattern	Use supported	Outcomes of the residues assessment
Stored cereal grains 12 ppm	Yes	Amend WHP statement to *‘DO NOT use for processing into food for human consumption or stock food within 13 weeks of treatment’.* Add trade advice statement: *EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL’s or tolerances should be obtained prior to treating cereal grain or grain storage facilities or equipment using this product.*
Grain storage facilities and equipment	Yes	Add WHP statement to all labels *‘DO NOT use for processing into food for human consumption or stock food within 13 weeks of treatment’.* Add critical comment: *‘Precautions should be taken to prevent surface contamination of grain’.* Add trade advice statement: *EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL’s or tolerances should be obtained prior to treating cereal grain or grain storage facilities or equipment using this product.*
Grain surface treatment	Yes	Add WHP statement to all labels *‘DO NOT use for processing into food for human consumption or stock food within 13 weeks of treatment’.* Add trade advice statement: *EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL’s or tolerances should be obtained prior to treating cereal grain or grain storage facilities or equipment using this product.*
Broiler poultry house litter, walls, roof and feed sheds	Yes	No changes
Locust and grasshopper pests in cereal grains	Yes	Add restraint: ‘*DO NOT apply more than 3 application per season to cereals’* Add trade advice statement: *EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oaten hay, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL’s or tolerances should be obtained prior to treating cereal grain or grain storage facilities or equipment using this product.*
Sitona weevil in lucerne fodder and forage	Yes	Add restraint: *‘DO NOT apply more than one application per year to lucerne’*

Use pattern	Use supported	Outcomes of the residues assessment
Locust and grasshopper pest in pasture and pasture seed crops	Yes	Add restraint: *'DO NOT apply more than 3 applications per year to pasture or pasture seed crops'* Amend original term 'Pasture, Pasture Seed Crops, Forage Crops including grazing Sorghum, Lucerne, Soybeans, Cereal Crops' on label to *'Pastures, pasture seed crops, lucerne and cereal crops.'*
Non-locust pests in pasture (pasture cockchafer, corbie, winter corbie, underground grass grub and oxycanus grub).	No	No residues data submitted to support control of non-locust pests on pasture.
Locust and grasshopper pests in soybean	No	Insufficient residues data to support the registered use (particularly the 14 day grazing WHP).
Locust and grasshopper pests in apples, cabbages, cherries, grapes, lettuce and tomatoes.	No	Insufficient residues data to support the registered use.

While a number of fenitrothion use patterns could be supported from a residues and trade perspective, only the use of fenitrothion on stored cereal grains and a limited field use on cereal grains and grazing sorghum at a maximum rate of 330 g ac/ha is also supported by the environmental, human health and spray drift risk assessments. As such, the following trade advice statement is recommended on product labels for uses in stored grain (amended to remove reference to grain storage facilities and equipment)

> **EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain using this product.**

For those labels that include limited field use (in cereal crops and grazing sorghum to 330 g ac/ha; supported after data submitted in the PRD consultation period) the following trade advice statement should be added to labels also including this field use:

> **EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oaten hay, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain or grain storage facilities or equipment using this product.**

5.10.1 Amendments to the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023

Table 21 to Table 23 include the recommended MRL changes in the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023 (MRL Standard for Residues of Chemical Products), which will be required as an outcome of the review of registered products. It is noted that no changes are required for the existing MRLs for GC 0080 Cereal grains at 10 mg/kg, PE 0112 Eggs at *0.05 mg/kg, SO 0088 Oilseeds at 0.1 mg/kg, PO 0111 Poultry, edible offal at *0.05 mg/kg, VD 0070 Pulses at 0.1 mg/kg, CM 0654 Wheat bran, unprocessed at 20 mg/kg and CF 1210 Wheat germ at 20 mg/kg.

MRLs for registered uses not supported by the APVMA chemical review will be deleted after the completion of any phase out period. As discussed above, the environmental, human health and spray drift risk assessments have not supported the use of fenitrothion except for uses in stored cereal grains and limited use in cereal grains and grazing sorghum up to 330 g ac/ha). It is noted that the residues assessment also supported field use in forage crops, lucerne and pastures, grain storage facilities and equipment, and in poultry houses. While those uses were not supported by the environmental or human health risk assessments, the same MRL recommendations in Table 1 of the MRL Standard for Residues of Chemical Products for cereal grains and animal commodities are required for the stored grain and cereal crops/grazing sorghum uses.

Although the use of fenitrothion in grain storage facilities and equipment are not expected to be supported due to human health concerns, the MRL recommendations for pulses and oilseeds (retention of the existing MRLs at 0.1 mg/kg) remain appropriate due to the supported stored cereal grain use. Exposure of stored pulses and oilseeds to fenitrothion may still occur in structures previously used for treated cereal grains following residue transfer from the cereal grain to the surface of the storage structure, in addition to contact with facilities and equipment directly treated with fenitrothion.

The uses of fenitrothion in pastures and forage crops generally as well as to grain storage structures, equipment, and broiler poultry houses are not expected to be supported by the APVMA review; however, dietary exposure to livestock and poultry will continue to occur via treated stored cereal grains, cereal grain crops and grazing sorghum. With the removal of pasture and general forage crops, the maximum dietary burden for mammalian livestock will reduce from 40 to 10 ppm in the feed (driven by the MRL for cereal grains required for the post-harvest use). The maximum dietary burden for poultry will remain at 10 ppm. Noting the new maximum rate at 330 g ai/ha for cereal crops and grazing sorghum, a fenitrothion MRL for Cereal forage and fodder at 7 mg/kg is considered appropriate to cover these uses in conjunction with a grazing withholding period of 14 days. The previous MRL recommendations for mammalian and poultry animal commodities remain appropriate noting the finite residues are not expected from the supported uses.

As the field use in soybean, lucerne and pasture are not supported by the APVMA chemical review, MRLs in Table 4 of the MRL Standard for Residues of Chemical Products will not be required for oilseed and lucerne forage or fodder, or pasture. Therefore, the existing MRLs in Table 4 will be deleted. An MRL for Cereal forage and fodder will be added at 7 mg/kg replacing the existing MRL for Straw, fodder (dry and hay of cereal grains and other grass-like plants (dry weight basis) at T10 mg/kg. An MRL for rice hulls at 50 mg/kg will be added to Table 4, which is required for the stored cereal grain use. There is an existing Table 5 entry for fenitrothion when used as a seed dressing, which will also be deleted as it is not associated with a current use.

Table 21: Amendments to Table 1 of the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023

Code		Commodity	MRL (mg/kg)		
			No Change	Delete	Add
FP	0226	Apple	–	1	–
VB	0041	Cabbages, head	–	0.5	–
GC	0080	Cereal grains	10	–	–
FS	0013	Cherries	–	1	–
MO	0105	Edible offal (mammalian)	–	T*0.05	*0.05
PE	0112	Eggs	*0.05	–	–
FB	0269	Grapes	–	1	–
VL	0482	Lettuce, head	–	0.5	–
VL	0483	Lettuce, leaf	–	0.5	–
MM	0095	Meat (mammalian) [in the fat]	–	T*0.05	*0.05
ML	0106	Milks [in the fat]	–	T*0.05	*0.01
SO	0088	Oilseed	0.1	–	–
PM	0110	Poultry meat [in the fat] #	–	*0.05	*0.05
PO	0111	Poultry, edible offal of	*0.05	–	–
VD	0070	Pulses	0.1	–	–
CM	01206	Rice bran, unprocessed	–	T20	20
VO	0448	Tomato	–	0.5	–
CM	0654	Wheat bran, unprocessed	20	–	–
CF	1210	Wheat germ	20	–	–

#The expression of the MRL for PM 0110 Poultry meat will be changed to Poultry meat [in the fat]

Table 22: Amendments to Table 4 of the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023

Code		Commodity	MRL (mg/kg)		
			No Change	Delete	Add
AL	1020	Alfalfa [lucerne] fodder	–	T5	–
AL	1021	Alfalfa [lucerne] forage (green)	–	T5	–
		Cereal forage and fodder	–	–	7
AL	0157	Legume animal feeds {except Alfalfa [lucerne] fodder; Alfalfa [lucerne] forage }	–	T10	–
		Oilseed forage and fodder	–	T10	–
		Rice hulls	–	–	50
AS	0161	Straw, fodder (dry and hay of cereal grains and other grass-like plants (dry weight basis)	–	T10	–

Table 23: Amendments to Table 5 of the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023

Substance	Use
DELETE	
Fenitrothion	For use in seed dressings

6 Environmental safety

6.1 Previous assessments

In 1999, an interim environmental assessment report for fenitrothion was published by the APVMA (then the NRA), which raised concerns about high avian and aquatic invertebrate toxicity. As an outcome of the assessment, various risk management recommendations were implemented to reduce environmental risks including aquatic buffer zones for application to broadacre crops, lucerne, and pasture, and limitations on the quantity applied and frequency of application in certain situations.

6.2 Current assessment

Four fenitrothion registrations remain for control of locusts and other insect pests in pasture and certain field, pasture, orchard, vineyard, and vegetable crops. Application rates range from 250 to 1,300 g ac/ha, with up to 3 applications possible per season at rates up to 650 g ac/ha.

Several fenitrothion products are also registered for control of mealworm in poultry houses or various insect pests in stored grain protection (including structural treatments). These are indoor applications and are considered to result in low environmental exposure. Therefore, they have not been quantitatively assessed. However, certain environmental protection statements still apply as indicated under ‘Environment recommendations’.

The environmental risk assessment scenarios considered in the current assessment are summarised in Table 24. Environmental risks were determined according to contemporary methodology outlined in the APVMA Risk Assessment Manual – Environment. Additional data available since the initial 1999 assessment have also been considered.

Table 24: Environmental risk assessment scenarios

Category	Situation	Risk assessment scenario
Animal housing	Poultry houses	Negligible exposure of the environment
Grain protection	Stored grain protection, including structural treatments	Negligible exposure of the environment
Field crops and pasture	Cereals, forage crops, soybeans	3× 550 g ac/ha 14-day retreatment interval
	Lucerne	3× 650 g ac/ha 7-day retreatment interval
	Pasture and pasture seed crops	1× 1,300 g ac/ha
Tree and vine crops	Apples, cherries, grapes	3× 550 g ac/ha 14-day retreatment interval
Vegetable crops	Tomatoes, lettuce, cabbage	3× 550 g ac/ha 14-day retreatment interval

6.3 Fate and behaviour in the environment

The fate and behaviour of fenitrothion in the environment have been described in the interim 1999 environment assessment report. A few guideline studies have since been generated that inform the key regulatory endpoints for the exposure assessment, which are summarised in Table 25. A full listing of endpoints is provided in Appendix C.

Fenitrothion is non-volatile and has low solubility in water. Its octanol-water partition coefficient indicates a high potential for bioaccumulation. Fenitrothion does not dissociate in water and is susceptible to photochemical degradation under alkaline conditions.

Lewis & Tzilivakis (2017) collated data on the dissipation of fenitrothion on or within various plant matrices using a systematic review approach using several scientific databases. Collated literature was subjected to a quality assessment, for which 14 published articles covering 15 crops across various matrices (leaves, fruits, grass blades, leaf litter) were determined to be acceptable. Mean DT_{50} values for foliar residues ranged from 0.50 to 20 days (geomean 3.2 days); mean DT_{50} values for residues in fruit ranged from 2.2 to 8.3 days (geomean 4.7 days). Fenitrothion is non-systemic and is not known to translocate in plants.

Fenitrothion is non-persistent in soil (geomean DT_{50} 1.1 days) and is moderately mobile (mean Koc 497 mL/g). There is no relationship between soil adsorption and soil organic carbon. However, because the lowest Kf was found for the lowest organic carbon soil (1.3%), this value was considered most appropriate for the runoff assessment. The mean result is used for the food chain assessment (Kf 17 mL/g). Fenitrothion is non-persistent in aquatic systems (geomean DT_{50} 1.6 days) with limited partitioning to sediment (max 28% in sediment; Kf 42 mL/g). Fenitrothion has low volatility and is not subject to long-range transport through the air.

In the southern Flinders Ranges of South Australia, fenitrothion was not detected in any of 9 waterways sampled both before and after spraying in locust control operation in spring 2000. Following extensive flooding in Southeast Queensland in January 2011, fenitrothion was not detected in several waterways linked to high industrial activity discharging into Moreton Bay.

Table 25: Key regulatory endpoints for exposure assessment

Compartment	Value		Reference
Animal food items	Foliage:	DT_{50} 3.2 d	Bahaffi et al. 2005, Gilmour et al. 1999, Hu et al. 2009, Likas & Tsiropoulos 2007, Sundaram 1986, Willis & McDowell 1987, Zongmao & Haibin 1997
	Fruit:	DT_{50} 4.7 d	Bahaffi et al. 2005, Cabras & Angioni 2000, Cabras et al. 1997, Fernández-Cruz et al. 2004, Ishii 2004, Malhat et al. 2017, Passarella et al. 2009
	Other:	DT_{50} 10 d	Default
Soil	DT_{50} 1.1 d		Cranor & Daly 1989, Yeomans & Swales 2001
(Runoff assessment)	Kf 4.9 mL/g, 1/n 0.95		Spillner & Neuberger 1979
(Food chain assessment)	Kf 17 mL/g		
Water	DT_{50} 1.6 d		Swales 2001
Sediment	DT_{50} 1.6 d		Swales 2001
	Kp 42 mL/g		Spillner & Neuberger 1979

Compartment	Value	Reference
Air	DT_{50} 0.23 d	Nishiyama et al. 2000

A full listing of endpoints is presented in Appendix C

6.4 Effects on non-target species

The effects of fenitrothion on non-target species have been described in the interim 1999 environment assessment report. A few guideline studies have since been generated and literature published that inform the key regulatory endpoints for the effects assessment, which are summarised in Table 26. A full listing of studies and endpoints is provided in Appendix C.

Based on the available information, fenitrothion is regarded as having high toxicity to mammals (lowest LD_{50} 97 mg ac/kg bw, *Sminthopsis macroura*) and high toxicity to birds (lowest LD_{50} 11 mg ac/kg bw, *Sturnix vulgaris*) following a single oral dose. Fenitrothion also has high toxicity to birds following short-term dietary exposure (lowest LC_{50} 50 mg ac/kg bw/d, *Zonotrichia albicollis*). Limited laboratory data are available for other terrestrial vertebrate species (i.e. reptiles and amphibians). In an acute exposure study of an agamid lizard, *Pogona vitticeps*, no mortality was observed at oral doses of up to 16 mg/kg bw. Therefore, the following protection statement is required on fenitrothion product labels where there is potential for exposure (followed by an appropriate risk management statement).[2]

Toxic to birds and wild mammals.

A species sensitivity distribution (SSD) analysis was performed on the available acute laboratory data (LD_{50} values) for terrestrial vertebrates. HD_5 values of 44 mg ac/kg bw and 6.9 mg ac/kg bw were derived for wild mammals and birds, respectively, which are lower than the lowest LD_{50} values. Therefore, the acute RAL's established for the risk assessment were revised based on the HD_5 values from the SSD analysis. An assessment factor of 3 was applied, resulting in acute RALs of 15 mg ac/kg bw for mammals and 2.3 mg ac/kg bw for birds to address uncertainty.

Following dietary exposure in reproductive toxicity tests, reduced pup body weights in litters of both generations, viability and lactation indices of mammals were observed at doses as low as 7.4 mg ac/kg bw/d (NOEL 2.3 mg ac/kg bw/d, *Rattus norvegicus*), reduced egg production was observed in birds at doses as low as 3.1 mg ac/kg bw/d (NOEL 2.3 mg ac/kg bw/d, *Colinus virginianus*), and reduced adult body weight was observed at doses as low as 9.2 mg ac/kg bw/d (NOEL 6.0 mg ac/kg bw/d, *Anas platyrhynchos*).

A field study in Senegal investigating bird mortality and activity following application of 485 or 825 g ac/ha to savannah recovered 6 dead/debilitated birds on the lower dose plot and 10 birds on the higher dose plot (Table 43 in Appendix C). Mortality on the low dose plot was estimated to be 2% of larger birds and 7% of smaller birds, while it was 6% and 7%, respectively, on the high dose plot. Bird numbers on fenitrothion treated plots declined by 30–47%, a much greater reduction than estimated to be due to mortality. A general decrease occurred with all bird species monitored. Population reductions appeared to mainly reflect bird movement in response to a reduction in grasshopper prey.

[2] Not required for stored grain protection. Products used only in poultry houses need only identify the hazard to birds.

A field study in Queensland measured cholinesterase activity in birds captured at 3 sites before and after application of 267 g ac/ha (Table 49 in Appendix C). Mean inhibitions of total ChE activity ranged 20% in white-browed woodswallow to 70% in zebra finch. Mean inhibition of 6.0% for birds of prey, 33% for granivorous birds, 36% for honeyeaters, and 35% for insectivorous birds were also reported by the authors. The authors concluded that fenitrothion exposure may have had detrimental effects on the native birds, particularly as evaluation showed many of the birds captured were breeding and/or moulting at the time, the most energetically expensive events in the avian life cycle.

Another field study examined the effect of fenitrothion on avian assemblages in arid and semiarid agro-ecosystems of western New South Wales and Queensland when used for locust control. The authors noted that avian assemblages varied over time, independent of pesticide application, reflecting significant redistribution and mobility of birds across a highly disturbed agricultural landscape, irrespective of pesticide exposure.

In an unpublished field study submitted to the APVMA, the effects of fenitrothion exposure on the ChE levels of small mammals were examined following application of 267 g ac/ha during locust control operations in south-west Queensland. Up to 40% suppression of plasma AChE activity was observed in stripe-face dunnarts post-spray. AChE activity was comparable to pre-spray levels at the next sampling period (2 months post-spray), but it is unclear how long suppression of AChE activity lasted during that time period.

The available field studies on terrestrial vertebrates adequately demonstrate exposure to fenitrothion, but the minimal detectable differences (MDD) due to treatment-related effects have not been reported and, as a result, the extent of impacts is not clearly established. The APVMA has considered published studies investigating cholinesterase activity under both laboratory and field conditions, noting sublethal symptoms of cholinesterase inhibition include fatigue. Such toxic symptoms can often lead to death due to increased susceptibility to predation or reduced ability to compete. Migratory birds may be particularly at risk, as exposure could impair their cognitive and motor functions, and result in issues with refuelling, orientation and navigation, and therefore migratory success (EFSA 2023). A review by Grue et al. (1991) suggests a critical level of about 40 to 60% AChE inhibition may apply for substantial effects on behaviour and physiology; however, more subtle effects may occur at lower levels and there is no clear method for linking these types of observations to population-level effects. Therefore, such studies could not be used quantitatively in the risk assessment.

Fenitrothion has moderate toxicity to fish (lowest LC_{50} 1.3 mg ac/L, *Oncorhynchus mykiss*) and algae (E_rC_{50} 2.7 mg ac/L, *Pseudorkirchneriella subcapitata*), and high toxicity to aquatic invertebrates (lowest LC_{50} 0.0081 mg ac/L, *Chironomus riparius*). The major metabolites NMC and AM-FNT are less toxic than the parent substance fenitrothion. Based on the available data, the following protection statement is required on fenitrothion product labels.

> **Very toxic to aquatic life. DO NOT contaminate wetlands or watercourses with this product or used containers.**

Following long-term exposure to fenitrothion, reduced growth of fish in the early life stages was observed at concentrations as low as 0.17 mg ac/L (NOEC 0.088 mg ac/L, *Oncorhynchus mykiss*) and reduced survival and fecundity of aquatic invertebrates was observed at concentrations as low as 0.00023 mg ac/L (NOEC 0.000087 mg ac/L, *Daphnia magna*).

Fenitrothion shows a low potential to bioaccumulate in fish. Under flow-through conditions at a nominal concentration of 0.05 mg/l, the steady state BCF was reached within approximately one day of exposure (Ohshima *et al*. 1988). The average BCFs for the parent compound over the exposure period for whole fish, fillet and viscera were 29, 19 and 36, respectively. Fenitrothion readily depurates from fish tissues with an estimated CT_{95} of less than one day. It is concluded that fenitrothion will not persist in fish. In fish tissues, fenitrothion, DM-FNT, NMC and the AAMC related metabolites together accounted for 85–96% of the radioactive residue (Ohshima & Mikami 1990). These metabolites also depurate readily from fish tissues with a CT_{95} of less than 7 days.

A field study investigating impact on invertebrates in temporary ponds following application of 500 g ac/ha to a cultivated savannah measured initial concentrations of 80 µg ac/L in the pond water (DT_{50} 34 hours). Fenitrothion significantly reduced population densities of backswimmers of the genus *Anisops* (Hemiptera, Notonectidae) and in addition caused an extensive kill of other species of insects. Both insecticide applications were also followed by reductions of zooplankton densities, especially Cladocera. Recovery proceeded at fixed rates, which were different for each taxon. *Anisops* spp. recovered from the treatments in 0.5 to 3 weeks, most likely through aerial migration. Cladocerans returned to normal densities in 3.5 to 6 weeks. In a separate field study, no apparent impact on macroinvertebrate communities was observed following locust spray operations in South Australia.

The RAL established for the aquatic risk assessment is based on an SSD (BurrliOz v2.0) of acute aquatic invertebrate data. The SSD showed the lower limit HC_5 derived from the curve (0.18 µg ac/L) to be less than 1/3 of the median HC_5 (0.57 µg ac/L). Additionally, the lower tail of the toxicity data are, overall, positioned on the left side of the SSD curve. As a result of these considerations an assessment factor of 6 was applied to the median HC_5 resulting in a RAL of 0.095 µg ac/L.

Fenitrothion has high toxicity to adult bees by contact exposure (LD_{50} 0.16 µg ac/bee, *Apis mellifera*) and oral exposure (LD_{50} 0.20 µg ac/bee, *Apis mellifera*). Therefore, the following hazard statement is advised for fenitrothion product labels that have outdoor uses (followed by an appropriate risk management statement).[3]

Toxic to bees.

For the spray drift assessment, the RAL is 27 g ac/ha based on the contact LD_{50} 0.16 µg ac/bee and a conversion factor of LOC 0.4/ExpE 2.4 * 1,000 as per APVMA's spray drift risk assessment manual (SDRAM).

There are no contemporary data on the toxicity of fenitrothion to predatory and parasitic arthropods. Fenitrothion products are not considered to be compatible with integrated pest management programs utilising beneficial arthropods. Therefore, the following protection statement is advised for fenitrothion agricultural product labels.[4]

Toxic to beneficial arthropods. Not compatible with integrated pest management (IPM) programs utilising beneficial arthropods. Minimise spray drift to reduce harmful effects on beneficial arthropods in non-crop areas.

In an Australian field study using fenitrothion for plague locust control, effects on non-target invertebrates were investigated during locust control operations on a Mitchell grass plain in south-western Queensland following application at 267 g ac/ha. Significant differences in invertebrate community compositions between the treated and control sites were evident for up to 39 days (yellow pan traps) and over 79 days (pitfall traps), with invertebrate

[3] Not required for poultry houses or stored grain protection
[4] Not required for poultry houses or stored grain protection

assemblages among all sites again being similar when sampled 189 days post spray. The response pattern of the sprayed sites was driven mostly by decreases in the abundance of Orthoptera, Formicidae and Collembola.

Fenitrothion is moderately toxic to soil macro-organisms such as earthworms (LC_{50corr} 116 mg ac/kg dry soil, *Eisenia fetida*), the metabolite NMC is also moderately toxic (LC_{50corr} 18 mg/kg dry soil, *Eisenia fetida*). Fenitrothion did not influence soil processes such as nitrogen transformation at the highest test concentration (NOEC 10 mg ac/kg dry soil).

Field studies are available that investigated the effect of fenitrothion, applied once as a granular formulation at 2.24 kg ac/ha, on soil dwelling organisms. No effect on the abundance of earthworms (*Allolobophora caliginosa*) was reported. Effects on individual species of collembola and acari cannot be excluded, though where an effect could not be excluded in most cases recovery was observed within 30 weeks.

The toxicity of a 40% WP formulation to 6 species of non-target terrestrial plants has been tested following post-emergent exposure in a screening test. All ER_{25} values are >1,000 g ac/ha. Fenitrothion does not show any fungicidal activity against 7 test diseases (Oguri 2001).

Normal agricultural practice is not expected to lead to significant exposure of sewage treatment works to fenitrothion. The activated sludge test indicates that no adverse effect on microbial activity in sewage treatment works is expected at concentrations of 1,000 mg ac/L (L’Haridon 2002).

Table 26: Acute toxicity endpoints used for SSD analyses

Group	Species	Toxicity value
Mammals	*Sminthopsis macroura*	LD_{50} 97 mg ac/kg bw
	Sminthopsis crassicaudata	LD_{50} 129 mg ac/kg bw
	Rattus norvegicus	LD_{50} 287 mg ac/kg bw
	Cavia porcellus	LD_{50} 974 mg ac/kg bw
	Mus musculus	LD_{50} 1334 mg ac/kg bw
		HD_5 44 mg ac/kg bw (95% CI 12 -159)
Birds	*Sturnix vulgaris*	LD_{50} 11 mg ac/kg bw
	Agelaius phoeniceus	LD_{50} 25 mg ac/kg bw
	Colinus virginianus	LD_{50} 26 mg ac/kg bw
	Phasianus colchicus	LD_{50} 44 mg ac/kg bw
	Tympanuchus phasianellus	LD_{50} 53 mg ac/kg bw
	Coturnix japonica	LD_{50} 80 mg ac/kg bw
	Passer domesticus	LD_{50} 316 mg ac/kg bw
	Carpodacus mexicanus	LD_{50} 316 mg ac/kg bw
	Gallus gallus	LD_{50} 500 mg ac/kg bw
	Anas platyrhychos	LD_{50} 1406 mg ac/kg bw
		HD_5 8.1 mg ac/kg bw (95% CI 0.41-39)
Aquatic invertebrates	*Paratya compressa*	LC_{50} 0.36 µg ac/L
	Cheumatopsyche brevilineata	EC_{50} 7.8 µg ac/L
	Chironomus riparius	LC_{50} 8.1 µg ac/L
	Anisops sardeus	LC_{50} 8.6 µg ac/L
	Daphnia magna	EC_{50} 9.3 µg ac/L
	Hyalella azteca	LC_{50} 9.7 µg ac/L
	Neocaridina denticulata	LC_{50} 140 µg ac/L
	Streptocephalus sudanicus	EC_{50} 1200 µg ac/L
		HC_5 0.57 µg ac/L (95% CI 0.18-0.87)

Mammal and bird LD_{50} values from Table 48 in Appendix C; aquatic invertebrate LC/EC_{50} values from Table 50 in Appendix C; only definitive endpoints were used in the SSD analysis

Table 27: Regulatory acceptable levels for non-target species

Group	Exposure	Endpoint	AF	RAL
Mammals	Acute	HD_5 44 mg ac/kg bw	3	15 mg ac/kg bw
	Chronic	NOEL 2.3 mg ac/kg bw/d	1	2.3 mg ac/kg bw/d
Birds	Acute	LD_{50} 8.1 mg ac/kg bw	3	2.7 mg ac/kg bw
	Chronic	NOEL 2.3 mg ac/kg bw/d	1	2.3 mg ac/kg bw/d
Aquatic species	Acute	HC_5 0.57 µg ac/L	6	0.095 µg ac/L
Adult bees	Acute contact	LD_{50} 0.16 µg ac/bee	2.5	0.064 µg ac/bee
	Acute oral	LD_{50} 0.20 µg ac/bee	2.5	0.080 µg ac/bee
Soil organisms	Chronic	NOEC 10 mg ac/kg ds	1	10 mg ac/kg ds
Terrestrial plants	Post-emergent	ER_{25} >1000 g ac/ha	2	500 g ac/ha

Endpoints from Table 26 (HD_5, HC_5) and Appendix C (remaining)
AF = assessment factor
RAL = regulatory acceptable level = endpoint / AF

6.5 Risks to non-target species

6.5.1 Terrestrial vertebrates

Maximum acceptable application rates for wild mammals and birds following both acute and chronic exposure have been calculated for each application timing (Appendix D). Overall risk assessment conclusions are presented in Table 28. Acceptable risks could be concluded in grazing sorghum and cereal crops (excluding corn and maize) at growth stages BBCH 40-69 at rates up to 376 g ac/ha. Acceptable risks could not be concluded for at least one focal species at any application timing at the lowest registered rate in the remaining use situations.

Szabo et al. (2009) was examined to determine whether the assessment for locust control could be further refined using specific focal species. Willie wagtail was predicted to be the most frequently present bird during locust control operations in eastern Australia; however, the report does not contain sufficient detail for determining specific focal species to refine the risk assessment as per EFSA (2009, 2023a) guidelines.

Mineau (2002) was also examined to determine whether a higher rate could be supported based on his model to predict the probability of bird mortality from pesticide sprays on the basis of the field study record. For fenitrothion, application rates of 169–175 g ac/ha were calculated by the APVMA for a 5% probability of kill, which are below the lowest registered rates and lower than that supported by the generic focal species assessment.

The available information indicates that there is the potential for adverse effects due to the proposed uses of fenitrothion, i.e. either direct mortality or indirect mortality due to behavioural impairment. This is the conclusion of the generic focal species risk assessment and is indicated by the observations of ChE and AChE activity, and the probability of kill based on Mineau (2002). The additional field studies considered in this response to comments do not clearly exclude the potential for adverse effects. This is due to methodological limitations and the lack of consideration of their power to detect effects (MDD). Whilst there is acknowledged uncertainty regarding the magnitude and potential frequency of any adverse effects the weight-of-evidence is not considered sufficient to conclude an acceptable risk; for uses other than those concluded to be acceptable based on the generic focal species risk assessment.

The log Pow 3.3 for fenitrothion indicates a potential for bioaccumulation. As bioaccumulation processes are often slow, a chronic assessment is appropriate. The food chain assessment for fish-eating species assumes that the RAL for aquatic species is not exceeded on the basis that only terrestrial use situations with acceptable risks to aquatic species will be approved. Provided water concentrations do not exceed the aquatic RAL, any accumulated residues in fish will not reach levels harmful to predators. Maximum acceptable seasonal rates were determined to be 924 g ac/ha for earthworm-eating mammals and 500 g ac/ha for fish-eating species in rice situations (Table 29). These rates are higher than those supported by the direct dietary assessments for birds and therefore there are no concerns about accumulated residues in prey (e.g. earthworms and fish) reaching levels harmful to predators.

Table 28: Summary of risk assessment outcomes for terrestrial vertebrates

Category	Crop	Rate (g/ha)	Timing	Max acceptable (g/ha) Wild mammals	Max acceptable (g/ha) Birds	Overall outcome
Field crops and pasture	Pasture	246-1300	BBCH <10	1026	133	Not supported
			BBCH 10-39	108	89	
			BBCH ≥50	108	110	
	Pasture seed crops	246-550	BBCH <10	1026	133	Not supported
			BBCH 10-39	108	89	
			BBCH ≥50	108	110	
	Forage crops	246-550	BBCH <10	1026	110	Not supported
			BBCH 10-19	853	101	
			BBCH 20-39	418	49	
			BBCH 40-49	108	49	
			BBCH ≥50	359	107	
	Grazing sorghum, cereal crops	246-550	BBCH <10	1026	110	BBCH <40: not supported
			BBCH 10-19	348	89	BBCH 40-69: max 376 g/ha supported
			BBCH 20-29	853	89	BBCH ≥70: not supported
			BBCH 30-39	1705	226	
			BBCH 40-69	359	376	
			BBCH 70-89	359	47	
			BBCH ≥90	359	100	
	Corn, maize	246-550	BBCH <10	1026	110	Not supported
			BBCH 10-29	108	49	
			BBCH 30-39	215	97	
			BBCH ≥40	430	195	
	Lucerne	246-650	BBCH <10	1026	110	Not supported
			BBCH 10-19	853	101	
			BBCH 20-39	418	49	
			BBCH 40-49	108	49	
			BBCH ≥50	359	107	

Category	Crop	Rate (g/ha)	Timing	Max acceptable (g/ha) Wild mammals	Birds	Overall outcome
	Soybean	246-550	BBCH <10	1026	110	Not supported
			BBCH 10-19	418	49	
			BBCH 20-39	418	107	
			BBCH 40-49	108	107	
			BBCH ≥50	359	107	
Fruit and vegetables	Apples, cherries	246-550	BBCH <10	108	99	Not supported
			BBCH 10-19	134	58	
			BBCH 20-39	179	58	
			BBCH 40-70	359	58	
			BBCH 71-79	306	58	
			BBCH ≥50	359	58	
	Grapes	246-550	BBCH <10	108	110	Not supported
			BBCH 10-19	179	99	
			BBCH 20-39	215	105	
			BBCH 40-69	359	105	
			BBCH 70-89	359	94	
			BBCH ≥90	359	105	
	Cabbages, lettuce	246-550	BBCH <10	1026	110	Not supported
			BBCH 10-19	418	30	
			BBCH 20-39	418	99	
			BBCH 40-49	108	99	
			BBCH ≥50	359	107	
	Tomatoes	246-550	BBCH <10	1026	110	Not supported
			BBCH 10-19	108	101	
			BBCH 20-49	108	107	
			BBCH 50-69	359	107	
			BBCH 70-89	324	47	
			BBCH ≥90	359	107	

Maximum seasonal rates supported for each growth stage/ focal species combination are provided in Appendix D of this document

Table 29: Food chain assessment for terrestrial vertebrates (maximum acceptable threshold)

Exposure	Indicator species	Group	Shortcut value	PECmedia (mg/kg or mg/L)	DDD (mg/kg/d)	RAL (mg/kg/d)	RQ
Chronic	Earthworm-eating species	Mammals	1.28	1.2	2.3	2.3	1.0
		Birds	1.05	1.2	1.9	2.3	0.82
	Fish-eating species (terrestrial situations)	Mammals	0.142	0.000095	0.00039	2.3	<0.01
		Birds	0.159	0.000095	0.00044	2.3	<0.01
	Fish-eating species (rice situations)	Mammals	0.142	0.50	2.1	2.3	0.90
		Birds	0.159	0.50	2.3	2.3	1.0

Shortcut values from EFSA (2009)
PEC_{media} = predicted environmental concentration in:
soil of 5 cm depth (mg/kg) = 924 g ac/ha (maximum acceptable seasonal rate to achieve RQ 1.0) /750
water of 15 cm depth (terrestrial situations) (mg/L) = aquatic RAL (from Table 27)
water of 10 cm depth (rice situations) (mg/L) = 500 g ac/ha (maximum acceptable seasonal rate to achieve RQ 1.0) /1000
PEC_{food} = PEC_{medium} * BCF, where:
$BCF_{earthworm}$ is 1.5 based on [0.84 + 0.012 * 10^(log Pow 3.3)] / Kf 17 (from Table X)
BCF_{fish} is 29 (Oshima et al. 1988)
DDD = daily dietary dose (mg/kg bw/d) = shortcut value * PEC_{food}
RAL = regulatory acceptable level (from Table 27)
RQ = risk quotient = PEC / RAL, where acceptable RQ ≤1

6.5.2 Aquatic species

For outdoor terrestrial uses of fenitrothion, runoff risks to aquatic species were determined by the APVMA as indicated in Appendix E. Runoff risks were determined to be acceptable in all situations supported by the terrestrial vertebrate situation without any timing restriction (i.e., in most cereals up to 376 g ac/ha). Because the assessment assumes a runoff event occurs 3 days after application, the following restraints are required for the supported terrestrial use situations.[5]

To avoid runoff, DO NOT apply if heavy rains or storms are forecast within 3 days.
DO NOT irrigate to the point of field runoff for at least 3 days after application.

Risks of releasing rice paddy water resulting in entry of fenitrothion into natural water bodies were assessed according to MED-Rice (2003). Acceptable risks to aquatic species could not be concluded if paddy water was released within 365 days of application as the RQ remained greater than one (Table 30). Continued use of fenitrothion in rice situations is therefore not supported.

As indicated in Table 27, the RAL for the spray drift assessment is 0.095 µg ac/L for the protection of natural aquatic areas. Risks of spray drift are assessed separately in the Spray drift section, as needed.

[5] Not required for poultry houses or stored grain protection

Table 30: Assessment of risks of released paddy water to aquatic species in rice situations

Parameter		Max label	Max supported*	Note
Application rate	(g/ha)	550	376	Maximum registered rate in rice situations and *maximum rate supported by the terrestrial vertebrate assessment
Crop interception Fint	(unitless)	0.50	0.50	For BBCH 20-59 from Linders et al. 2000
Water exposure rate	(g/ha)	413	282	= application rate * (1 – Fint * 0.50)
Depth of water in rice field	(m)	0.10	0.10	Default value for rice situations (MED-Rice 2003)
Water DT_{50}	(d)	1.6	1.6	From Table 25
RAL	(µg/L)	0.095	0.095	From Table 27
Tier 1 (paddy water)				
PEC	(µg/L)	413	282	=0.1 * water exposure rate (g/ha) * water depth (m)
RQ	(unitless)	4342	2968	= PEC / RAL, where acceptable RQ ≤1
Tier 2 (dilution in receiving water, no degradation)				
PEC	(µg/L)	38	26	=tier 1 PEC / (1+ dilution factor 10)
RQ	(unitless)	395	270	= PEC / RAL, **where acceptable RQ ≤1**
Tier 3 (dilution in receiving water, degradation over 365d withholding period)				
TWA factor	(unitless)	0.0063	0.0063	= [1 – EXP (-ln(2) / water DT_{50} (d) * withholding period (d)]] / [ln(2) / water DT_{50} (d) * withholding period (d)]
PEC	(µg/L)	0.24	0.16	=tier 2 PEC / (1+ dilution factor 10)
RQ	(unitless)	2.5	1.7	= PEC / RAL, **where acceptable RQ ≤1**

RQ = risk quotient = PEC / RAL, where acceptable RQ ≤1

6.5.3 Bees

Available monitoring data suggest that occurrence of fenitrothion residues in bee-relevant matrices are rare; however, adverse incidents have been recorded and are mostly attributed to applications where bees are foraging (see Table 52 in Appendix C). Exposure of pollinators foraging from oversprayed blooming plants was determined to be acceptable at rates up to 2.9 g ac/ha (Table 31). Given the lowest application rate is 246 g ac/ha (and in light of the findings of the terrestrial vertebrate assessment), the following pollinator restraints are required for all spray applications of fenitrothion where exposure of pollinators is possible. Restraints are not required where exposure was deemed to be negligible (i.e., post-harvest uses).

> **Toxic to bees. DO NOT apply to bee-attractive crops from the onset of flowering (BBCH ≥60). DO NOT allow spray drift to flowering weeds or flowering crops in the vicinity of the treatment area. Before spraying, notify beekeepers to move hives to a safe location with an untreated source of nectar and pollen if there is potential for managed hives to be affected by the spray or spray drift.**

It is noted that only use in cereal crops (excluding corn, maize and rice) up to 376 g ac/ha at BBCH 40-69 is supported by the terrestrial vertebrate assessment (flowering occurs BBCH 60-69). Some cereal crops (e.g., sorghum, millet, maize, teosinte, wild rice) are considered bee-attractive food sources for pollen (EFSA 2023b, USDA 2017), while others (e.g., wheat, triticale, barley, rye, oats) are no longer considered attractive food sources for bees based on a recent expert knowledge elicitation by EFSA (2023b). Therefore, the standard pollinator protection statement was modified slightly to allow for application during the blooming period in cases where the crop is not attractive to bees.

Table 31: Fenitrothion – Maximum rate not requiring pollinator restraints (2.9 g ac/ha)

Life stage	Exposure	Rate (g/ha)	Predicted total dose (µg/bee)	RAL (µg/bee)	RQ
Adults	Acute contact	2.9	0.0070	0.064	0.11
	Acute oral	2.9	0.083	0.084	1.0

Predicted total dose calculated using USEPA BeeREX tool for adult worker bee foraging for nectar and larval drone within the hive
RAL = regulatory acceptable level from Table 26
RQ = risk quotient = PEC / RAL, where acceptable RQ ≤1

6.5.4 Other non-target arthropod species

In the absence of contemporary toxicity data, fenitrothion products are not considered to be compatible with integrated pest management programs utilising beneficial arthropods. Therefore, the following protection statement is advised for outdoor uses of fenitrothion products. [6]

> **Toxic to beneficial arthropods. Not compatible with integrated pest management (IPM) programs utilising beneficial arthropods. Minimise spray drift to reduce harmful effects on beneficial arthropods in non-crop areas.**

6.5.5 Soil organisms

Risks to soil organisms are assessed using a tiered approach. A screening level risk assessment assumes the worst-case scenario of a direct overspray of soil without interception in order to identify those substances and associated uses that do not pose a risk to soil organisms. Acceptable risks of fenitrothion to soil organisms could be concluded at the screening level at the maximum single and seasonal rate of 1,300 g ac/ha (pasture) (Table 32). Available field studies suggests that there are no long-term effects on soil organisms. Therefore, no protection statements are required for soil organisms on fenitrothion product labels.

Table 32: Screening level assessment of risks to soil organisms

Group	Rate (g/ha)	PEC (mg/kg dry soil)	RAL (mg/kg dry soil)	RQ
Soil organisms	1 300	1.7	10	0.17

Maximum single and seasonal rate based on 1× 1300 g ac/ha in pasture situations
PEC = predicted environmental concentration in top 5-cm soil (mg ac/kg dry soil) = rate (g ac/ha)/750
RAL = regulatory acceptable level (from Table 27)
RQ = risk quotient = PEC / RAL, where acceptable RQ ≤1

[6] Not required for poultry houses or stored grain protection

6.5.6 Terrestrial plants

As indicated in Table 27, the RAL for the spray drift assessment is 500 g ac/ha for the protection of vegetation areas. Risks of spray drift are assessed in the Spray drift section, as needed.

6.6 Recommendations

Uses supported from the viewpoint of environmental safety are listed in Table 33 with the required protection statements and restraints. Uses that are not supported from the viewpoint of environmental safety are listed in Table 34.

Table 33: Supported uses from the viewpoint of environmental safety

Situation	Protection statements and restraints
All supported situations	Very toxic to aquatic life. DO NOT contaminate wetlands or watercourses with this product or used containers.
Stored grain protection, including structural treatments	(No additional protection statements or restraints are required).
Poultry houses	Toxic to birds. Remove birds from fowl houses before spraying. Avoid spraying drinking water and feed troughs.
Grazing sorghum, cereal crops (excluding corn/maize/rice), up to 376 g ac/ha	To avoid runoff, DO NOT apply if heavy rains or storms are forecast within 3 days. DO NOT irrigate to the point of field runoff for at least 3 days after application. DO NOT apply more than 1 spray per field per year Toxic to birds and wild mammals. To protect wildlife, DO NOT apply before booting (BBCH <40) or after flowering is complete (BBCH >69). Toxic to bees. DO NOT apply to bee-attractive crops from the onset of flowering (BBCH ≥60). DO NOT allow spray drift to flowering weeds or flowering crops in the vicinity of the treatment area. Before spraying, notify beekeepers to move hives to a safe location with an untreated source of nectar and pollen, if there is potential for managed hives to be affected by the spray or spray drift. Toxic to beneficial arthropods. Not compatible with integrated pest management (IPM) programs utilising beneficial arthropods. Minimise spray drift to reduce harmful effects on beneficial arthropods in non-crop areas.

Table 34: Uses not supported from the viewpoint of environmental safety

Situation	Basis
Pasture and pasture seed crops	Unacceptable risk to terrestrial vertebrates
Grazing sorghum (>376 g ac/ha), cereal crops (>376 g ac/ha), corn, maize, rice, soybeans, forage crops, lucerne	
Apples, cherries, grapes	
Tomatoes, lettuce, cabbage	
Rice	Unacceptable risk to terrestrial vertebrates above 376 g ac/ha Unacceptable risk to aquatic organisms via paddy water release

7 Efficacy and target safety

7.1 Efficacy

The label variations recommended in this Technical Report are within the currently approved use patterns. However, it is noted that fenitrothion/S-methoprene combination products do not include a defined protection period. Based on previous assessments, the APVMA is satisfied that the protection period stemming from use of these dual active products should be ‘up to 9 months’ based on previous assessments of fenitrothion products where tank mixes with S-methoprene are recommended.

The APVMA’s risk assessments for environment, worker health and safety, residues and trade were revised upon consideration of the submissions received during the public consultation on the Proposed Regulatory Decision for the reconsideration. The use of fenitrothion in cereal crops and grazing sorghum for the control of locust and grasshopper pests was supported with application rate and application timing restrictions. These restrictions are within the application rate and timing range indicated on currently approved labels; however, the following statement is required for use patterns where current instructions state to use a higher rate than now supported depending on crop density and pest stage.

Current statements:

- ‘Use higher rate through suitable boom sprayer in dense crops against adult grasshoppers’ (56170/67186/50775; higher rate is 400 or 550 g ac/ha depending on pest/crop).
- ‘Use the lowest rate possible to achieve effective control. Higher rates may be necessary where vegetation is either very sparse or very dense’ (50774; relevant for Australian plague locust, migratory locust, spur-throated locust, yellow-winged locust and small plague grasshopper).

[When vegetation is very sparse or very dense] [When adult grasshoppers are present in dense crops], use of this product may not result in full control of pests.

Spray drift assessments were completed to determine protective buffer zones for use of fenitrothion EC products in cereal crops and grazing sorghum. Although existing labels did not include specific instructions related to spray quality, a MEDIUM spray quality would typically be considered optimal for a contact/ingested insecticide such as fenitrothion. However, no adequately protective buffer zones could be calculated for fenitrothion EC products when using a MEDIUM spray quality. Acceptable buffer zones could be determined using a COARSE spray quality for boom spray application of fenitrothion EC and it is considered that this would be unlikely to result in a significant reduction in efficiency.

The use of the products, when used according to label directions, is expected to meet the efficacy criteria as described in the Agricultural and Veterinary Chemicals Code (Efficacy Criteria) Determination 2014 based on previous assessments and a demonstrated history of effective use.

7.2 Target crop safety

The label variations recommended in this Technical Report are within existing use patterns. Based on the previous satisfaction that the uses would be safe to target crops and that the APVMA has not received any adverse experience reports in relation to in-crop damage or off target damage from fenitrothion products, the APVMA is satisfied that the products will meet the safety criteria as they relate to target crop safety when used according to the proposed labels.

8 Spray drift

The APVMA's approach to spray drift management set out in the APVMA Spray Drift Policy July 2019 specifies consideration of spray drift in bystander areas, livestock areas, natural aquatic areas, pollinator areas and vegetation areas. The regulatory acceptable levels (RALs) for each area are summarised in Table 35 which is the maximum amount of spray drift exposure that is not expected to cause undue harm to sensitive areas.

Table 35: Regulatory acceptable levels of fenitrothion resulting from spray drift

Area considered	Regulatory acceptable level
Natural aquatic areas	0.095 µg ac/L
Pollinator areas	27 g ac/ha
Vegetation areas	500 g ac/ha
Bystander areas	7.74 g ac/ha
Livestock areas	100 mg/kg

The APVMA has only considered spray drift implications for uses of fenitrothion that are supported by worker health and safety, residues, trade and environmental risk assessments. These uses include:

- post-harvest cereal grain protection from stored cereal pests
- field uses in cereal grains and grazing sorghum for control of locusts and grasshoppers using boom spray application equipment and aerial application.

Post-harvest application of fenitrothion to cereal grain uses specialized equipment that includes nozzles integrated into the auger or a shielded sprayer on the conveyor belt that transfers the grain into the storage silos. In accordance with the APVMA Spray Drift Policy July 2019, mandatory downwind buffer zones are not required for post-harvest treatment of agricultural produce, including grain protection uses.

8.1 Spray drift assessment

For field uses in cereal grains and grazing sorghum, the worker health and safety, residues, trade and environment risk assessments were able to support fenitrothion rates of 270- 376 g ac/ha. Spray drift buffer zones were calculated for relevant use patterns for emulsifiable concentrate products using the spray drift risk assessment tool (SDRAT) using standard deposition curves for ground applications by boom spray and aerial application by airplane and helicopter. For assessment of fenitrothion ULV products, the US EPA Agricultural DISPersal (AgDISP) software was used to calculate buffer zones for a custom deposition curve as described in Spray Drift Risk Assessment Manual.

Details of each assessment is provided below. Where a buffer zone was required to ensure that RALs are not exceeded, it is recommended that the product labels be varied to include the mandatory downwind buffer zones outlined below.

8.1.1 Emulsifiable concentrate (EC) products – ground boom and aerial application

The spray drift assessments initially considered a MEDIUM spray quality for boom sprayer and aerial application equipment, however acceptable downwind buffer zones could not be generated as at the supported application rate (270-376 g ac/ha) exposure to sensitive areas was expected to exceed the RAL. When a COARSE spray quality was considered for boom sprayer and aerial application equipment, buffer zones could be established for boom sprayer at a maximum rate of 330 g ac/ha and a maximum target release height of 0.5 m, but not for rates above 330 g ac/ha or aerial applications (see Table 36 and Table 37).

Table 36: Buffer zones for ground boom application of fenitrothion EC with a coarse spray

Application rate	Boom height above target canopy	Mandatory downwind buffer zones (m)				
		Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
376 mL (376 g ac/ha)	1 m or lower	22	Not supported (> 400 m)	8	0	0
330 mL (330 g ac/ha)	1 m or lower	20	Not supported (> 400 m)	8	0	0
270 mL (270 g ac/ha)	1 m or lower	16	Not supported (> 400 m)	6	0	0
376 mL (376 g ac/ha)	0.5 m or lower	0	Not supported (>400 m)	0	0	0
330 mL (330 g ac/ha)	0.5 m or lower	0	398 m	0	0	0
270 mL (270 g ac/ha)	0.5 m or lower	0	340 m	0	0	0

Table 37: Buffer zones for aerial application of fenitrothion EC with a coarse spray

Application rate	Aircraft	Mandatory downwind buffer zones (m)				
		Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
376 mL (376 g ac/ha)	Fixed wing	100	Not supported (> 800 m)	38	0	0
330 mL (330 g ac/ha)	Fixed wing	92	Not supported (> 800 m)	32	0	0
270 mL (270 g ac/ha)	Fixed wing	78	Not supported (> 800 m)	26	0	0
376 mL (376 g ac/ha)	Helicopter	72	Not supported (> 800 m)	34	0	0
330 mL (330 g ac/ha)	Helicopter	66	Not supported (> 800 m)	32	0	0
270 mL (270 g ac/ha)	Helicopter	58	Not supported (> 800 m)	28	0	0

Current label instruction for fenitrothion EC products include application using misting (application using very fine droplet size). As a COARSE spray droplet size category (volume median diameter range of 329–440 µm) is the finest spray quality for which acceptable downwind buffer zones can be established, application of fenitrothion EC by misting was not considered acceptable.

For boom sprayer application of fenitrothion EC to cereal grain crops and grazing sorghum, the following spray drift restraints and downwind buffer zones, including rounding up of values as per the SDRAT, are required for the application of relevant EC fenitrothion products.

SPRAY DRIFT RESTRAINTS

Specific definitions for terms used in this section of the label can be found at apvma.gov.au/spraydrift.

DO NOT allow bystanders to come into contact with the spray cloud.

DO NOT apply in a manner that may cause an unacceptable impact to native vegetation, agricultural crops, landscaped gardens and aquaculture production, or cause contamination of plant or livestock commodities, outside the application site from spray drift. The buffer zones in the relevant buffer zone table/s below provide guidance but may not be sufficient in all situations. Wherever possible, correctly use application equipment designed to reduce spray drift and apply when the wind direction is away from these sensitive areas.

DO NOT apply unless the wind speed is between 3 and 20 kilometres per hour at the application site during the time of application.

DO NOT apply if there are hazardous surface temperature inversion conditions present at the application site during the time of application. Surface temperature conditions exist most evenings one to two hours before sunset and persist until one to two hours after sunrise.

DO NOT apply by a boom sprayer unless the following requirements are met:

- spray droplets not smaller than a COARSE spray droplet size category
- minimum distances between the application site and downwind sensitive areas (see ‘Mandatory downwind buffer zones’ section of the following table titled ‘Buffer zones for boom sprayers’) are observed.

Buffer zones for boom sprayers

Application rate	Boom height above the target canopy	Mandatory downwind buffer zones (metres)				
		Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
Up to 330 g ac/ha	0.5 m or lower	0	400	0	0	0
270 mL/ha or lower	0.5 m or lower	0	350	0	0	0

DO NOT apply by aircraft

8.1.2 Ultra-low volume (UL) products

8.1.2.1. Aerial application by fixed wing aircraft

Risks from ultra-low volume (UL) application considered a 5–10 m release height, windspeeds of 14 and 20 km/h and a VERY FINE spray quality for fixed wing aircraft using custom deposition curves generated using AGDISP™ software. The Very Fine droplet spectra was based on the ASAE very fine reference distribution in AGDISP that was converted with the DSD Converter to be consistent with APVMA droplet size distributions, in line with the APVMA spray drift policy. As UL formulations are oil-based products and not mixed with water, they have very low volatilisation. The spray material in AGDISP was therefore modified such that the spray does not evaporate.

When AGDISP was run with a scenario based on the APVMA standard aircraft setting with the number of nozzles and nozzle placement adjusted to account for rotary atomisers (assumed 10 nozzles for fixed wing and 4 nozzles for helicopter) all aquatic area buffer zones were greater than 2999 m.

Submissions provided to the APVMA outlined specific parameters used for aerial application of UL fenitrothion for locust control. AGDISP parameters were modified to include 2 nozzles, a 20 m swath width and a flow rate of 7 L/min with 5 spray replicates. At 20 km/h windspeed, mandatory buffer zones were all greater than 2999 m for natural aquatic areas, and large buffer zones were also required for bystander areas (Table 38). The buffer zones of >3 km for natural aquatic areas was considered impractical for a label use and as a result aerial spray application of UL fenitrothion was not supported.

Table 38: Buffer zones for aerial application of UL fenitrothion

Application rate	Aircraft	Release height	Mandatory downwind buffer zones (m)				
			Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
306 mL (376 g ac/ha)	Custom Fixed wing	5 m or lower	688	Not supported (>2999 m)	121	0	0
200 mL (246 g ac/ha) or lower	Custom Fixed wing	5 m or lower	524	Not supported (>2999 m)	198	0	0
306 mL (376 g ac/ha)	Custom Fixed wing	10 m or lower	1000	Not supported (>2999 m)	176	0	0
200 mL (246 g ac/ha) or lower	Custom Fixed wing	10 m or lower	689	Not supported (>2999 m)	296	0	0

8.1.2.2. Ground application by misting

Risks from ultra-low volume (UL) application considered a 2 m release height windspeeds of 14 and 20 km/h and a VERY FINE spray quality for fixed wing aircraft using custom deposition curves generated using AGDISP™ software. The Very Fine droplet spectra was based on the ASAE very fine reference distribution in AGDISP that was converted with the DSD Converter to be consistent with APVMA droplet size distributions, in line with the APVMA spray drift policy. As UL formulations are oil-based products and not mixed with water, they have very low volatilisation. The spray material in AGDISP was therefore modified such that the spray does not evaporate.

At 20 km/h windspeed mandatory buffer zones for natural aquatic areas were 2.1 km at the lowest label rate and 2.6 km for the highest label rate (see Table 39). Buffer zones of this size were considered impractical for a label use, and as a result, the application of UL fenitrothion by ground misting was not supported.

Table 39: Buffer zones for ground application of UL fenitrothion

Application rate	Release height	Mandatory downwind buffer zones (m)				
		Bystander areas	Natural aquatic areas	Pollinator areas	Vegetation areas	Livestock areas
306 mL (376 g ac/ha)	2 m or lower	361	Not supported (2660 m)	198	0	0
200 mL (246 g ac/ha)	2 m or lower	283	Not supported (2100 m)	121	0	0

9 Conclusion

This document details the contemporary health, environment, residues and trade and spray drift assessments completed during the reconsideration of fenitrothion, including the consideration of information received during the 3 month consultation period on proposed regulatory decision. The assessments concluded that the ongoing use of fenitrothion chemical products was acceptable for control of insect pests in stored cereal grain and for limited field uses on cereal grain crops and grazing sorghum. The outcomes of the assessments are summarised in Table 1 and specific label instructions required to mitigate risks are detailed in Table 41. All other uses were assessed as unacceptable based on risks to human health (worker exposure or residues) and/or the environment (including spray drift). The ongoing use of the ultra-low volume product was not supported due to an unacceptable risk to the environment through downwind spray drift.

Appendices

Appendix A – Public consultation

The APVMA received 9 written submissions in response to the publication of the Proposed Regulatory Decision. The APVMA received permission to publish 3 of these submissions, which are accessible on the APVMA website. Details of the submissions are listed in Table 40 and the APVMA's consideration of these submissions are summarised below.

Table 40: Submissions in response to the proposed regulatory decision on the reconsideration of fenitrothion

Submitter	Comments
Grains Research and Development Corporation (GRDC)	The GRDC requested refinement of worker health and safety assessment for field uses and questioned choice of studies for environment assessment (birds).
National Working Party on Grain Protection	The NWPGP submitted an extensive submission that described the importance of grain protectants in their industry and provided background information demonstrating how fenitrothion fits within the suite of pest control tools available to and management systems in place within the industry. The NWPGP also noted concerns about potential loss of fenitrothion for structural treatments and locust control.
Agronomist	The agronomist was concerned about the impact that the potential loss of fenitrothion pasture pest uses would have in Tasmania and highlighted the lack of alternatives for pastures pests. Argued that withholding periods could be increased to address residues concerns.
Confidential submissions	All confidential submissions have been considered by the APVMA and included the following: • Alternate modelling of the environment and worker health and safety assessments • Additional Information relevant to the use of fenitrothion for locust control, including additional data items • Residues monitoring data • Information on the importance of UL product for locust control • Information on work rates for various use patterns

Health assessment

Worker safety- Cereals, pasture and forage crops

The GRDC and others questioned the use of default values of 600 ha/day and up to 1000 ha/day for groundboom application in broadacre cropping scenarios and requested refinement of the 'worker exposure risk assessment to reflect the more realistic workday scenarios'.

APVMA Response: Review of the published RTR revealed a transcription error that resulted in an incorrect statement in the published document. The statement that GRDC quotes in their submission was related to aerial application, not groundboom application. Nevertheless, the occupational exposure modelling that was conducted for fenitrothion provided a gradation of risk, with increasing application rates requiring greater levels of PPE and limitations on maximum area treated per day. Although the background table presented default baseline assumptions, the risk assessment has already addressed the concerns raised by GRDC, as the modelling took into consideration application rates, PPE and engineering controls and concluded with the maximum area that could be treated while still achieving acceptable margins of exposure for occupational workers.

Structural uses of fenitrothion

The NWPGP and others questioned the default values used for grain storage structural uses, in particular the 4000 L/day value for mechanically pressurised handgun application (see Table 9), commenting that it was an unrealistic value considering industry use of fenitrothion, without providing evidence of what a realistic daily usage rate would be. One submission included a reverse modelling approach, identifying daily work rates that would be protective of workers and suggesting that workplace cholinesterase monitoring could be used as a risk management tool.

APVMA response: We appreciate the feedback from others and note recommendations to work with the registrant and industry to ensure model assumptions accurately reflect use and practices within Australia and have considered whether any modification to the risk estimates would be appropriate. The Health Assessment Team sought additional feedback from affected stakeholders, to determine whether any reduction in use rates could be reliably implemented with an expectation that occupational users would continue to be protected, when using fenitrothion at reasonable worst case use rates. We have been advised by stakeholders in the grains industry that the default value for backpack application is at the upper end of reasonable anticipated work rates (144 L/day vs 150 L/day), hence the risk estimate for backpack application remains unchanged. In the same communication, estimated work rates using mechanically pressurized handgun were stated as 1440 L/day compared to the default value of 4000 L/day in the OPHEC calculator. As the original MOE was 7, reducing the daily rate to 1500 L will result in a MOE of <20, which remains unacceptable (see Table 9).

Considering the daily work rates identified by stakeholders in the grains industry, the rates established using a reverse modelling approach proposed by one submission were impractical and practically speaking, unenforceable. While the submission included a recommendation for cholinesterase monitoring with specific application methods, this will not mitigate the risk encountered by the individuals handling fenitrothion, it will only demonstrate that they have been overexposed to the chemical. In summary, structural uses that rely on backpack or mechanically pressurized handgun application methods are not acceptable from a WH&S perspective.

Residues assessment

Grains industry and international trade

The NWPGP provided an extensive submission outlining how the Australian grains industry manages the risk to international trade associated with fenitrothion. Independent residues data was provided confidentially to support the submission. The NWPGP and other also expressed concerns regarding the following label statement 'In stored grain in WA – for use by Bulk Handling Authorities only'.

APVMA response: The Australian fenitrothion MRL for cereal grains at 10 mg/kg is higher than that established in all other markets and the APVMA sought comment from the grains industry on their ability to manage the risk to international trade associated with fenitrothion. The submission by the NWPGP has consulted broadly across industry on the associated risks and has provided a comprehensive response on how industry is able to manage this potential risk through its current practices. Furthermore, monitoring data from the National residues survey demonstrates 97-100% compliance with major market requirements with respect to MRLs/tolerances confirming that these risks are being managed. The APVMA concludes the risks to trade are being adequately managed and are not considered to be undue.

The NWPGP and others have expressed their desire to remove the general wording 'Other Limitations – In stored grain in WA – for use by Bulk Handling Authorities only' from fenitrothion labels noting 'that Bulk Handling Authorities do not exist under any current legislation' and citing the Australian Grains Industry Post Harvest Chemical Usage Recommendations and Outturn Tolerances 2023/24 definitions. The APVMA however does recognise that there are currently some differences in the Western Australian bulk handling system as approximately 90% of grain delivered in Western Australia is exported, which is a higher percentage than in other states where there is a larger domestic and feedlot market. Also, on-farm use of stored grain protectants has been less common in Western Australia than in other states, the experience in managing the potential trade risks associated with residues which may occur in grain following the use of stored grain protectants and the maturity of management systems is less developed than other states where stored grain protectants have been more commonly used for a longer period. The removal of the bulk handling statements for WA may represent a new or increased trade risk and therefore any removal of such statements would need to be considered on a case-by-case basis via a registration application. The registration application would need to include a stewardship proposal as a part of the registration application. The APVMA would then need to undergo a trade consultation based on the merits of the individual proposal.

Use of fenitrothion in pasture

A Tasmanian agronomist argued that as fenitrothion was important to beef and dairy farmers and that fenitrothion residues have not previously caused trade concerns in animal commodities the grazing and harvest withholding periods could be doubled until pasture specific residues data could be generated in an estimated 5 years. They also argued that the EU was not a key market for beef and dairy.

APVMA response: The registered uses on pasture for control of pasture cockchafer, corbie, winter corbie, underground grass grub and oxycanus grub at 480–1300 g ai/ha were not supported by the 1999 Interim or 2004 Review reports. The Interim report required Australian data for other grass-like pasture situations and other forage crops where non-locust pests are to be controlled. Since 1999, no Australian data has provided for pasture situations. In the absence of further data, the non-locust uses on pasture cannot be supported due to insufficient data to support the uses at rates higher than the maximum locust rate of 550 g ai/ha. To consider appropriate grazing withholding periods for the higher rate pasture uses the APVMA would require pasture data to be able to quantify the potential residue in pasture from the proposed use. This would also include data in cattle that may have been over sprayed at these higher rates. The outstanding data requirements for pasture were first identified in 1999 and affirmed in 2004. This data is necessary to assess residues in animal commodities and thus estimate risks to consumer safety and trade. The 2004 report noted 'because of unacceptable potential risks to human beings, uses on pastures for the control of pasture pests are to be deleted from labels'. The APVMA considers that sufficient time has been provided to allow for the generation of this outstanding data to support these pasture uses.

For beef, whilst the EU market represents only ~6% of Australia's total beef export, Australian beef and veal exports were approximately 7.4kt in volume worth $169 million Australian dollars in 2023/24 fiscal year. This does not include value added products that may include Australian beef animal commodities. The APVMA does consider the EU market to be a significant market. Whilst the APVMA does need to consider the EU market with respect to trade, the primary reason for the APVMA not being able to support the pasture uses at rates higher than the maximum locust rates of 550 g ai/ha is because of the lack of data to quantify a domestic grazing withholding period. For dairy, Australia's most significant markets are in Asia and it is noted that Korea and Taiwan have lower 'Milks' MRLs than are established in the rest of the world including the EU. Therefore, the EU markets have no bearing of the Australian risks associated with the pasture use.

Monitoring data or the absence of known export issues is not sufficient alone to justify the continued use noting the APVMA must be satisfied based on the safety and trade criteria from the AgVet code. Whilst the APVMA acknowledges that longer grazing withholding periods and longer export slaughter intervals may mitigate potential trade risks the APVMA requires relevant residues trial data matching the registered good agricultural practice (GAP) in order to assess appropriate grazing withholding periods and slaughter intervals.

Environmental assessment

New data for consideration

The following submission was received for consideration in the wild mammal assessment.

- Confidential Author, 2024. Field study on effect of south-west Queensland control operations on small mammal population. Reference no. A3314333.

The following studies were cited in the public submissions that are considered relevant to the environmental assessment.

- Fildes K, Astheimer LB, Story PG, Buttemer WA, Hooper MJ, 2006. Cholinesterase response in native birds exposed to fenitrothion during locust control operations in eastern Australia. Environ Toxicol Chem 25(11): 2964-2970.
- Story PG, French K, 2023. Avian assemblages are maintained after aerial applications of ULV fenitrothion for control of the Australian plague locust (Chortoicetes terminifera (Walker)) in arid and semiarid agroecosystems. Wildl Res 50(10): 849-857.
- Story PG, Hooper MJ, Astheimer LB, Buttemer WA, 2011. Acute oral toxicity of an organophosphorus pesticide fenitrothion to fat-tailed and stripe-faced dunnarts and its significance for risk assessments in Australia. Environ Toxicol Chem 30(5): 1163-1169.
- Story PG, Mineau P, Mullie WC, 2013. Insecticide residues in Australian plague locusts (Chortoicetes terminifera Walker) after ultra low volume aerial application of the organophosphorus insecticide fenitrothion. Environ Toxicol Chem 32(12): 2792-2799.

- Szabo JK, Davy PJ, Hooper MJ, Astheimer LB, 2009. Predicting avian distributions to evaluate spatio temporal overlap with locust control operations in eastern Australia. Ecol Appl 19(8): 2026-2037.
- Trottier BL, Fraser AR, Planet G, Ecobichon DJ, 1980. Subacute toxicity of technical fenitrothion in male rats. Toxicology 17: 29-38.

APVMA response: The new field data and cited information has been considered by the APVMA. Additionally, the APVMA has independently acquired/ reconsidered the following studies since the draft RTR was published.

- Barnett EA, Hunter K, Flethcher MR, Sharp EA, 2000. Pesticide poisoning of animals 1999: investigations of suspected incidents in the United Kingdom. Ministry of Agriculture, Fisheries and Food, Sand Hutton, York UK.
- Bayer AG, 1964. OMS 43 summary on mammalian toxicity. Reference no. A2524187.
- Bernal J, Garrido-Bailón E, del Nozal MJ, González-Porto AV, Martín-Hernández R, Diego, Jiménez JJ, Bernal JL, Higes M, 2010. Overview of pesticide residues in stored pollen and their potential effect on bee colony (Apis mellifera) losses in Spain. J Econ Entomol 103(6): 1964-1971.
- Chauzat MP, Faucon JP, Martel AC, Lachaize J, Cougoule N, Aubert M, 2006. A survey of pesticide residues in pollen loads collected by honey bees in France. J Econ Entomol 99(2): 253-262.
- Chauzat MP, Martel AC, Cougoule N, Porta P, Lachaize J, Zeggane S, Aubert M, Carpentier P, Faucon JP, 2011. An assessment of honeybee colony matrices, Apis mellifera (Hymenoptera: Apidae) to monitor pesticide presence in continental France. Environ Toxicol Chem 30(1): 103-111.
- Contador-Kelsall I, Maute K, Story PG, Hose GC, French K, 2022. Sublethal pesticide exposure influences behaviour, but not condition in a widespread Australian lizard. Conserv Physiol 10(1): coac024.
- Dubois KP, Puchala E 1960. The acute toxicity and anticholinesterase action of Bayer 41831. Reference no. 5522.
- EHP (Department of Environment and Heritage Protection), 2012. Contaminants in the waters and sediment of Oxley Creek. Queensland EHP, Brisbane.
- Fletcher MR, Hunter K, Barnett EA, Sharp EA, 1999. Pesticide poisoning of animals 1998: investigations of suspected incidents in the United Kingdom. Ministry of Agriculture, Fisheries and Food, Sand Hutton, York UK.
- Forsyth DJ, Martin PA, 1993. Effects of fenitrothion on survival, behavior, and brain cholinesterase activity of white-throated sparrows (Zonotrichia albicollis). Environ Toxicol Chem 12: 91-103.
- Grue CE, 1982. Response of common grackles to dietary concentrations of 4 organophosphate pesticides. Arch Environ Contam Toxicol 11: 617-626.
- Grue CE, Hart ADM, Mineau P, 1991. Biological consequences of depressed brain cholinesterase activity in wildlife. In: Mineau P (ed), Cholinesterase-inhibiting insecticides: their impact on wildlife and the environment. Elsevier, New York, pp. 151-209.
- Heath RG, Spann JW, Hill EF, Kreitzer JF, 1972. Comparative dietary toxicities of pesticides to birds. Special Scientific Report – Wildlife 152, Bureau of Sport Fisheries and Wildlife, US Department of the Interior, Washington DC, 57 pp.

- Hill EF, Camardese MB, 1986. Lethal dietary toxicities of environmental contaminants and pesticides to Coturnix. Technical Report 2, Fish and Wildlife Service, US Department of the Interior, Washington DC, 147 pp.
- Hill EF, Heath RG, Spann JW, Williams JD, 1975. Lethal dietary toxicities of environmental pollutants to birds. Special Scientific Report – Wildlife 191, Fish and Wildlife Service, US Department of the Interior, Washington DC, 61 pp.
- Hudson RH, Haegele MA, Tucker RK, 1979. Acute oral and percutaneous toxicity of pesticides to mallards: correlations with mammalian toxicity data. Toxicol Appl Pharmacol 47: 451-560.
- Hudson RH, Tucker RK, Haegele MA, 1984. Handbook of toxicity of pesticides to wildlife. Resource Publication 153, Fish and Wildlife Service, US Department of the Interior, Washington DC.
- Kadota T, Miyamoto J, 1975. Acute and sub-acute toxicity of sumithion to Japanese quails. Sci Pest Control (Botyu-Kagaku) 40(2): 54-58.
- Kadota T, Okuno Y, Miyamoto J, 1975. Acute oral toxicity and delayed neurotoxicity of 5 organophosphorus compounds, salithion, cyanox, surecide, sumithion and suminxon in adult hens. Sci Pest Control (Botyu-Kagaku) 40(2): 49-53.
- Kanoh S, Kawasaki H, Yoshida M, Nishio A, 1982. Studies on chronic toxicity of the low levels of O,O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothionate (sumithion) in the rat. J Toxicol Sci 7(1): 43-50.
- Mineau P, 2002. Estimating the probability of bird mortality from pesticide sprays on the basis of the field study record. Environ Toxicol Chem 21(7): 1497-1506.
- Miyamoto J, Sato Y, Kadota T, Fujinami A, 1963. Studies on the mode of action of organophosphorous compounds. Part 2. Inhibition of mammalian cholinesterase in vivo following administration of Sumithion and methylparathion. Agric Biol Chem 27: 669-676.
- Mundy RL, Bowman MC, Farmer JH, Haley TJ, 1978. Quantitative structure activity study of a series of substituted OO-dimethyl O-(P-nitrophenyl) phosphorothioates and O-analogs. Arch Toxicol 41(2): 111-123.
- Padilla S, Corum D, Padnos B, Hunter DL, Beam A, Houck KA, Sipes N, Kleinstreuer N, Knudsen T, Dix DJ, Reif DM, 2012. Zebrafish developmental screening of the ToxCast phase I chemical library. Reprod Toxicol 33: 174-187.
- Rainsford KD, 1978. Toxicity in the brain of organophosphate insecticides: comparison of the toxicities of metabolites with parent compounds using an intracerebral injection method. Pestic Biochem Physiol 8(3): 302-316.
- Schafer EW, 1972. The acute oral toxicity of 369 pesticidal, pharmaceutical and other chemicals to wild birds. Toxicol Appl Pharmacol 21: 315-330.
- Schafer EW, Bowles WA, 1985. Acute oral toxicity and repellency of 933 chemicals to house and deer mice. Arch Environ Contam Toxicol 14(1): 111-129.
- Schafer EW, Bowles WA, Hurlbut J, 1983. The acute oral toxicity, repellency, and hazard potential of 998 chemicals to one or more species of wild and domestic birds. Arch Environm Contam Toxicol 12: 335-382.
- South Australia EPA, 2001. Assessment of the impact of insecticide spraying of Australian plague locusts. South Australia Department for Environment and Heritage, Adelaide SA.

- Stevens MM, Faulder RJ, Coombes NE, 1996. Microcosm assessment of potential molluscides for control of the rice snail Isidorella newcombi sens. lat. (Gastropoda: Basommatophora: Planorbidae). Aust J Agric Res 47: 673-680.
- Suzuki T, Ikegami M, Goka K, Sakamoto Y, 2023. Insecticide residues associated with apple orchard treatments in the mason bee Osmia cornifrons and their nests. Environ Toxicol Chem 42(7): 1564-1574.

The following studies were also cited in various submissions; however, they were not relied on for the reasons given.

- Buttemer WA, Story PG, Fildes KJ, Baudinette RV, Astheimer LB, 2008. Fenitrothion, an organophosphate, affects running endurance but not aerobic capacity in fat-tailed dunnarts (Sminthopsis crassicaudata). Chemosphere 72: 1315-1320.
- Story PG, 2015. Sensitivity of the dasyurids Sminthopsis crassicaudata (Gould 1844) and S. macroura (Gould 1845) to the organophosphorus insecticide fenitrothion and its impact on locomotory and thermogenic performance in S. macroura. MSc Thesis, University of Wollongong, New South Wales, Australia.
- Story PG, French K, Astheimer LB, Buttemer WA, 2016. Fenitrothion, an organophosphorus insecticide, impairs locomotory function and alters body temperatures in Sminthopsis macroura (Gould 1845) without reducing metabolic rates during running endurance and thermogenic performance tests. Environ Toxicol Chem 35(1): 152-162.

The 3 studies join the body of evidence that negative effects on AChE activity of wild mammals occur following exposure to high levels of fenitrothion, resulting in transient fatigue with a long recovery period. The dose at which no adverse impact on AChE activity in dunnarts was not determined in these studies.

- Fairbrother A, Bennett JK, 1988. The usefulness of cholinesterase measurements. J Wildl Dis 24(3): 587-590.
- Rattner BA, Fairbrother A, 1991. Biological variability and the influence of stress on cholinesterase activity. In: Mineau P (ed), Cholinesterase inhibiting insecticides. Their impact on wildlife and the environment. Elsevier, New York, pp. 89-107.
- Story P, Cox M, 2001. Review of the effects of organophosphorus and carbamate insecticides in vertebrates. Are there implications for locust management in Australia? Wildl Res 28(2): 179-193.

These 3 publications were cited in the context of cholinesterase (ChE) measurements being a useful tool in diagnosing organophosphorus or carbamate insecticide exposure in animals. Methods for diagnosis of vertebrate mortality were not required to inform the review and therefore the publications were not relied on.

- Fildes KJ, 2008. Pesticide exposure in free-living native birds and the effects of acute dosing of fenitrothion and fipronil on physiological performance in selected species. PhD thesis, University of Wollongong

Chapter 4 of this thesis was cited in the context of baseline or reference activities for OP exposure. Sublethal effects of fenitrothion on native birds were examined in the laboratory; however, the dose at which no adverse impact on peak metabolic rate (PMR) was not determined, noting other ecologically relevant effects were also observed at some doses tested (such as mortality or reduced body weight). Furthermore, there is no clear linkage of PMR and AChE activity to population level effects.

- Gard NW, Hooper MJ, 1993. Age-dependent changes in plasma and brain cholinesterase activities of eastern bluebirds and European starlings. J Wild Dis 29(1): 1-7.

This study was cited in the context of the method used to measure AChE activity; however, methods for AChE analysis are not required for the review.

- Hill EF, Fleming JW, 1982. Anticholinesterase poisoning of birds: field monitoring and diagnosis of acute poisoning. Environ Toxicol Chem 1: 27-38.
- Ludke JL, Hill EF, Dieter MP 1975 Cholinesterase (ChE) response and related mortality among birds fed ChE inhibitors. Arch Environ Contam Toxicol 3: 1-21.

These 2 studies were cited in the context of the level of linking ChE inhibition to mortality under field conditions; however, reference values are needed for each specific focal species in order for this approach to be of value in a risk assessment. Insufficient field information is available to identify species focal species relevant to the use of fenitrothion in Australia.

- Maute K, Story PG, Hose GC, Warden AC, Dojchinov G, French K, 2021. Observations on populations of a small insectivorous bird Malurus leucopterus leuconotus Dumont 1824 after an application of 2 ultra-low volume (ULV) insecticides fenitrothion and fipronil in arid Australia. Aust J Zool 69(6): 229-238.

The authors noted that reduced feeding behaviour and plasma ChE activity in birds subject to subacute exposure to OPs can return to levels similar to controls within 8 hours. Only 2 of the birds captured within 24 h of spray applications at fenitrothion sites were sampled appropriately for use in ChE assays, and only 7 samples were collected over 2 weeks. Therefore, the authors were not able to detect significant depression in total ChE activity, as most samples were collected many days after pesticide applications (1–14 days). Due to the small sample size post application, this report was not relied on. Furthermore, the authors acknowledged that the conditions of the study were not representative of those typical of a locust control campaign.

- Shore RF, Dell-Omo G, 1998. Does sub-lethal exposure to organophosphate pesticide affect capture rates in free-living rodents? Bull Environ Contam Toxicol 61: 440-447.

This study was cited to suggest that trapped animals in field studies can reasonably be expected to be representative of pesticide exposure, at least in the first 2 days after application. The study was not relied on because it does not contain data that can be used to refine the assessment.

- Story PG, Walker PW, McRae H, Hamilton JG, 2005. A case study of the Australian Plague Locust Commission and environmental due diligence: why mere legislative compliance is no longer sufficient for environmentally responsible locust control in Australia. Integr Environ Assess Manag 1(3): 345-251.

This study was cited to suggest APLC’s environmental management system (EMS) can be used to manage risks to terrestrial vertebrates. It is understood that APLC’s EMS includes ‘ongoing risk assessment’ (before- and after-spray); however, the methodology used and what outcomes would be considered acceptable are not clear.

- Zhao Y, Newman MC, 2004. Shortcomings of the laboratory-derived median lethal concentration for predicting mortality in field populations: exposure duration and latent mortality. Environ Toxicol Chem 23(9): 2147-2153.

- Zhao Y, Newman MC, 2006. Effects of exposure duration and recovery time during pulses exposures. Environ Toxicol Chem 25(5): 1298-1304.

The 2 studies were cited to support argument that laboratory data are not useful in determining risk of ecologically relevant sublethal effects under field conditions. All information submitted and available to the APVMA has been considered. The risk assessment framework is a tiered process, which includes the consideration of field studies. A field study can only be used as a part of a weight of evidence consideration. Field studies must sufficiently show that the use of the product will not result in mortality or negatively affect the population density or normal make-up or functioning. A number of deficiencies in the available field studies are such that a conclusion of acceptable/ low/ negligible impact cannot be reached. For example, the statistical power for the relevant measurement endpoints were not reported and the APVMA is unable to determine whether a field effect can be detected. None of the field studies make use of radio-tracking and therefore uncertainty remains as to whether animals leave the study area before mortality occurs, or their carcass is not detected. In contrast, many of the field studies demonstrate, based on AChE measurements, that animals are being exposed to levels causing sublethal effects that are likely to make them more susceptible to predation or other cause of death. The 2 studies cited do not study fenitrothion specifically and are not relied on.

Food chain assessment

It was suggested that, while the assessment of chronic toxicity forms part of a standardised risk assessment, the potential for chronic toxicity should not be assessed on the basis of the value of the Pow constant alone. Any potential for bioaccumulation in vertebrates is outweighed by the rapid metabolism of fenitrothion and it’s oxon derivative.

> **APVMA response:** The food chain assessment considered potential residues accumulating at lower trophic levels (e.g. earthworms) as opposed to accumulation in mammals. Metabolism data are not available for fenitrothion at lower trophic levels. Regardless, a high seasonal rate (924 g ac/ha) for earthworm-eating species was determined to be acceptable without consideration of properties such as soil dissipation or foliar interception. A need to refine this value was not identified given acute dietary exposure of directly contaminated food items was shown to be as the pathway of greatest concern for terrestrial vertebrates.

Regulatory acceptable levels

Clarification was requested on the choice of acute avian toxicity endpoint and how it was arrived at as reported in Table 25 (regulatory acceptable levels for non-target species).

> **APVMA response:** The text explained the choice of the acute avian toxicity endpoint and the full listing of endpoints was presented in Appendix C of the Final Review Technical Report. The LD_{50} 45 mg ac/kg bw was the geomean of 3 definitive LD_{50} values from fully reliable guideline studies (presented in Table 42). The APVMA has since revised the acute RALs for both birds and wild mammals having had regard to all available published and unpublished values, which provided sufficient endpoints to derive an HD_5 based on a species sensitivity distribution (SSD). Footnotes have been added to relevant tables to improve clarity on sources of endpoints.

Field studies

Some have questioned the relevance of the field study by Mullié & Keith (1993) to the Australian use situation. Some Australian field studies have been cited for consideration.

> **APVMA response:** Mullié & Keith (1993) was only summarised and tabulated as available field effects information on fenitrothion. A more comprehensive discussion of field data is available in APVMA (1999); however, all available field studies are considered to be supplemental information as they do not inform the risk assessment in a quantifiable way and can only be used in a weight-of-evidence assessment. Unfortunately, none of the available field studies can be confirmed to have sufficient statistical power to detect an adverse effect. In contrast, many studies noted sublethal adverse effects that could potentially result in population level impacts. In addition, some field studies cited in the public submissions that contribute to the weight-of-evidence assessment have been added to the listing of endpoints.

Risks to terrestrial vertebrates

The environmental concerns regarding locust control in cereals were not clear to some, and clarification on the outcomes were requested.

> **APVMA response:** Appendix C of APVMA (2024) is a listing of all environmental data available to the APVMA, with the laboratory studies on terrestrial vertebrates listed in Table 42 and the field studies in Table 43. Appendix D of APVMA (2024) provides details on the risk assessment methodology and outcomes for terrestrial vertebrates across various crops and growth stages, while Table 26 of the same document provides an overall summary of the conclusions. In order to provide a more extensive risk characterisation, maximum acceptable application rates for terrestrial vertebrates have been calculated for each application timing (Appendix D of this document). Based on this analysis, risk assessment conclusions are now presented for the full rate ranges.

Risk mitigation measures

Many have commented that risks to non-target species can be managed, such as applying buffer zones to sensitive areas or APLC's environmental management system (EMS) in locust control operations.

> **APVMA response:** The APVMA is satisfied that risks of fenitrothion to non-target species other than terrestrial vertebrates can be successfully managed. However, the APVMA is not satisfied that effective risk management strategies are available for the protection of terrestrial vertebrates following broadcast applications of fenitrothion in the majority of situations. It is understood that APLC's EMS includes 'ongoing risk assessment' (before- and after-spray); however, the methodology used and what outcomes would be considered acceptable are not clear.
>
> Buffer zones for the protection of birds or other terrestrial vertebrates are not currently considered as a risk mitigation option. Furthermore, they do not mitigate risks to species that may feed within the treatment area, which is the focus of the risk assessment. Risk mitigation measures can be considered in certain situations provided there is supporting information to demonstrate a quantifiable reduction in risk.

Tasmanian pasture situations

A Tasmanian agronomist noted that fenitrothion for control of corbie in Tasmanian pastures appears to be acceptable to bees based on very little to no flowering and no reported detection of residues in bees, wax or product. It was also suggested that fenitrothion is an acceptable risk to terrestrial vertebrates in Tasmania, as risk are mitigated by a number of factors: (1) on average only a small percentage of farms are sprayed; (2) these areas are sprayed over a significant timeframe to suit grazing withholds and swath suitability; and (3); intensive high product grazing system inherently do not support high native bird and mammal populations.

> **APVMA response:** The APVMA is satisfied that risks of fenitrothion to non-target species other than terrestrial vertebrates can be successfully managed. The APVMA is not satisfied that the risk to terrestrial vertebrates is acceptable based on the available information. The proposed factors mitigating exposure of wild mammals and birds could be relevant to the assessment; however, supporting scientific information is needed to refine the assessment to demonstrate a quantifiable reduction in risk.

Appendix B – Summary of Assessment Outcomes

Table 41: Fenitrothion uses supported by all risk assessments

<table>
<tr><th>Crop/host</th><th>Pest</th><th>Rate</th><th>Amended instructions for use*</th></tr>
<tr><td colspan="4">Post-harvest uses</td></tr>
<tr><td>Stored cereal grains including malting barley</td><td>Stored grain insect pests (excluding Sitophilus spp.)</td><td>6 g ac/L
(6 g ac/tonne) 6ppm: 3 months protection
Fenitrothion and S-methoprene combination product</td><td>Withholding period: Not required when used as directed.
Protection statement: Very toxic to aquatic life. DO NOT contaminate wetlands or watercourses with this product or used containers.
Trade advice statement: EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain using this product.</td></tr>
<tr><td rowspan="2">Stored Cereal (uninfested wheat, barley, oats, rice, sorghum and millet)</td><td rowspan="2">Stored grain insect pests (excluding lesser grain borer)</td><td>6 g ac/L
(6 g ac/tonne) 6ppm: 3 months protection</td><td>Withholding period: Not required when used as directed.
Protection: Very toxic to aquatic life. DO NOT contaminate wetlands or watercourses with this product or used containers.
Trade advice statement: EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain using this product.</td></tr>
<tr><td>12 g ac/L
12 g ac/tonne grain
12ppm: 6 months protection</td><td>Withholding period: DO NOT use for processing into food for human consumption or stock food within 13 weeks of treatment.
Protection statement: Very toxic to aquatic life. DO NOT contaminate wetlands or watercourses with this product or used containers.
Trade advice statement: EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain using this product.</td></tr>
</table>

Crop/host	Pest	Rate	Amended instructions for use*
Tank mix with insect growth regulator for treatment of stored cereal	Stored grain insect pests (excluding *Sitophilus* spp.)	6 g ac/L (6 g ac/tonne) 6ppm: up to 9 months protection when applied with IGR grain protectant at label rates e.g. Methograin IGR Grain Protectant	**Withholding period:** Not required when used as directed. **Protection statement:** Very toxic to aquatic life. DO NOT contaminate wetlands or watercourses with this product or used containers. **Trade advice statement:** EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain using this product.
Field crops			
Grazing sorghum, cereal crops (excluding corn/maize/rice)	Australian plague locust, spur-throated locust, migratory locust	270–330 g ac/ha maximum *(EC only)*	**Restraints:** DO NOT apply by aircraft. Spray drift restraints and relevant buffer zones (see Spray drift) **Directions for use**: A single operator MUST NOT mix and apply more than 110 L of neat product per day (equivalent to spraying an area of no more than 320 ha per day at themaximum rate of 330 mL/ha or no more than 400 ha per day at the minimum rate of 270 mL/ha. DO NOT use open mixing/loading equipment. Closed mixing and loading must be used. DO NOT apply using open cab equipment. Enclosed cab application MUST be used. DO NOT apply before booting (BBCH<40) or after flowering is complete (BBCH ≥69) When adult locusts are present in dense crops, use of this product may not result in full control of pests. Apply a maximum of 1 spray per field per growing season. **Withholding periods:** Stored cereal grain: DO NOT use for processing into food for human consumption or stock food within 13 weeks of treatment. Crops for human consumption: DO NOT harvest for 14 days after application. Crops for animal consumption/stockfeed: DO NOT graze or cut for stock feed for 14 days after application. **Trade advice statement:** EXPORT OF TREATED PRODUCE: Users should note that maximum residue limits (MRLs) or import tolerances may not exist in all markets for cereal grains, oaten hay, oilseeds or pulses which may be exposed to fenitrothion following the use of [chemical product name]. If necessary, details of overseas MRL's or tolerances should be obtained prior to treating cereal grain using this product. **Precautions:** DO NOT enter treated cereal or grazing sorghum crops for 11 days after treatment for scouting and 16 days after treatment for irrigation (handset). When prior entry
	Wingless grasshopper	300 g ac/ha *(EC only)*	

Crop/host	Pest	Rate	Amended instructions for use*
			is necessary, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing (and elbow length chemical resistant gloves. Clothing must be laundered after each day's use. **Protection statements:** Very toxic to aquatic life. DO NOT contaminate wetlands or watercourses with this product or used containers. To avoid runoff, DO NOT apply if heavy rains or storms are forecast within 3 days. DO NOT irrigate to the point of field runoff for at least 3 days after application. Toxic to birds and wild mammals. To protect wildlife, DO NOT apply before booting (BBCH <40) or after flowering is complete (BBCH >69). Toxic to bees. DO NOT apply to bee-attractive crops from the onset of flowering (BBCH >60). DO NOT allow spray drift to flowering weeds or flowering crops in the vicinity of the treatment area. Before spraying, notify beekeepers to move hives to a safe location with an untreated source of nectar and pollen, if there is potential for managed hives to be affected by the spray or spray drift. Toxic to beneficial arthropods. Not compatible with integrated pest management (IPM) programs utilising beneficial arthropods. Minimise spray drift to reduce harmful effects on beneficial arthropods in non-crop areas.

*All instructions for use on labels of agricultural chemical products should also align with requirements set out in the Agricultural Labelling Code.

Table 42: Fenitrothion uses that are not supported due to safety and/or trade concerns

Crop/host	Pest	Rate	Assessment outcome
Post-harvest uses			
Grain storage facilities and equipment	Stored grain insect pests (except lesser grain borer and/or sawtoothed grain beetle)	10 g ac/L, 1 L dilute spray treats 20 m^2	Not supported – safety (worker health and safety concerns)
Surface treatment bulk stored cereal grain, stacks of bags etc.	Stored grain insect pests (except lesser grain borer and/or sawtoothed grain beetle)	10 g ac/L, 1 L dilute spray treats 20 m^2	Not supported – safety (worker health and safety concerns)
Broiler poultry house litter, walls, roof and feed sheds	Lesser mealworm (litter beetle), darkling beetle (black beetle)	10 g ac/L, 10 L dilute spray treats 70m^2	Not supported – safety (worker health and safety concerns)
Field crops			
Pasture, pasture seed crops, corn, maize, rice, forage crops	Australian plague locust, spur-throated locust, migratory locust	246–550 g ac/ha *(EC: 270–550 g ac/ha; UL: 246–492 g ac/ha)*	Not supported – safety (environment) concerns

Crop/host	Pest	Rate	Assessment outcome
excluding grazing sorghum, lucerne	Wingless grasshopper	300-308 g ac/ha *(EC: 300 g ac/ha; UL: 308 g ac/ha)*	Not supported – safety (environment) concerns
	Yellow-winged locust	246–394 g ac/ha *(UL only)*	Not supported – safety (environment) concerns
	Small plague grasshopper	246–369 g ac/ha *(UL only)*	Not supported – safety (environment) concerns
Grazing sorghum, cereal crops	Australian plague locust, spur-throated locust, migratory locust	246-492 g ac/ha *(UL only)*	Not supported – safety (environment) and spray drift concerns
	Yellow-winged locust	246–394 g ac/ha *(UL only)*	Not supported – safety (environment) and spray drift concerns
	Wingless grasshopper	308 g ac/ha *(UL only)*	Not supported – safety (environment) and spray drift concerns
	Small plague grasshopper	246–369 g ac/ha *(UL only)*	Not supported – safety (environment) and spray drift concerns
Lucerne	Sitona weevil	250–650 g ac/ha	Not supported – safety (environment) concerns Closed mixing/loading required to mitigate worker health and safety concerns above 550 g ac/ha
Pasture	Pasture cockchafer	480–700 g ac/ha	Not supported – safety (environment and residues) and trade concerns Closed mixing/loading required to mitigate worker health and safety concerns above 550 g ac/ha
	Corbie, winter corbie	800–1,300 g ac/ha	Not supported – safety (environment and residues) and trade concerns Closed mixing/loading required to mitigate worker health and safety concerns
	Underground grass grub	500–1,000 g ac/ha	Not supported – safety (environment and residues) and trade concerns Closed mixing/loading required to mitigate worker health and safety concerns above 550 g ac/ha

Crop/host	Pest	Rate	Assessment outcome
	Oxycanus grub	1,200–1,300 g ac/ha	Not supported – safety (environment and residues) and trade concerns Closed mixing/loading required to mitigate worker health and safety concerns
Apples, cabbages, cherries, grapes, lettuce, tomatoes, soybean	Australian plague locust, spur-throated locust, migratory locust	246–550 g ac/ha *(EC: 270–400 g ac/ha, UL: 246–492 g ac/ha)*	Not supported – safety (environment and residues) and trade concerns
	Wingless grasshopper	300–308 g ac/ha *(EC: 300 g ac/ha; UL: 308 g ac/ha)*	Not supported – safety (environment and residues) and trade concerns
	Small plague grasshopper	246–369 g ac/ha *(UL only)*	Not supported – safety (environment and residues) and trade concerns

Appendix C – Listing of environmental endpoints

Table 43: Physical and chemical properties

Substance	Study	Result	Reference
Fenitrothion	Vapour pressure	6.8×10^{-4} Pa at 20°C 1.6×10^{-3} Pa at 25°C	Schetter 2000
	Henry's law constant	9.9×10^{-3} Pa m^3 mol^{-1}	Okada 2001
	Solubility in water	19 mg/L at 20°C	Concha 2000
	Partition coefficient	log P_{ow} 3.3	Shepler & Schick 2002
	Dissociation constant	No dissociable moieties	
	UV-VIS absorption (max)	solution / λ_{max} / ε (L/mol/cm) acidic 268 nm 6920 neutral 267 nm 6950 basic 264 nm 4860 basic 393 nm 10600	Yoshida 2000

Table 44: Dissipation in animal food items

Substance	Matrix	Result		Reference
Fenitrothion	Leaves	White spruce:	DT_{50} 20 d	Sundaram 1986
		Spruce: Maize: Bermuda grass: Apple:	DT_{50} 7.9 d DT_{50} 3.0 d DT_{50} 2.6 d DT_{50} 1.6 d	Willis & McDowell 1987
		Cabbage:	DT_{50} 6.6 d	Hu et al. 2009
		Parsley: Rocket:	DT_{50} 4.1 d DT_{50} 4.0 d	Bahaffi et al. 2005
		Grape:	DT_{50} 2.5 d	Likas & Tsiropoulos 2007
		Pasture:	DT_{50} 1.5 d	Gilmour et al. 1999
		Tea:	DT_{50} 0.50 d	Zongmao & Haibin 1997
		Geomean DT_{50} 3.2 d		
	Fruit	Persimmon:	DT_{50} 8.3 d	Fernández-Cruz et al. 2004
		Apricot:	DT_{50} 6.9 d	Cabras et al. 1997
		Pear:	DT_{50} 6.7 d	Passarella et al. 2009
		Fig: Grape:	DT_{50} 5.6 d DT_{50} 2.9 d	Bahaffi et al. 2005
		Rice:	DT_{50} 4.5 d	Ishii 2004
		Grape:	DT_{50} 3.8 d	Cabras & Angioni 2000
		Tomato:	DT_{50} 2.2 d	Malhat et al. 2017
		Geomean DT_{50} 4.7 d		

Table 45: Fate and behaviour in soil

Study	Substance	Result	Reference
Soil photolysis	Fenitrothion	DT_{50} 85 d (irradiated) DT_{50} 182 d (dark control) 4.3% mineralisation after 30 d 6.8% bound residues after 30 d No major photoproducts	Dykes & Carpenter 1988
Aerobic laboratory soil	Fenitrothion	Sandy loam: DT_{50} 2.4 d	Cranor & Daly 1989
		Sandy loam: DT_{50} 0.62 d Sandy loam: DT_{50} 1.4 d Clay loam: DT_{50} 0.74 d Clay loam: DT_{50} 0.85 d Geomean DT_{50} 1.1 d 23–54% mineralisation after 90–122 d 26–70% bound residues after 90–122 d Max 44% NMC	Yeomans & Swales 2001
	NMC	Sandy loam: DT_{50} 3.3 d	Cranor & Daly 1989, Kodaka et al. 2000
		Sandy loam: DT_{50} 2.8 d Sandy loam: DT_{50} 3.1 d Clay loam: DT_{50} 3.3 d Clay loam: DT_{50} 3.0 d Geomean DT_{50} 3.1 d	Yeomans & Swales 2001
Anaerobic laboratory soil	Fenitrothion	Sandy loam DT_{50} 0.80 d 0.1% mineralisation after 122 d 79% bound residues after 122 d Max 14% NMC, DT_{50} 1.2 d Max 11% AM-FNT, DT_{50} 16 d Max 10% AA-FNT, DT_{50} 50 d	Cranor & Daly 1990, Kodaka et al. 2000
Adsorption/ desorption	Fenitrothion	Soil / %OC / Kf / Koc / 1/n Sand 1.3 4.9 384 0.86 Sandy loam 3.1 32 1022 0.94 Silty clay 3.9 13 330 1.04 Silty clay 7.1 18 252 0.97 Sediment 42 830 1966 1.10 Mean Kf 17 mL/g, Koc 497 mL/g, 1/n 0.95 (excluding sediment)	Spillner & Neuberger 1979
	NMC	Soil / %OC / Kf / Koc / 1/n Sandy loam 0.8 2.4 303 0.81 Clay loam 2.7 7.6 281 0.76 Silty clay loam 2.9 7.8 270 0.71 Mean Kf 5.9 mL/g, Koc 285 mL/g, 1/n 0.76	Lewis 2001

Table 46: Fate and behaviour in water and sediment

Study	Substance	Result	Reference
Hydrolysis	Fenitrothion	pH 5, 25°C: DT_{50} 196 d, max 10% DM-FNT pH 7, 25°C: DT_{50} 183 d, no major degradates pH 9, 25°C: DT_{50} 101 d, max 15% NMC	Ito et al. 1988

Study	Substance	Result	Reference
Aqueous photolysis	Fenitrothion	DT_{50} 3.5 d (irradiated) DT_{50} 106 d (dark control) 42% mineralisation after 30 d Max 10% CA-FNT	Katagi et al. 1988
		Quantum yield 8.0 x 10^{-4} at 313 nm DT_{50} 0.76 d at 40°N in spring	Takahashi 1981
Ready biodegradability	Fenitrothion	Not readily biodegradable	Gruetzner 2000
Degradation in water/sediment	Fenitrothion	Millstream Pond: water DT_{50} 0.88 d Emperor Lake: water DT_{50} 1.3 d Geomean DT_{50} 1.1 d	Swales 2001
		Millstream Pond: sediment DT_{50} 1.1 d	
		Millstream Pond: system DT_{50} 1.6 d Emperor Lake: system DT_{50} 1.6 d Geomean DT_{50} 1.6 d	
		14-15% mineralisation after 59 d 71-76% bound residue after 59 d Max 28% fenitrothion in sediment Max 33% NMC (24% in water, 13% in sediment) Max 19% AM-FNT (18% in water, 4.7% in sediment) Max 17% DM-AM-FNT (17% in water, nd in sediment)	
Monitoring data	Fenitrothion	Fenitrothion was not detected (LOD 0.5 µg/L) in any of 9 waterways sampled in the southern Flinders Ranges of South Australia both before and after spraying in locust control operation in spring 2000	South Australia EPA 2001
		Fenitrothion was not detected (LOR 0.001 µg/L) in any of the 11 samples collected over the 2011 year from waterways associated with high industrial activity that discharged to Moreton Bay QLD following extensive flooding in January of that year	EHP 2012

Table 47: Fate and behaviour in air

Study	Substance	Result	Reference
Photochemical oxidative degradation	Fenitrothion	DT_{50} 0.23 d	Nishiyama et al. 2000

Table 48: Laboratory studies on terrestrial vertebrates

Group	Exposure	Species	Toxicity value	Reference
Mammals	Acute	*Sminthopsis macroura*		Story et al. 2011
		Sminthopsis crasicaudata		Story et al. 2011
		Peromyscus maniculatus		Schafer & Bowles 1985
		Rattus norvegicus	LD50 250 mg ac/kg bw	Kanoh et al. 1982
			LD_{50} >300 mg ac/kg bw	Moon 2010
			LD_{50} 330 mg ac/kg bw	Kadota et al. 1972
			Geomean LD_{50} 287 mg ac/kg bw (2 trials)	

Group	Exposure	Species	Toxicity value	Reference
Mammals	Acute	*Cavia porcellus*	LD_{50} 500 mg ac/kg bw	Dubois & Puchala 1960
			LD_{50} 1000 mg ac/kg bw	Bayer AG 1964
			LD_{50} 1850 mg ac/kg bw	Miyamoto et al. 1963
			Geomean LD_{50} 974 mg ac/kg bw (3 trials)	
		Odocoileus hemionus	LD_{50} >727 mg ac/kg bw	Hudson et al. 1984
		Mus musculus	LD_{50} 988 mg ac/kg bw	Mundy et al. 1978
			LD_{50} 1800 mg ac/kg bw	Rainsford 1978
			Geomean LD_{50} 1344 mg ac/kg bw (2 trials)	
			Geomean LD_{50} 342 mg ac/kg bw (5 mammal species)	
	Dietary	*Rattus norvegicus*	NOEL 2.5 mg ac/kg bw/d	Trottier et al. 1980
	Chronic	*Rattus norvegicus*	NOEL 2.3 mg ac/kg bw/d	Hoberman 1990
Birds	Acute	*Sturnix vulgaris*	LD_{50} 11 mg ac/kg bw	Schafer et al. 1983
		Agelaius phoeniceus	LD_{50} 25 mg ac/kg bw	Schafer 1972
		Colinus virginianus	LD_{50} 23 mg ac/kg bw	Grimes & Jaber 1988a
			LD_{50} 24 mg ac/kg bw LD_{50} 27 mg ac/kg bw LD_{50} 32 mg ac/kg bw	Hudson et al. 1984
			Goeman LD_{50} 26 mg ac/kg bw (4 trials)	
		Phasianus colcicus	LD_{50} 35 mg ac/kg bw	Fletcher 1971
			LD_{50} 56 mg ac/kg bw	Hudson et al. 1984
			Geomean LD_{50} 44 mg ac/kg bw (2 trials)	
		Coturnix japonica	LD50 56 mg ac/kg bw	Schafer et al. 1983
			LD_{50} 115 mg ac/kg bw	Kadota et al. 1974, Kadota & Miyamoto 1975
			Geomean LD_{50} 80 mg ac/kg bw (2 trials)	
		Anas platyrhynchos	LD_{50} >244 mg ac/kg bw	Grimes & Jaber 1988b
			LD_{50} 1190 mg ac/kg bw	Hudson et al. 1979
			LD_{50} 1662 mg ac/kg bw	Hudson et al. 1984
			Geomean LD_{50} 1406 mg ac/kg bw (2 trials)	
			Geomean LD_{50} 45 mg ac/kg bw (3 species)	
	Dietary	*Colinus virginianus*	LDD_{50} 68 mg ac/kg bw/d	Grimes & Jaber 1988c
		Anas platyrhynchos	LDD_{50} 601 mg ac/kg bw/d	Grimes & Jaber 1988d
		Zonotrichia albicollis	LC_{50} 50 mg ac/kg diet	Forsyth & Martin 1993
		Quiscalus quiscula	LC_{50} 78 mg ac/kg diet	Grue 1982
		Colinus virginianus *Phasianus colchicus* *Anas platyrhychos*	LC_{50} 157 mg ac/kg diet LC_{50} 453 mg ac/kg diet LC_{50} 2482 mg ac/kg diet	Heath et al. 1972
		Coturnix japonica	LC_{50} 440 mg ac/kg diet	Hill et al. 1975
			LC_{50} 652 mg ac/kg diet	Hill & Carmadese 1986
	Chronic	*Colinus virginianus*	NOEL 2.3 mg ac/kg bw/d	Beavers et al. 1991
		Anas platyrhynchos	NOEL 6.0 mg ac/kg bw/d	Beavers et al. 1989

Group	Exposure	Species	Toxicity value	Reference
Reptiles	Acute	*Pogona vitticeps*	No mortality at 16 mg ac/kg bw	Contador-Kelsall et al. 2022

Table 49: Field studies on terrestrial vertebrates

Situation	Exposure	Effect		Reference
Semi-arid thornbush savannah	1x 485 or 825 g ac/ha	Up to 7% bird mortality observed in both low and high dose plots with 30-47% reduction in numbers, mainly due to movement in response to a reduction in grasshopper prey		Mullié & Keith 1993
Open plain pasture	1x 267 g ac/ha	Species/group *Taeniopygia guttata* *Lalage sueurii* *Artamus personatus* Honeyeaters Insectivorous birds Granivorous birds *Artamus superciliosus* Birds of prey	ChE inhibition 70% 65% 42% 36% 35% 33% 20% 6.0%	Fildes et al. 2006
Arid open plain pasture	1x 267 g/ha	Plasma AChE inhibition up to 40% in *Sminthopsis macoura*		Anon, 2024(A3314333)
Arid & semiarid agro-ecosystems	1x 267 g ac/ha	Species *Acrocephalus stentoreus* *Ocyphaps lophotes* *Geopelia placida* *Corvus coronoides* *Gymnorhina tibicen* *Threskiornis spinicollis* *Artamus superciliosus* *Northiella haematogaster* *Grallina cyanoleuca* *Manorina melanocephala* *Artamus personatus* 10 *Falco cenchroides*	Contribution to dissimilarity of avian assemblages: 15% 13% 13% 13% 12% 8.6% 8.4% 8.4% 8.2% 7.7% 1.4% 1.5%	Story & French 2023
Grazing paddocks	1x 261-307 g/ha	Food item Locust nymph – live Locust nymph – debilitated 11 Locust nymph – dead	RUD[7] (µg/kg) 0.2-31 (mean 6.3) 0.5-26 (mean 7.8) 2.3-40 (mean 17)	Story et al. 2013
Spruce-fir forests	1x 210 g/ha	Food item 12 Spruce budworm larvae	Residue (µg/kg) 700-1200	Forsyth & Martin 1993

Table 50: Laboratory studies on aquatic species

Substance	Group	Exposure	Species	Toxicity value	Reference
Fenitrothion	Fish	Acute	*Oncorhynchus mykiss*	LC_{50} 1.3 mg ac/L	Swigert 1987a
			Pseudorasbora parva	LC_{50} 2.3 mg ac/L	Kagoshima et al. 1974
			Lepomis macrochirus	LC_{50} 2.5 mg ac/L	Swigert 1987b
			Cyprinus carpio	LC_{50} 4.1 mg ac/L	Kagoshima et al. 1974
		Chronic	*Oncorhynchus mykiss*	NOEC 0.088 mg ac/L	Cohle 1988

[7] Residue-unit-dose is scaled to application rate of 1 kg/ha

Substance	Group	Exposure	Species	Toxicity value	Reference
			Danio rerio	AC_{10} 7.3 mg ac/L	Padilla et al. 2012
Fenitrothion	Invertebrates	Acute	*Paratya compressa*	LC_{50} 0.00036 mg ac/L	Shigehisa & Shiraishi 1998
			Cheumatopsyche brevilineata	EC_{50} 0.0078 mg ac/L	Yokoyama et al. 2009
			Chironomus riparius	LC_{50} 0.0081 mg ac/L	Burke & Flenley 2011
			Anisops sardeus	LC_{50} 0.0086 mg ac/L	Lahr et al. 2001
			Daphnia magna	EC_{50} 0.0086 mg ac/L	Forbis 1987
				EC_{50} 0.010 mg ac/L	Matsumoto et al. 2009
				Geomean EC_{50} 0.0093 mg ac/L (2 trials)	
			Hyalella azteca	LC_{50} 0.0097 mg ac/L	Burke & Scholey 2011a
			Neocaridina denticulata	LC_{50} 0.14 mg ac/L	Burke 2011
			Streptocephalus sudanicus	EC_{50} 1.2 mg ac/L	Lahr et al. 2001
		Chronic	*Daphnia magna*	NOEC 0.000087 mg/L	Burgess 1988
	Algae	Chronic	*Pseudokirchneriella subcapitata*	E_rC_{50} 2.7 mg ac/L	Burke & Scholey 2011b
NMC	Invertebrates	Acute	*Daphnia magna*	EC_{50} 18 mg/L	Putt 2001
AM-FNT	Invertebrates	Acute	*Daphnia magna*	EC_{50} 5.9 mg/L	Gries 2002

Table 51: Microcosm and field studies on aquatic species

Crop	Exposure	Effect	Reference
Cultivated savannah	1x 500 g ac/ha	Reduced populations of backswimmers (*Anisops* spp.), other insects, and zooplankton (especially Cladocera) in natural temporary ponds	Lahr et al. 2000
Cropping country	Not specified	No apparent impact on macroinvertebrate communities in any of 9 waterways after locust spray operations in spring 2000	South Australia EPA 2001
Indoor microcosm	3 mg/L	3.5% corrected mortality of rice snail (*Isidorella newcombi*) after 24h exposure	Stevens et al. 1996

Table 52: Effects on bees

Test substance	Species	Life stage	Exposure	Toxicity value	Reference
Fenitrothion	*Apis mellifera*	Adult	Acute contact	LD_{50} 0.16 µg ac/bee	Hoberg 2001
			Acute oral	LD_{50} 0.20 µg ac/bee	Hoberg 2001

Table 53: Monitoring data and adverse incident reports on bees

Situation	Exposure	Effect	Reference
Apiaries evenly distributed in 5 sites located on continental France	Not specified	Fenitrothion was detected at 511 µg/kg in 1/87 beeswax samples, but was not detected in 198 bee-collected pollen samples, 239 honey samples, or 307 bee samples in 2002-2005	Chauzat et al. 2006, 2011
Apiaries in 17 different regions of Spain	Not specified	Fenitrothion was detected in 1/448 stored pollen samples at 7 µg/kg in 2006 and 1/397 samples at 4 µg/kg in 2007	Bernal et al. 2010

Situation	Exposure	Effect	Reference
Four apple orchards in Japan	No history of fenitrothion use	Fenitrothion was detected in honeybees (1.5 µg/kg), mason bee nesting materials (2.3-8.4 µg/kg), and wildflowers (<1.6-337 µg/kg) at one site in proximity to urban area; not detected in soil or same matrices at other sites	Suzuki et al. 2023
Raspberry crop (suspected)	0.086 µg/bee	All 7 honeybee colonies of an apiary in Fife UK died in one incident in 1998	Fletcher et al. 1999
Suburban area	0.19 µg/bee	All 7 honeybee colonies of an apiary in Wales UK died in one incident in 1999; however, source of exposure could not be determined	Barnett et al. 2000

Table 54: Field studies on other non-target arthropod species

Test substance	Crop	Exposure	Effect	Reference
Fenitrothion	Mitchell grass plain	1× 267 g ac/ha	Significant impact on invertebrate community composition for over 79 days with recovery by 189 DAT	Walker et al. 2016

Table 55: Laboratory studies on soil organisms

Substance	Group	Exposure	Species/process	Toxicity value	Reference
Fenitrothion	Macro-organisms	Acute	*Eisenia fetida*	LC_{50corr} 116 mg ac/kg dry soil	Ellgehausen et al. 1985
	Micro-organisms	Chronic	Respiration	NOEC 10 mg ac/kg dry soil	Mikami et al. 1984
			Nitrification	NOEC 10 mg ac/kg dry soil	Mikami et al. 1984
NMC	Macro-organisms	Acute	*Eisenia fetida*	LC_{50corr} 18 mg/kg dry soil	Teixeira 2001

Table 56: Field studies on soil organisms

Test substance	Crop	Exposure	Effect	Reference
GR formulation	Pasture	2.24 kg ac/ha	No deleterious effects on populations of the earthworm *Allolobophora caliginosa*	Martin 1976
			No overall effect on abundance of arthropods, collembola or acari was detected. For individual species that exhibited reduced abundance, recovery was observed within 30 weeks in majority of cases.	Martin 1978

Table 57: Effects on non-target terrestrial plants (post-emergent exposure)

Test substance	Species	ER_{25}	ER_{50}	Reference
WP 40%	*Ambrosia trifida* *Chenopodium album* *Digitaria saguinalis* *Setaria faberi* *Sorghum halepense* *Xanthium strumarium*	>1,000 g ac/ha >1,000 g ac/ha >1,000 g ac/ha >1,000 g ac/ha >1,000 g ac/ha >1,000 g ac/ha	>1,000 g ac/ha >1,000 g ac/ha >1,000 g ac/ha >1,000 g ac/ha >1,000 g ac/ha >1,000 g ac/ha	Mito 2001

Appendix D – Terrestrial vertebrate assessments

Risks to terrestrial vertebrates following dietary exposure to contaminated food items are assessed using a tiered approach. The acute assessment assumes 100% of food items are obtained from the treatment area on the last day of application, while the chronic assessment assumes 50% of food items are obtained from the treatment area for the first 21 days after the last application (PT 0.5).

The use patterns were divided up into groups which consist of crop species that have similar growing patterns. It is assumed that the exposure of a 'generic focal species' within each group will be the same as they relate to feeding habits and other ecological needs. A 'generic focal species' is not a real species; however, it is considered to be representative of all those species potentially at risk. The APVMA utilises the EFSA (2009) generic focal species which are considered protective of species that occur in Australia. Interception of the spray by the crop is taken into account by calculating the residue level on the several food types, depending on the growth stage of the crop. This consideration is reflected in the EFSA (2009) shortcut values.

The maximum acceptable application rate following both acute and chronic exposure for each application timing have been calculated in this document to compare against the full rate ranges registered for each situation (Table 58 for wild mammals; Table 59 for birds). Only application timings that are considered to be relevant to the generic focal species have been considered.

Table 58: Assessment of risks to wild mammals (acute RAL 15 mg/kg; chronic RAL 2.3 mg/kg/d)

Situation	Crop group	Generic focal species	Crop stage	Shortcut value		Acceptable rate (g/ha)	
				acute	chronic	acute	chronic
Grazing sorghum, cereal crops	Cereals	Small insectivore	BBCH 10-19	7.6	4.2	1930	2079
			BBCH ≥20	5.4	1.9	2716	4596
		Small herbivore	BBCH ≥40	40.9	21.7	359	975
		Large herbivore	Early (shoots)	42.1	22.3	348	948
		Small omnivore	BBCH <10	14.3	5.7	1026	1532
			BBCH 10-29	17.2	7.8	853	1120
			BBCH 30-39	8.6	3.9	1705	2239
			BBCH ≥40	5.2	23	2821	3797
Corn, maize	Maize	Small insectivore	BBCH 10-19	7.6	4.2	1930	2079
			BBCH ≥20	5.4	1.9	2716	4596
		Small herbivore	BBCH 10-29	136.4	72.3	108	293
			BBCH 30-39	68.2	36.1	215	586
			BBCH ≥40	34.1	18.1	430	1168
		Small omnivore	BBCH <10	14.3	5.7	1026	1532
			BBCH 10-29	17.2	7.8	853	1120
			BBCH 30-39	8.6	3.9	1705	2239
			BBCH ≥40	4.3	1.9	3411	4596
Forage crops, lucerne	Legume forage	Small insectivore	BBCH 10-19	7.6	4.2	1930	2079
			BBCH ≥20	5.4	1.9	2716	4596
		Small herbivore	BBCH 40-49	136.4	72.3	108	293
			BBCH ≥50	40.9	21.7	359	975
		Large herbivore	BBCH 21-49	35.1	14.3	418	1479
		Small omnivore	BBCH <10	14.3	5.7	1026	1532
			BBCH 10-49	17.2	7.8	853	1120
			BBCH ≥50	5.2	2.3	2821	3797

Situation	Crop group	Generic focal species	Crop stage	Shortcut value		Acceptable rate (g/ha)	
				acute	chronic	acute	chronic
Soybean	Pulses	Small insectivore	BBCH 10-19	7.6	4.2	1930	2079
			BBCH ≥20	5.4	1.9	2716	4596
		Small herbivore	BBCH 40-49	136.4	72.3	108	293
			BBCH ≥50	40.9	21.7	359	975
		Large herbivore	BBCH 10-49	35.1	14.3	418	1479
			BBCH ≥50	10.5	4.3	1397	4918
		Small omnivore	BBCH <10	14.3	5.7	1026	1532
			BBCH 10-49	17.2	7.8	853	1120
			BBCH 50-79	5.2	2.3	2821	397
			BBCH ≥80	14.4	6.6	1019	1323
Pasture, pasture seed crops	Grassland	Large herbivore	All season	32.6	17.3	450	1222
		Small insectivore	Late season	5.4	1.9	2716	4596
		Small herbivore	All season	136.4	72.3	108	293
		Small omnivore	BBCH <10	14.3	5.7	1026	1532
			Early/late season	14.4	6.6	1019	1323
Apples, cherries	Orchards	Small insectivore	BBCH <10	5.4	1.9	2716	4596
		Small herbivore	BBCH <10	136.4	72.3	108	293
			BBCH 10-19	109.2	57.8	134	366
			BBCH 20-39	81.9	43.4	179	487
			BBCH ≥40	40.9	21.7	359	975
		Frugivore	BBCH 71-79	47.9	22.7	306	657
		Large herbivore	BBCH <10	35.1	14.3	418	1479
			BBCH 10-19	28.1	11.5	522	1839
			BBCH 20-39	2.1	8.6	695	2459
			BBCH ≥40	10.5	4.3	1397	4918
		Small omnivore	BBCH <10	17.2	7.8	853	1120
			BBCH 10-19	13.8	6.2	1063	1409
			BBCH 20-39	10.3	4.7	1424	1858
			BBCH ≥40	5.2	2.3	2821	3797
Grapes	Vineyards	Large herbivore	BBCH <10	27.2	27.2	539	1905
			BBCH 10-19	15.3	16.3	900	3156
			BBCH 20-39	13.6	13.6	1078	3845
			BBCH ≥40	3.1	8.1	1811	6409
		Small insectivore	BBCH 10-19	7.6	7.6	1930	2079
			BBCH ≥20	5.4	5.4	2716	4596
		Small herbivore	BBCH <10	136.4	136.4	108	293
			BBCH 10-19	81.9	81.9	179	487
			BBCH 20-39	68.2	68.2	215	586
			BBCH ≥40	40.9	40.9	359	975
		Small omnivore	BBCH <10	17.2	17.2	853	1120
			BBCH 10-19	10.3	10.3	1424	1858
			BBCH 20-39	8.6	8.6	1705	2239
			BBCH ≥40	5.2	5.2	2821	3797

Situation	Crop group	Generic focal species	Crop stage	Shortcut value		Acceptable rate (g/ha)	
				acute	chronic	acute	chronic
Tomatoes	Fruiting vegetables	Frugivore	BBCH 71-89	45.2	25.2	324	592
		Small insectivore	BBCH 10-19 BBCH ≥20	7.6 5.4	4.2 1.9	1930 2716	2079 4596
		Small herbivore	BBCH 10-49 BBCH ≥50	136.4 40.9	72.3 21.7	108 359	293 975
		Small omnivore	BBCH <10 BBCH 10-49 BBCH ≥50	14.3 17.2 5.2	5.7 7.8 2.3	1026 853 2821	1532 1120 3797
Cabbages, lettuce	Leafy vegetables	Small insectivore	BBCH 10-19 BBCH ≥20	7.6 5.4	4.2 1.9	1930 2716	2079 4596
		Small herbivore	BBCH 40-49 BBCH ≥50	136.4 40.9	72.3 21.7	108 359	293 975
		Large herbivore	All season	35.1	14.3	418	1479
		Small omnivore	BBCH <10 BBCH 10-49 BBCH ≥50	14.3 17.2 5.2	5.7 7.8 2.3	1026 853 2821	1532 1120 3797

RAL = regulatory acceptable level from Table 27
Generic focal species and shortcut values for indicated crop groups from EFSA (2009)
Maximum acceptable seasonal rate (g/ha)
= RAL * 1000 / (shortcut * PT (acute 1.0, chronic 0.5) * FFT 1.0 * TWA factor (acute 1.00, chronic 0.53))

Table 59: Assessment of risks to birds (acute RAL 2.7 mg/kg; chronic RAL 2.3 mg/kg/d)

Situation	Crop group	Generic focal species	Crop stage	Shortcut value		Acceptable rate (g/ha)	
				acute	chronic	acute	chronic
Grazing sorghum, cereal crops	Cereals	Small granivore	BBCH <10	24.7	11.4	110	766
		Small insectivore	BBCH <10 BBCH 71-89	10.9 57.6	5.9 22.4	248 47	1480 390
		Large herbivore	BBCH 10-29	30.5	16.2	89	1305
		Small omnivore	BBCH <10 BBCH 10-29 BBCH 30-39 BBCH ≥40	17.4 24.0 12.0 7.2	8.2 10.9 5.4 3.3	156 113 226 376	1065 801 1617 2646
		Small granivore/ insectivore	Late season	27.0	12.5	100	699

Situation	Crop group	Generic focal species	Crop stage	Shortcut value		Acceptable rate (g/ha)	
				acute	chronic	acute	chronic
Corn, maize	Maize	Small granivore	BBCH <10	24.7	11.4	110	766
		Medium granivore	BBCH 10-29	6.6	3.0	410	2911
			BBCH 30-39	3.3	1.5	820	5822
			BBCH ≥40	1.6	0.8	1691	10916
		Small insectivore/ worm feeder	BBCH 10-29	10.5	5.7	258	1532
		Small omnivore	BBCH <10	17.4	8.2	156	1065
			BBCH 10-29	24.0	10.9	113	801
			BBCH 30-39	12.0	5.4	226	1617
			BBCH ≥40	6.0	2.7	451	3234
		Medium herbivore/ granivore	BBCH 10-29	55.6	22.7	49	385
			BBCH 30-39	27.8	11.4	97	766
			BBCH ≥40	13.9	5.7	195	1532
		Small insectivore	BBCH <10	10.9	5.9	248	1480
			BBCH 10-19	26.8	11.3	101	773
			BBCH ≥20	12.6	4.8	215	1819
Forage crops, lucerne, soybean	Legume forage, pulses	Small granivore	BBCH <50	24.7	11.4	110	766
			BBCH ≥50	7.4	3.4	336	2568
		Small omnivore	BBCH <10	17.4	8.2	156	1065
			BBCH 10-49	24.0	10.9	113	801
			BBCH ≥50	7.2	3.3	375	2646
		Small insectivore	BBCh <10	10.9	5.9	248	1480
			BBCH 10-19	26.8	11.3	101	773
			BBCH ≥20	25.2	9.7	107	900
		Medium herbivore/ granivore	BBCH 21-49	55.6	22.7	49	385
Pasture, pasture seed crops	Grassland	Small granivore	New sown	20.4	9.4	133	929
			Late season	24.7	11.4	110	766
		Large herbivore	Growing shoots	30.5	16.2	89	1305
		Small insectivore	BBCH <10	10.9	5.9	248	1480
			Growing shoots	26.8	11.3	101	773
Apples, cherries	Orchards	Small insectivore	Spring/summer	46.8	18.2	58	480
		Small insectivore/ worm feeder	BBCH <10	7.4	2.7	366	3234
			BBCH 10-19	5.9	2.1	459	4158
			BBCH 20-39	4.4	1.6	615	5458
			BBCH ≥40	2.2	0.8	1230	10916
		Small granivore	BBCH <10	27.4	12.6	99	693
			BBCH 10-19	21.9	10.1	124	865
			BBCH 20-39	16.4	7.6	165	1149
			BBCH ≥40	8.2	3.8	330	2298

Situation	Crop group	Generic focal species	Crop stage	Shortcut value		Acceptable rate (g/ha)	
				acute	chronic	acute	chronic
Grapes	Vineyards	Small insectivore	BBCH <10	10.9	5.9	248	1480
			BBCH 10-19	27.4	11.5	99	759
			BBCH ≥20	25.7	9.9	105	882
		Small granivore	BBCH <10	24.7	11.4	110	766
			BBCH 10-19	14.8	6.9	183	1266
			BBCH 20-39	12.4	5.7	218	1532
			BBCH ≥40	7.4	3.4	366	2568
		Frugivore	Ripening	28.9	14.4	94	1036
		Small omnivore	BBCH <10	17.4	8.2	156	1065
			BBCH 10-19	14.4	6.5	188	1344
			BBCH 20-39	12.0	5.4	226	1617
			BBCH ≥40	7.2	3.3	376	2646
Tomatoes	Fruiting vegetables	Small granivore	BBCH <50	24.7	11.4	110	766
			BBCH ≥50	7.4	3.4	366	2568
		Small omnivore	BBCH <10	17.4	8.2	156	1065
			BBCH 10-49	24.0	10.9	113	801
			BBCH ≥50	7.2	3.3	376	2646
		Frugivore (crow)	BBCH 71-89	57.4	32.0	47	466
		Frugivore (starling)	BBCH 71-89	49.4	20.7	55	721
		Small insectivore	BBCH <10	10.9	5.9	248	1480
			BBCH 10-19	26.8	11.3	101	773
			BBCH ≥20	25.2	9.7	107	900
Cabbages, lettuce	Leafy vegetables	Small granivore	BBCH <10	24.7	11.4	110	766
			BBCH 10-49	27.4	12.6	99	693
			BBCH ≥50	8.2	3.8	330	2298
		Small omnivore	BBCH <10	17.4	8.2	156	1065
			BBCH 10-49	24.0	10.9	113	801
			BBCH ≥50	7.2	3.3	376	2646
		Small insectivore	BBCH <10	10.9	5.9	248	1480
			BBCH 10-19	26.8	11.3	101	773
			BBCH ≥20	25.2	9.7	107	900
		Medium herbivore/ granivore	BBCH 10-19	90.6	37.0	30	236

RAL = regulatory acceptable level from Table 27
Generic focal species and shortcut values for indicated crop groups from EFSA (2009)
Maximum acceptable seasonal rate (g/ha)
= RAL * 1000 / (shortcut * PT (acute 1.0, chronic 0.5) * FFT 1.0 * TWA factor (acute 1.00, chronic 0.53))

Appendix E – Runoff assessments

Assessment scenarios

Runoff has been modelled following the methodology described in the APVMA Risk Assessment Manual, Environment- Appendix B. To perform the appropriate high tier calculations, the runoff assessment has been undertaken using the PERAMA[8] software. All runoff calculations assume that 50% of residues intercepted by the foliage are washed off due a rainfall event and contribute to the total soil residue subject to runoff.

Table 60: Soil exposure rates assessed for the runoff assessments of fenitrothion

Use pattern	Situation	Application rate and frequency	Foliar interception fraction	Fraction field treated	Fraction of 10 ha treated	Seasonal rate over 10 ha (g/ha)
Field crops and pasture	Cereals, maize, corn	3× 550 g ac/ha 14d interval	0	1	1	550
	Forage crops, soybeans	3× 550 g ac/ha 14d interval	0.35	1	1	454
	Lucerne	3× 650 g ac/ha 7d interval	0.35	1	1	543
	Pasture, pasture seed crops	1× 1,300 g ac/ha	0.90	1	1	715
Tree and vine crops	Apples, cherries	3× 550 g ac/ha 14d interval	0.50	1	1	413
	Grapes	3× 550 g ac/ha 14d interval	0.40	1	1	440
Vegetable crops	Tomatoes	3× 550 g ac/ha 14d interval	0.50	1	1	413
	Lettuce, cabbage	3× 550 g ac/ha 14d interval	0.25	1	1	481

Risk assessment scenarios as described in section 2; foliar interception values are based on EFSA (2020) defaults for similar situations; exposure rates based on indicated application rate, frequency, soil DT_{50} 1.1 days, foliar interception (with 50% wash-off) and fractions of field & 10 ha treated.

Tier 1 assessments

The Tier 1 (screening level) is a worst-case scenario where slope is fixed at 8%, which is considered protective of 95% of agricultural activities in Australia. The rainfall value is set at 8 mm, which results in the maximum receiving water concentration using the standard water body of 1 ha and 15 cm initial depth. When the clay dominated Queensland soil profile is used; the catchment is 10 ha. Further, for this worst-case scenario, a fallow/bare soil runoff profile is assessed. The risk was found not to be acceptable for any of the scenarios assessed.

Tier 2 assessments

A regional assessment (Tier 2) was undertaken as either a state based or tropical/subtropical based assessment depending on the cropping situation and production areas. At this level of assessment, the 90th percentile slope

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value is applied. The rainfall value used is determined as that required to result in the maximum water concentration using the standard water body (1 ha surface area, 15 cm deep). At this level of assessment, the rainfall value is determined to be that resulting in the maximum water body concentration and reflects the soil profile applied in the modelling, not the actual rainfall pattern of the region being assessed. The risk was found not to be acceptable for any of the scenarios assessed.

Tier 3 assessments

This highest tier of assessment applies long term rainfall data for representative weather stations in the different regions, which has been obtained from the Bureau of Meteorology. Further, the receiving water characteristics are based on long term stream flow monitoring data and this tier therefore allows assessments to be undertaken on both spatial and temporal scales.

The high tier assessment approach for runoff has been used for a number of years and through this experience, scope for additional refinements have become apparent. There are 2 areas where significant improvement has been made.

The first relates to fraction of catchment treated at a given time. The current approach in the APVMA manual assumes for in-stream analysis that 20% of a catchment is treated at a given time, and all treated area contributes to runoff. This has been shown to potentially underestimate exposure for some situations such as cereals and pasture, and overestimate exposure for cropping situations where growing occurs over smaller areas such as horticultural crops.

The updated MCAS-S data on a 1 km^2 scale have been assessed for major land uses and proportions of catchments grown to a particular land use have now been assessed. These values, while stated in MCAS-S as being ‘catchment’ are probably more appropriate to be considered a basin level so may underestimate exposure in smaller catchments. However, overall, the results are considered applicable as a general indication of the dominance of a particular land use within a catchment scale assessment.

In order to identify a fraction of catchment for a particular land use, catchments where ≥90% of the land use in a region was found were used for the analysis. The fraction of catchment was then taken as the 90th percentile value from this range of catchments. This value was lower than the highest catchment but tended to be higher than the majority of catchments. Nonetheless, it is considered sufficiently conservative to include situations where higher contributions in sub-catchment areas are found and these data are not available.

The second area for improvement relates to the time over which the rainfall event is assumed to occur (currently 1 h for the 25th percentile rainfall value and 2 h for the 75th percentile rainfall value). The 25th and 75th rainfall values are based on daily rainfall (24 h) data from different weather stations within the growing regions. These results have now been compared to a 1 in 10 year rainfall intensity for a 24 hour duration to better allocate a duration of the rainfall event being assessed. The rainfall intensity values are obtained from the intensity frequency distribution data available from BOM.

The coordinates for the town/weather station assessed are used. As an example, in Cairns, the 25th percentile rainfall value in January is 16 mm, and the 1 in 10 year 24 h rainfall intensity is 16.1 mm/h. Therefore, the use of a 1 h duration for this is appropriate. However, in Richmond, Tasmania, the 25th percentile rainfall value in summer is 11.7 mm, and the 1 in 10 year 24 h rainfall intensity is 2.98 mm/h. Therefore, with this intensity, the 25th percentile rain event will occur over a duration of 3.9 hours. This method, while increasing realism, still does not address temporal rainfall trends in the different areas because the BOM value is an annual result irrespective of the time of year the result was obtained. However, this methodology is considered a significant improvement to the modelling in PERAMA.

Regions showing acceptable risk without timing restrictions are summarised in Table 61; regions showing unacceptable risks at any time are summarised in Table 62; regions showing acceptable risks with timing restrictions are summarised in Table 63.

Table 61: Tier 3 scenarios showing acceptable runoff risks of fenitrothion to aquatic species without timing restrictions

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Cereals, maize, corn									
Queensland and NT	0.86	0.16	87	Winter	25 75	13 29	1.0 2.3	0.003 0.012	98 >99
NSW and ACT	0.82	0.27	147	Summer	25 75	16 31	2.1 3.5	0.001 0.006	>99 >99
Victoria	0.51	0.64	353	Autumn	25 75	18 31	3.5 5.5	0.001 0.004	96 >99
Tasmania	1.1	0.01	3.9	Winter	25 75	12 23	1.9 3.0	0.002 0.009	>99 >99
South Australia	1.1	0.64	354	Summer	25 75	20 36	5.0 8.5	0.003 0.010	90 >99
Western Australia	1.1	0.66	362	Summer	25 75	20 39	3.5 5.9	0.001 0.004	>99 98
Forage crops									
Queensland and NT	0.48	0.20	91	Winter	25 75	13 29	1.0 2.3	0.003 0.008	96 >99
NSW and ACT	2.5	0.53	241	Summer	25 75	17 42	1.3 2.8	0.010 0.038	93 98
Tasmania	3.6	0.35	159	Winter	25 75	11 20	1.3 2.6	0.013 0.036	96 >99
Lucerne									
Queensland and NT	0.48	0.20	109	Winter	25 75	13 29	1.0 2.3	0.001 0.004	96 >99
NSW and ACT	2.5	0.53	288	Summer	25 75	17 42	1.3 2.8	0.010 0.038	92 97
Tasmania	3.6	0.35	190	Winter	25 75	11 20	1.3 2.6	0.013 0.037	95 >99
Pasture and pasture seed crops									
Queensland and NT	0.48	0.20	143	Winter	25 75	13 29	1.0 2.3	0.001 0.004	96 >99
NSW and ACT	2.5	0.53	379	Summer	25 75	17 42	1.3 2.8	0.004 0.022	93 97
Tasmania	3.6	0.35	250	Winter	25 75	11 20	1.3 2.6	0.004 0.018	98 >99

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Apples, cherries									
Queensland and NT	1.8	0.03	14	Winter	25	13	1.0	0.006	>99
					75	29	2.3	0.023	>99
NSW and ACT	1.8	0.08	31	Summer	25	17	1.3	0.003	>99
					75	42	2.8	0.017	>99
Victoria	1.2	0.09	38	Autumn	25	18	1.3	0.002	97
					75	32	2.9	0.007	>99
Tasmania	5.4	0.07	28	Winter	25	11	1.3	0.007	>99
					75	21	2.6	0.039	>99
South Australia	2.3	0.10	40	Summer	25	19	1.3	0.004	92
					75	34	3.0	0.014	>99
Western Australia	1.6	0.02	8.3	Summer	25	19	1.3	0.001	>99
					75	28	2.9	0.001	>99
Grapes									
NSW and ACT	1.8	0.08	33	Summer	25	17	1.3	0.003	>99
					75	42	2.8	0.016	>99
Victoria	1.2	0.09	40	Autumn	25	18	1.3	0.002	97
					75	32	2.9	0.007	>99
Tasmania	5.4	0.07	29	Winter	25	11	1.3	0.007	>99
					75	21	2.6	0.036	>99
South Australia	1.2	0.10	43	Summer	25	19	1.3	0.004	95
					75	34	3.0	0.013	>99
Western Australia	1.6	0.02	8.8	Summer	25	19	1.3	0.001	>99
					75	28	2.9	0.001	>99
Wet Tropics	3.0	0.06	2.5	Oct	25	12	0.6	0.009	98
					75	31	1.4	0.038	>99
Burdekin	0.80	0.13	58	Oct	25	13	0.8	0.002	96
					75	36	2.1	0.011	>99
Mackay/Whitsunday	2.0	0.28	123	Oct	25	14	0.7	0.003	96
(pasture inter-row)					75	23	1.1	0.012	>99
Fitzroy	1.9	0.01	3.1	Apr	25	14	0.8	0.008	98
					75	43	1.9	0.032	97
Mary/Burnett	1.6	0.09	40	Oct	25	14	1.0	0.006	>99
					75	35	2.5	0.021	98
SE Queensland	1.7	0.05	20	Dec	25	13	1.3	0.006	98
					75	33	3.2	0.021	96
Northern NSW	3.4	0.04	18	Oct	25	13	1.0	0.011	>99
					75	28	2.2	0.040	99
Tomatoes									
NSW and ACT	1.8	0.08	37	Summer	25	17	1.3	0.006	>99
					75	42	2.8	0.024	>99
Victoria	1.2	0.09	44	Summer	25	20	1.4	0.005	90
					75	34	3.4	0.012	>99
Tasmania	5.4	0.07	32	Winter	25	11	1.3	0.021	>99
					75	23	2.6	0.064	>99
South Australia	1.2	0.10	47	Summer	25	19	1.3	0.004	91
					75	34	3.0	0.011	>99

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Western Australia	1.6	0.02	9.6	Summer	25 75	19 34	1.3 2.9	0.001 0.006	>99 >99
Wet Tropics	3.0	0.06	27	Nov	25 75	14 39	0.6 1.8	0.020 0.063	97 >99
Burdekin	0.80	0.13	63	Oct	25 75	13 36	0.8 2.1	0.004 0.014	90 >99
Fitzroy	1.9	0.01	3.4	Apr	25 75	14 43	0.8 1.9	0.013 0.041	97 96
Mary/Burnett	1.6	0.09	44	Oct	25 75	14 35	1.0 2.5	0.011 0.028	98 96
SE Queensland	1.7	0.05	22	Dec	25 75	13 32	1.3 3.2	0.010 0.029	97 94
Northern NSW	3.4	0.04	20	Oct	25 75	13 28	1.0 2.2	0.021 0.056	99 98
Soybeans, lettuce and cabbage									
NSW and ACT	1.8	0.08	37	Summer	25 75	17 42	1.3 2.8	0.007 0.028	99 >99
Tasmania	5.4	0.07	32	Winter	25 75	12 23	1.3 2.6	0.024 0.075	>99 >99
South Australia	1.2	0.10	47	Summer	25 75	19 34	1.3 3.0	0.005 0.013	**89** >99
Western Australia	1.6	0.02	9.6	Summer	25 75	19 34	1.3 2.9	0.001 0.008	>99 >99
Wet Tropics	3.0	0.06	27	Oct	25 75	12 31	0.6 1.4	0.020 0.061	96 99
Fitzroy	1.9	0.01	3.4	Apr	25 75	14 43	0.8 1.9	0.015 0.048	96 96
Mary/Burnett	1.6	0.09	44	Oct	25 75	14 35	1.0 2.5	0.012 0.033	97 94
SE Queensland	1.7	0.05	22	Dec	25 75	13 32	1.3 3.2	0.012 0.034	96 93
Northern NSW	3.4	0.04	20	Oct	25 75	13 28	1.0 2.2	0.025 0.065	98 98

Only worst-case scenarios are presented for each region; seasonal 10 ha exposure rates from Table 60 have been readjusted to account for the fractions of a full catchment treated; risks are considered acceptable where ≥90% of receiving waters are protected.

Table 62: Regions showing unacceptable runoff risks of fenitrothion to aquatic species at any time

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Lucerne									
Victoria	1.7	0.63	286	Winter	25 75	17 30	1.2 2.1	0.007 0.016	88 98

Only best-case scenarios are presented for each region; seasonal 10 ha exposure rates from Table 60 have been readjusted to account for the fractions of a full catchment treated; risks are considered acceptable where ≥90% of receiving waters are protected.

Table 63: Regions showing acceptable runoff risks of fenitrothion with timing restrictions

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Forage crops									
Victoria	1.7	0.63	286	Autumn	25	18	1.3	0.007	**74**
					75	32	2.9	0.017	93
				Winter	25	17	1.2	0.007	90
					75	30	2.1	0.016	99
				Spring	25	17	1.3	0.007	**82**
					75	28	2.6	0.015	95
				Summer	25	20	1.4	0.008	**59**
					75	34	3.4	0.019	**89**
South Australia	1.3	0.63	286	Autumn	25	19	1.4	0.005	**79**
					75	31	3.0	0.012	95
				Winter	25	18	1.3	0.004	92
					75	26	2.7	0.009	99
				Spring	25	19	1.3	0.005	**85**
					75	28	2.7	0.010	97
				Summer	25	19	1.3	0.005	**64**
					75	34	3.0	0.013	93
Western Australia	1.4	0.35	159	Autumn	25	19	1.3	0.001	**89**
					75	27	3.2	0.004	>99
				Winter	25	19	1.4	0.001	96
					75	27	3.0	0.003	>99
				Spring	25	18	1.3	0.001	91
					75	22	2.6	0.002	>99
				Summer	25	19	1.3	0.001	**80**
					75	28	2.9	0.004	97
Lucerne									
South Australia	1.3	0.63	342	Autumn	25	19	1.4	0.005	**77**
					75	31	3.0	0.012	94
				Winter	25	18	1.3	0.004	91
					75	26	2.7	0.009	99
				Spring	25	19	1.3	0.005	**83**
					75	28	2.7	0.010	96
				Summer	25	19	1.3	0.005	**62**
					75	34	3.0	0.013	90
Western Australia	1.4	0.35	190	Autumn	25	19	1.3	0.001	**87**
					75	27	3.2	0.004	>99
				Winter	25	19	1.4	0.001	95
					75	27	3.0	0.004	>99
				Spring	25	18	1.3	0.001	**89**
					75	22	2.6	0.002	>99
				Summer	25	19	1.3	0.001	**77**
					75	28	2.9	0.004	96

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Pasture and pasture seed crops									
Victoria	1.7	0.63	450	Autumn	25	18	1.3	0.003	**73**
					75	32	2.9	0.010	91
				Winter	25	17	1.2	0.003	**89**
					75	30	2.1	0.009	98
				Spring	25	17	1.3	0.003	**82**
					75	28	2.6	0.008	94
				Summer	25	20	1.4	0.004	**58**
					75	34	3.4	0.010	**85**
South Australia	1.3	0.63	450	Autumn	25	19	1.4	0.002	**79**
					75	31	3.0	0.006	94
				Winter	25	18	1.3	0.002	92
					75	26	2.7	0.005	99
				Spring	25	19	1.3	0.002	**84**
					75	28	2.7	0.005	96
				Summer	25	19	1.3	0.002	**63**
					75	34	3.0	0.007	**89**
Western Australia	1.4	0.35	250	Autumn	25	19	1.3	0.001	90
					75	27	3.2	0.002	>99
				Winter	25	19	1.4	0.001	96
					75	27	3.0	0.002	>99
				Spring	25	18	1.3	0.001	92
					75	22	2.6	0.001	>99
				Summer	25	19	1.3	0.001	**82**
					75	28	2.9	0.002	97

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Tomatoes									
Mackay/Whitsunday	2.0	0.28	134	Jan	25	14	0.7	0.014	96
					75	58	2.8	0.050	>99
				Feb	25	16	0.8	0.016	98
					75	51	2.4	0.048	>99
				Mar	25	16	0.8	0.017	>99
					75	49	2.4	0.047	>99
				Apr	25	13	0.6	0.012	97
					75	39	1.9	0.041	>99
				May	25	12	0.6	0.010	93
					75	24	1.1	0.026	98
				Jun	25	14	0.7	0.013	91
					75	33	1.6	0.036	99
				Jul	25	12	0.6	0.010	90
					75	31	1.5	0.034	>99
				Aug	25	11	0.5	0.009	**85**
					75	30	1.4	0.033	93
				Sep	25	12	0.6	0.011	**84**
					75	32	1.5	0.035	93
				Oct	25	14	0.7	0.014	**72**
					75	23	1.1	0.025	94
				Nov	25	12	0.6	0.011	**71**
					75	38	1.8	0.040	>99
				Dec	25	14	0.7	0.014	**84**
					75	40	1.9	0.041	99
Lettuce and cabbage									
Victoria	1.2	0.09	44	Autumn	25	18	1.3	0.006	93
					75	32	2.9	0.013	>99
				Winter	25	17	1.2	0.005	97
					75	30	2.1	0.012	>99
				Spring	25	17	1.3	0.005	96
					75	28	2.6	0.011	>99
				Summer	25	20	1.4	0.006	**88**
					75	34	3.4	0.014	>99

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Burdekin	0.80	0.13	63	Jan	25	16	1.0	0.007	>99
					75	50	2.9	0.020	>99
				Feb	25	16	0.9	0.007	>99
					75	53	3.2	0.021	>99
				Mar	25	15	0.9	0.006	>99
					75	50	3.0	0.020	>99
				Apr	25	14	0.8	0.006	>99
					75	39	2.3	0.017	>99
				May	25	12	0.7	0.005	>99
					75	28	1.7	0.013	>99
				Jun	25	13	0.8	0.005	>99
					75	28	1.7	0.014	>99
				Jul	25	13	0.7	0.005	>99
					75	29	1.7	0.014	>99
				Aug	25	13	0.8	0.005	>99
					75	29	1.7	0.014	>99
				Sep	25	15	0.9	0.006	96
					75	34	2.0	0.016	>99
				Oct	25	13	0.8	0.005	**88**
					75	36	2.1	0.017	>99
				Nov	25	14	0.8	0.006	>99
					75	33	2.0	0.015	>99
				Dec	25	14	0.9	0.006	>99
					75	42	2.5	0.018	>99

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Mackay/Whitsunday	2.0	0.28	134	Jan	25	14	0.7	0.016	95
					75	58	2.8	0.059	>99
				Feb	25	16	0.8	0.019	98
					75	51	2.4	0.056	>99
				Mar	25	16	0.8	0.020	99
					75	49	2.4	0.055	>99
				Apr	25	13	0.6	0.015	96
					75	39	1.9	0.048	>99
				May	25	12	0.6	0.012	92
					75	24	1.1	0.031	98
				Jun	25	14	0.7	0.015	90
					75	33	1.6	0.042	99
				Jul	25	12	0.6	0.012	**89**
					75	31	1.5	0.040	99
				Aug	25	11	0.5	0.011	**83**
					75	30	1.4	0.039	92
				Sep	25	12	0.6	0.013	**82**
					75	32	1.5	0.041	92
				Oct	25	14	0.7	0.016	**69**
					75	23	1.1	0.030	91
				Nov	25	12	0.6	0.013	**69**
					75	38	1.8	0.047	>99
				Dec	25	14	0.7	0.016	**82**
					75	40	1.9	0.048	99
Grapes									
Mackay/Whitsunday (bare soil inter-row)	2.0	0.28	123	Jan	25	14	0.7	0.008	98
					75	58	2.8	0.041	>99
				Feb	25	16	0.8	0.010	>99
					75	51	2.4	0.038	>99
				Mar	25	16	0.8	0.010	>99
					75	49	2.4	0.037	>99
				Apr	25	13	0.6	0.007	99
					75	39	1.9	0.31	>99
				May	25	12	0.6	0.005	96
					75	24	1.1	0.019	99
				Jun	25	14	0.7	0.007	95
					75	33	1.6	0.027	>99
				Jul	25	12	0.6	0.005	95
					75	31	1.5	0.025	>99
				Aug	25	11	0.5	0.004	92
					75	30	1.4	0.024	95
				Sep	25	12	0.6	0.006	91
					75	32	1.5	0.026	95
				Oct	25	14	0.7	0.008	**82**
					75	23	1.1	0.018	>99

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
				Nov	25	12	0.6	0.006	**83**
					75	38	1.8	0.031	>99
				Dec	25	14	0.7	0.008	91
					75	40	1.9	0.032	>99

Seasonal 10 ha exposure rates from Table 60 have been readjusted to account for the fractions of a full catchment treated; risks are considered acceptable where ≥90% of receiving waters are protected.

Appendix F – PBT and pop assessments

The Stockholm Convention provides scientifically based criteria for potential POPs (persistent organic pollutants) and a process that ultimately may lead to elimination of a POP substance globally. POPs are persistent, bioaccumulative, and toxic (PBT) and also have potential for long-range transport.

Persistence criterion

The criteria for persistence in Annex D of the convention are expressed as single-media criteria as follows:

- Evidence that the half-life of the chemical in water is greater than 2 months (60 days), or that its half-life in soil is greater than 6 months (180 days), or that its half-life in sediment is greater than 6 months (180 days); or
- Evidence that the chemical is otherwise sufficiently persistent to justify its consideration within the scope of the Convention.

The half-lives for fenitrothion in water and sediment and soil do not exceed 60 and 180 days, respectively. In 2 water/sediment systems, the geomean DT_{50} values were 1.1 days in water and 1.1 days in sediment (Swales 2001). The half-life of fenitrothion in soil did not exceed 180 days. The geomean DT_{50} in 5 aerobic laboratory soils was determined to be 1.1 days (Cranor & Daly 1989, Yeomans & Swales 2001). It can thus be concluded that fenitrothion does not meet the persistence criterion.

Bioaccumulation criterion

As noted above, the criteria for bioaccumulation in Annex D of the Stockholm Convention are given as follows:

- Evidence that the bioconcentration factor or bioaccumulation factor in aquatic species for the chemical is greater than 5000 or, in the absence of such data, that the log Pow is greater than 5;
- Evidence that a chemical presents other reasons for concern, such as high bioaccumulation in other species, high toxicity or ecotoxicity; or
- Monitoring data in biota indicating that the bioaccumulation potential of the chemical is sufficient to justify its consideration within the scope of the Convention.

Fenitrothion is considered not bioaccumulative based on a whole fish BCF of 29 (Ohshima et al. 1988).

Toxicity criterion

For persistent and bioaccumulative substances, exposure may be anticipated to cover the whole life of an organism as well as multiple generations. Consequently, chronic ecotoxicity data, preferably covering impacts on reproduction, are used to establish the toxicity within the PBT context.

As noted, the Stockholm Convention on POPs provides scientifically based criteria for potential POPs and a process that ultimately may lead to elimination of a POP substance globally. The criteria for toxicity in Annex D of the POPs convention do not consist of numerical values, but are given as follows:

- Evidence of adverse effects to human health or to the environment that justifies consideration of the chemical within the scope of this Convention; or
- Toxicity or ecotoxicity data that indicate the potential for damage to human health or to the environment.

The lowest aquatic long-term effect value is below 10 µg/L (lowest NOEC is 0.087 µg/L, Burgess 1988). That study was performed for 21 days under flow-through conditions. When considering fenitrothion rapidly dissipates from aquatic systems (water/sediment DT_{50} 1.6 days), the aquatic toxicity value corresponds to an initial concentration of 0.79 µg ac/L[9], which is still below the 10 µg/L threshold. Therefore, fenitrothion is considered to meet the toxicity criterion.

Potential for long-range environmental transport

The criteria for long-range transport in Annex D of the Stockholm convention are expressed as follows:

- Measured levels of the chemical in locations distant from the sources of its release that are of potential concern.
- Monitoring data showing that long-range environmental transport, with the potential for transfer to a receiving environment, (via air, water or migratory species).
- Environmental fate properties and/or model results that demonstrate that the chemical has a potential for such transportation, with the potential for transfer to a receiving environment in locations distant from the sources of its release. For a chemical that migrates significantly through the air, its half-life in air should be greater than 2 days.

Fenitrothion is non-volatile and has a modelled atmospheric half-life of <2 days (Nishiyama et al. 2000); therefore, it is unlikely to travel long distances through the air. There is no evidence to suggest fenitrothion is being transported long distances in the environment.

Conclusion

Fenitrothion does not fulfil the PBT criteria (not PBT) and has low potential for long-range transport. Therefore, fenitrothion does not meet the criteria for POPs in Annex D of the Stockholm convention.

[9] Initial concentration = mean measured endpoint / (1 - EXP (21 exposure days * (-ln(2)/DT50 1.6 days))) * (21 exposure days * ln(2)/DT_{50} 1.6 days

Acronyms and abbreviations

Shortened term	Full term
AA-FNT	acetylaminofenitrothion
AAMC	4-acetylamino-3-methylphenol
ac	active constituent
ADI	Acceptable daily intake (for humans)
AF	assessment factor
AM-FNT	aminofenitrothion
APVMA	Australian Pesticide and Veterinary Medicines Authority
ARfD	Acute reference dose
BBCH	Biologische Bundesanstalt, Bundessortenamt and Chemische Industrie
BCF	bioconcentration factor
BOM	Bureau of Meteorology
bw	body weight
CA-FNT	carboxyfenitrothion
CIPAC	Collaborative International Pesticides Analytical Council
cm	centimetre(s)
CT_X	time required for X% clearance
d	day(s)
DAF	Dermal Absorption Factor
DAT	days after treatment
DDD	daily dietary dose
DM-AM-FNT	O-(4-amino-3-methylphenyl) O-hydrogen O-methyl phosphorothioate
DM-FNT	desmethylfenitrothion
ds	dry soil
DT_X	period required for X% percent dissipation
EC_X	concentration causing X% effect (ErC_X is used for growth rate; EbC_X is used for biomass)

Shortened term	Full term
EFSA	European Food Safety Authority
ER_X	rate causing X% effect
ExpE	exposure estimate
FAO	Food and Agriculture Organization of the United Nations
FNT	fenitrothion
g	gram(s)
GR	granular formulation
ha	hectare(s)
HC_X	hazardous concentration for X% of the species
IPM	integrated pest management
Kd or Kf	(Freundlich) adsorption constant
kg	Kilogram(s)
Koc or Kfoc	(Freundlich) organic carbon partition coefficient
Kp	sediment sorption coefficient
L	Litre(s)
LC_X	lethal concentration to X% of the tested population (LC_{Xcorr} is a corrected value to account for bioavailability in the test system)
LD_X	lethal dose to X% of the tested population
LOAEL	Lowest Observed Adverse Effect Level
LOC	level of concern
m	metre(s)
max	maximum
MCAS-S	multi-criteria analysis shell for spatial decision support
mg	milligram(s)
mL	millilitre(s)
MRL	Maximum Residue Limit
nd	not detected

Shortened term	Full term
nm	nanometre(s)
NEDI	National Estimated Daily Intake
NESTI	National Estimated Short Term Intake
NMC	3-methyl-4-nitrophenol
NOAEL	No Observed Adverse Effect Level
NOEC	no observed effect concentration ($NOEC_{corr}$ is a corrected value to account for bioavailability in the test system)
NOEL	no observed effect level
OC	organic carbon
OECD	Organisation for Economic Co-operation and Development
Pa	pascal(s)
PBT	persistent – bioaccumulative – toxic
PEC	predicted environmental concentration
PERAMA	Pesticide Environmental Risk Assessment Model for Australia
PHED	Pesticide Handler Exposure Database
POP	persistent organic pollutant
Pow	octanol-water partition coefficient
PPE	Personal Protective Equipment
ppm	parts per million
PT	proportion of an animal’s daily diet obtained in habitat treated with pesticide
RAL	regulatory acceptable level
RQ	risk quotient
SDRAM	spray drift risk assessment manual
SSD	species sensitivity distribution
TMPP	Tetramethyl pyrophosphorothioate
TWA	time-weighted average
µg	microgram(s)

Shortened term	Full term
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VIS	visible
WHO	World Health Organisation
WP	wettable powder

Glossary

Term	Description
acute exposure	Contact between a pesticide and a target occurring over a short time (e.g., less than a day)
acute toxicity	Adverse effects of finite duration occurring within a short time (up to 14 d) after administration of a single dose (or exposure to a given concentration) of a test substance or after multiple doses (exposures), usually within 24 h of a starting point (which may be exposure to the toxicant, or loss of reserve capacity, or developmental change, etc.)
adsorption constant	A measure of the tendency of a chemical to bind to soils
adverse effect	Change in the morphology, physiology, growth, development, reproduction or life span of an organism, system, or subpopulation that results in impairment of the capacity to compensate for additional stress, or an increase in susceptibility to other influences
agricultural crop	Any terrestrial plant species grown commercially for food, fibre, foliage, fuel or medicinal production, with the exception of plants that are not part of a crop under management at the time of pesticide application (eg blackberries or volunteer grain plants that have escaped from a cropped area and become weeds in another area)
aquatic	Relating to water, as distinct from land or air
assessment factor	Reductive factor by which an observed or estimated endpoint of a pesticide is divided to arrive at a regulatory acceptable level
bioaccumulation	Progressive increase in the amount of a substance in an organism or part of an organism that occurs because the rate of intake exceeds the organism's ability to remove the substance from the body
bioconcentration	Uptake of a pesticide residue from an environmental matrix, usually through partitioning across body surfaces to a concentration in the organism that is usually higher than in the environmental matrix
bioconcentration factor	Ratio between the concentration of pesticide in an organism or tissue and the concentration in the environmental matrix (usually water) at apparent equilibrium during the uptake phase
bound residue	Residue associated with one or more classes of endogenous macromolecules that cannot be disassociated by extraction or digestion without alteration
catchment	Landform that collects precipitation and retains it in an impoundment or drains it through a single outlet
chronic exposure	Continued or intermittent long-term contact between an agent and a target
chronic toxicity	Adverse effects following chronic exposure
concentration	Amount of a material, agent (e.g., pesticide) dissolved or contained in unit quantity in a given medium or system
degradate	Chemical that is formed when a substance breaks down

Term	Description
dose	Total amount of a pesticide or agent administered to, taken up or absorbed by an organism, system, or (sub-) population
dissipation	Loss of pesticide residues from an environmental compartment due to degradation and transfer to another environmental compartment
dissociation constant	The ratio of concentration of dissociated ions to the concentration of original acid
effect assessment	Combination of analysis and inference of possible consequences of the exposure to a pesticide based on knowledge of the dose–effect relationship associated with that agent in a specific target organism, system, or (sub-) population
emulsifiable concentrate	A liquid, homogenous preparation to be applied as an emulsion after dilution in water
endpoint	Measurable ecological or toxicological characteristic or parameter of the test system that is chosen as the most relevant assessment criterion
environmental fate	Destiny of a pesticide or chemical after release to the environment involving considerations such as transport through air, soil, or water, bioconcentration, degradation, etc.
environmental risk	Probability that an adverse effect on humans an environmental system/receptor will be observed for a given exposure to a pesticide based on the probability of that exposure and the sensitivity of the system/receptor
exposure	Concentration or amount of a particular substance that is taken in by an individual, population or ecosystem in a specific frequency over a certain amount of time
exposure assessment	Evaluation of the exposure of an organism, system, or (sub-) population to a pesticide or agent (and its derivatives)
Freundlich isotherm	Empirical relationship describing the adsorption of a solute from a liquid or gaseous phase to a solid in which the quantity of material adsorbed per unit mass of adsorbent is expressed as a function of the equilibrium concentration of the sorbate
granular formulation	A free-flowing solid preparation of a defined granule size range ready for use
half-life	The time taken for the reactant concentration to fall to one-half its initial value
hazard	Inherent property of a pesticide having the potential to cause adverse effects when an organism, system, or (sub-) population is exposed to that agent or situation
Henry's law constant	A gas law that states the amount of gas absorbed by a given volume of liquid at a given temperature is directly proportional to the partial pressure of that gas in equilibrium with that liquid. As such it provides an indication of the preference of a chemical for air relative to water i.e. its volatility
hydrolysis	Chemical decomposition induced by water
in vitro	outside the living body and in an artificial environment
indicator species	Species whose presence shows the occurrence of defined environmental conditions

Term	Description
integrated pest managment	Use of pest and environmental information in conjunction with available pest control technologies to prevent unacceptable levels of pest damage by the most economical means and with the least possible hazard to persons, property, and the environment
larva	Recently hatched insect, fish, or other organism that has different physical characteristics than those seen in the adult, requiring metamorphosis to reach the adult body structure
metabolite	Substance formed as a consequence of metabolism in an organism
mineralisation	Conversion of an element from an organic form to an inorganic form. Mineralisation of pesticides most commonly refers to the microbial degradation to carbon dioxide as a terminal metabolite
no observed effect level	Greatest concentration or amount of a substance, found by experiment or observation, which causes no detectable adverse alteration of morphology, functional capacity, growth, development, or life span of the target organism under defined conditions of exposure
non-target species	Organisms that are not the intended targets of a particular use of a pesticide
organophosphorus	Generic term for pesticides containing phosphorus but commonly used to refer to insecticides consisting of acetylcholinesterase inhibiting esters of phosphate or thiophosphate
partition coefficient	log Pow is the logarithm (base-10) of the partition coefficient between n-octanol and water
persistence	Residence time of a chemical species (pesticide and/or metabolites) subjected to degradation or physical removal in a soil, crop, animal, or other defined environmental compartment
photolysis	Chemical decomposition induced by light or other radiant energy
regulatory acceptable level	Criterion or standard that is considered safe or without appreciable risk
runoff	Portion of the wet precipitation on the land that ultimately reaches streams and, eventually, the sea
solubility in water	The mass of a given substance (the solute) that can dissolve in a given volume of water
terrestrial	Relating to land, as distinct from water or air
vapour pressure	The pressure at which a liquid is in equilibrium with its vapour at a given temperature. It is a measure of the tendency of a material to vaporise. The higher the vapour pressure the greater the potential
volatile	Any substance which evaporates quickly
watercourse	A river, creek or other natural watercourse (whether modified or not) in which water is contained or flows (whether permanently or from time to time); and includes: • a dam or reservoir that collects water flowing in a watercourse • a lake or 'wetland' through which water flows • a channel into which the water of a watercourse has been diverted • part of a watercourse

Term	Description
	an estuary through which water flows.
wetland	An area of land where water covers the soil—all year or just at certain times of the year. They include: • swamps, marshes • billabongs, lakes, lagoons • saltmarshes, mudflats • mangroves, coral reefs • bogs, fens, and peatlands. A ‘wetland’ may be natural or artificial and its water may be static or flowing, fresh, brackish or saline.
wettable powder	A powder preparation to be applied as a suspension after dispersion in water

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