

**

Fenitrothion

Review Technical Report

April 2024

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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 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. It has been deliberately presented in a manner that is likely to be informative to the widest possible audience, thereby encouraging public comment.

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, which may include details 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
* efficacy and target crop or animal safety.

## Further information

Further information can be obtained via the contact details provided below. More details on the chemical review process can be found on the APVMA website: [apvma.gov.au](http://www.apvma.gov.au)

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# 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](https://www.apvma.gov.au/node/15276), [environmental impact](https://www.apvma.gov.au/node/15271), [toxicology](https://www.apvma.gov.au/node/15261), [chemistry](https://www.apvma.gov.au/node/15256) and [occupational health and safety](https://www.apvma.gov.au/node/15266)) 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.

## 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](https://www.apvma.gov.au/node/1115) and [APVMA Spray Drift Policy July 2019](https://apvma.gov.au/node/10796).

## 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

## 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.

### United States

The USEPA issued a [re-evaluation decision](https://archive.epa.gov/pesticides/reregistration/web/pdf/0445.pdf) 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.

### European Union

The authorisation for the use of fenitrothion was [withdrawn in the EU](https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32007D0379) 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.

### Canada

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

### 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.

### India

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

# Chemistry

## Active constituent

The nomenclature and structural formula of the active constituent fenitrothion are provided in Table 1.

Table 1: 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: | C9H12NO5PS |
| Molecular weight: | 277.2 gmol-1 |
| Structural formula: | Structural formula of fenitrothion |

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 2 below ([JMPR 2003](http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/JMPR/Evaluation03/fenitrothion_2003.pdf)).

Table 2: 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) |
| 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 Kow) | 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.m3mol-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 3).

Table 3: 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](https://apvma.gov.au/node/2907) (Agricultural Active Constituents Standard 2022) for fenitrothion, as excerpted in Table 4 below, and the [Food and Agriculture Organization of the United Nations (FAO) specification](https://www.fao.org/3/ca9650en/ca9650en.pdf) for fenitrothion technical material (TC) ([FAO 2010](https://www.fao.org/3/ca9650en/ca9650en.pdf)) 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 4: 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](https://www.fao.org/3/ca9650en/ca9650en.pdf)).

Figure 1: Structures of toxicologically significant impurities in fenitrothion

Structures of toxicologically significant impurities in fenitrothion: S-methyl fenitrothion (O,S-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate) 
CAS number 3344-14-7

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

Structures of toxicologically significant impurities in fenitrothion: Tetramethyl pyrophosphorothioate (TMPP)
CAS number 18764-12-0

Tetramethyl pyrophosphorothioate (TMPP), CAS number 18764-12-0

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](https://www.legislation.gov.au/F2022L00137/asmade) 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 two years under normal conditions.

## 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 5: 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 |
| Ultralow 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](https://www.fao.org/3/ca9650en/ca9650en.pdf) 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](https://www.fao.org/3/ca9650en/ca9650en.pdf)). 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 therefore recommended 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.](https://www.fao.org/3/ca9650en/ca9650en.pdf) It is further recommended that registrants 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.

## 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 6 below.
* To confirm compliance with the proposed specifications for fenitrothion chemical products as set out in Table 6, the APVMA would require product holders to provide batch results and stability data within 12 months of the final regulatory decision for the fenitrothion chemical review.

Table 6: The proposed specifications for fenitrothion chemical products

| Chemical | Formulation type | |
| --- | --- | --- |
| EC | UL |
| Fenitrothion1 | 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)-methoprene1 (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 |
| S-methyl fenitrothion2 | 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 |

1Allowable 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*](https://www.legislation.gov.au/F2022L01068/latest/text)*.*

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

# Toxicology

## 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](https://www.apvma.gov.au/node/15261) (APVMA 1999d) and an [assessment of the occupational health and safety](https://www.apvma.gov.au/node/15266) 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.

## Health based guidance values

### Acceptable daily intake

The [acceptable daily intake](https://www.apvma.gov.au/node/26596) (ADI) for fenitrothion is 0.002 mg/kg bw/day. It is based on a NOAEL of 0.2 mg/kg bw/d in a 1-year dietary study in dogs (Griggs *et al*., 1984), using a total uncertainty factor of 100.

### Acute reference dose

The [acute reference dose](https://www.apvma.gov.au/node/26591) (ARfD) of 0.03 mg/kg bw is based on a NOAEL of 0.33 mg/kg bw in a single dose study using human volunteers (Nosál M & Hladká A, 1968) using an uncertainty factor of 10.

## 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.

# Worker health and safety

## Previous assessments

In 1999, the APVMA (then the NRA) published an [interim occupational health and safety (OHS) assessment](https://www.apvma.gov.au/node/15266) 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](https://www.apvma.gov.au/node/15261) (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.

## 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 characterization 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 (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 (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](https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-exposure-seed-treatment#calc)).

The following assumptions have been used in the exposure modelling (see Table 7):

Table 7: 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 |
| 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  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:   1. Mixing, loading and application for agricultural and structural/surface treatment uses: US EPA OPHEC 2. Commercial and on-farm seed treatment uses: US EPA Seed treatment exposure calculator   Agricultural re-entry workers:  Post-application exposure: US EPA 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).

### 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 (i.e. single layer of clothing, buttoned to the neck and wrist and elbow-length chemical resistant gloves). 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](https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-exposure-seed-treatment#calc)) 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.

### 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 m2 (or to the point of runoff). In poultry sheds, 1 L of dilute spray treats 7 m2.

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. The results are presented in Table 8 below, which shows that no structural or surface treatments for grain protection are acceptable, nor is the use of fenitrothion in poultry sheds.

Table 8: 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 | MOE1 with modelled PPE2 |
| --- | --- | --- | --- |
| Backpack sprayer | Structural/surface3 | 150 L | 45 |
| Manually pressurized hand wand | Structural/surface3 | 150 L | 11 |
| Mechanically pressurized handgun | Structural/surface3 | 4,000 L | 7 |
| 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.

### Field crops

#### Ground-based application

##### Groundboom application

The basic assumptions for groundboom application to field crops is a default area treated per day of 50 hectares, as noted in Table 7. 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 600 ha in one day, or greater than 1,000 ha/day in broadacre scenarios.

The outcomes for the exposure risk assessment for the use of fenitrothion in field crops and pasture are outlined in Table 9. 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 9 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 (i.e. addition of sealed, lockable valves resulting in closed transfer of the product from its packaging to the spray tank) minimises operational exposure, but it is noted that the APVMA does not currently have evidence that use of this engineering control could be feasibly implemented and managed.

Table 9: 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 MOE1 |
| --- | --- | --- | --- | --- | --- | --- |
| 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 |
| 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 |
| 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.

##### 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 from those resulting from ground boom applications, overall MOEs are acceptable.

#### 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 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 risk estimates presented in Table 10 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 10: 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 MOE1 | Pilot MOE2 |
| --- | --- | --- | --- | --- |
| 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.

### 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 hectares, and modelling larger areas was not performed.

#### 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 (i.e. single layer of clothing buttoned to the neck and wrist and elbow-length chemical resistant gloves).

Table 11: 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 MOE1 |
| --- | --- | --- | --- | --- | --- | --- |
| 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

#### 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.

#### 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.

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

Re-entry interval modelling was performed using OPREC with the baseline assumptions in Table 7 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 (i.e. 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]](#footnote-2) 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 12 must be added to the relevant product labels and respected by re-entry workers. As set out in Table 12, 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 12: 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |
| 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 |

## First aid instructions

The existing FAISD Handbook entry for fenitrothion remains adequate and is presented in Table 13:

Table 13 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 14:

Table 14 Translation of first aid instruction (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. | |

## Safety directions

The First Aid Instructions, 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, 1280 g/L

The remainder of the safety direction entries should be deleted as they represent historical products that are no longer available for use.

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 15 should be included on product labels.

Table 15 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 16.

Table 16: 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 |
| 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 |

## Worker health and safety recommendations

The uses of fenitrothion that are not supported from a worker health and safety perspective are listed in Table 17.

Table 17: 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 supported 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 17, 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 9 to Table 12. 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 the APVMA does not currently have evidence that the use of this engineering control could be feasibly implemented and managed by industry. The feasibility of the use of closed mixing/loading systems was not further investigated, as the relevant uses were not supported in the contemporary residues and trade assessment and/or environment assessment below. The first aid instructions listed in Table 13 and the safety directions listed in Table 15 are reflective of use patterns supported by all assessment areas and should be included on all relevant product labels.

# Residues and trade

## Previous assessments

In 1999, the APVMA (then the NRA) published an [interim residues report](https://www.apvma.gov.au/node/15276) (APVMA 1999a). The APVMA also published a [draft review report](https://www.apvma.gov.au/node/15286) 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.

## 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).

## 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.

## 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.

### 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.

### 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.

### 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.

### 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.

### 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.

### 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.

### 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).

### 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.

## 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 (eg, 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.

## Spray drift (RAL)

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.

## 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.

## 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.

### 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](https://www.govinfo.gov/content/pkg/CFR-2023-title40-vol26/pdf/CFR-2023-title40-vol26-sec180-540.pdf)).

Table 18: Australian and overseas MRLs/tolerances for fenitrothion

| Commodity | Australia1 | Codex2 | EU3 | China4 | Japan5 | Korea6 | Taiwan7 |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | – | – |
| 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](https://www.legislation.gov.au/Series/F2023L01350) (Cited 28/10/2023)

2 [FAO Codex Alimentarius International Food Standards](http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/pesticide-detail/en/?p_id=37) (Cited 28/10/2023)

3 [European Commission Pesticide Residue (s) and maximum residue limits](https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/start/screen/mrls/details?lg_code=EN&pest_res_id_list=100) (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](https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Translation%20of%20Maximum%20Residue%20Limits%20for%20Pesticides%20in%20Foods_Beijing_China%20-%20People%27s%20Republic%20of_08-22-2021.pdf)  (Cited 28/10/2023)

5 [Japanese Food Chemical Research Foundation Table of MRLs for Agricultural Chemicals](http://db.ffcr.or.jp/front/pesticide_comp) (Cited 28/10/2023)

6 [Food Safety Korea Pesticide MRLs for agricultural commodities](http://www.foodsafetykorea.go.kr/residue/prd/mrls/list.do?menuKey=1&subMenuKey=161) (Cited 28/10/2023)

7 [Food and Drug Administration Taiwan Standards for Pesticide Residue Limits in Foods](https://consumer.fda.gov.tw/Law/Detail.aspx?nodeID=518&lang=1&lawid=127) (Cited 28/10/2023)

### 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](http://www.graintrade.org.au/sites/default/files/Outturn%20Tolerances%20202021%20Final.pdf), 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 seeks comments from members of the grain industry on their ability to manage the risk to international trade associated with fenitrothion through this consultation, before a final decision against the trade criteria is made for uses on stored cereal grain.

## Residues and trade recommendations

The outcomes of the residues and trade assessment of fenitrothion is summarised in Table 19. 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, 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 19: Summary of residue assessment outcomes for fenitrothion use patterns

| Use pattern | Use supported | Outcomes of the residues assessment |
| --- | --- | --- |
| Stored cereal grains 6ppm | 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 6ppm 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.* |
| Stored cereal grains 12ppm | 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 three application per season to cereals’* |
| Sitona weevil in lucerne fodder and forage | Yes | Add restraint: *‘DO NOT apply more than one application per year to lucerne’* |
| Locust and grasshopper pest in pasture and pasture seed crops | Yes | Add restraint: *‘DO NOT apply more than three 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 is also supported by the environmental and human health risk assessments. As such, the following trade advice statement is recommended on product labels (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.

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

Table 20 to Table 22 include the recommended MRL changes in the [Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023](https://www.legislation.gov.au/F2023L01350/latest/text)(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 and human health risk assessments have not supported the use of fenitrothion except for uses in stored cereal grains. It is noted that the residues assessment also supported field use in cereal grains, 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 use.

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 for 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 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. With the removal of pasture and forages, 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. Despite the reduction in the animal dietary burden for mammalian livestock, the MRL recommendations made above for animal commodities remains appropriate because finite residues are not expected in mammalian tissues and milk from the higher feeding burden and because the maximum feeding burden for poultry will remain unchanged.

As the field use in cereal crops, 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 cereal and lucerne forage or fodder, or pasture. Therefore, the existing MRLs in Table 4 will be deleted. A 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 20: Amendments to Table 1 of the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023

| Code | | Commodity | MRL (mg/kg) | |
| --- | --- | --- | --- | --- |
| DELETE | ADD |
| FP | 0226 | Apple | 1 | – |
| VB | 0041 | Cabbages, head | 0.5 | – |
| FS | 0013 | Cherries | 1 | – |
| MO | 0105 | Edible offal (mammalian) | T\*0.05 | \*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 |
| PM | 0110 | Poultry meat [in the fat] # | \*0.05 | \*0.05 |
| CM | 01206 | Rice bran, unprocessed | T20 | 20 |
| VO | 0448 | Tomato | 0.5 | – |

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

Table 21: Amendments to Table 4 of the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023

| Code | | Commodity | MRL (mg/kg) | |
| --- | --- | --- | --- | --- |
| DELETE | ADD |
| AL | 1020 | Alfalfa [lucerne] fodder | T5 | – |
| AL | 1021 | Alfalfa [lucerne] forage (green) | T5 | – |
| 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 22: 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 |

# Environmental safety

## Previous assessments

In 1999, an [interim environmental assessment report](https://www.apvma.gov.au/sites/default/files/publication/15271-fenitrothion-interim-report-env.pdf) 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.

## 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. Three applications possible per season at the 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 in under ‘Environment recommendations’.

The environmental risk assessment scenarios considered in the current assessment are summarised in Table 23. Environmental risks were determined according to contemporary methodology outlined in the [APVMA Risk Assessment Manual – Environment](https://apvma.gov.au/node/46416). Additional data available since the initial 1999 assessment have also been considered.

Table 23: 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 |

## 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 24. A full listing of endpoints is provided in Appendix B.

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 DT50 values for foliar residues ranged from 0.50 to 20 days (geomean 3.2 days); mean DT50 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 DT50 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 DT50 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.

Table 24: Key regulatory endpoints for exposure assessment

| Compartment | Value | Reference |
| --- | --- | --- |
| Animal food items | Foliage: DT50 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: DT50 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: DT50 10 d | Default |
| Soil | DT50 1.1 d | Cranor & Daly 1989, Yeomans & Swales 2001 |
| (Runoff assessment)  (Food chain assessment) | Kf 4.9 mL/g, 1/n 0.95  Kf 17 mL/g | Spillner & Neuberger 1979 |
| Water | DT50 1.6 d | Swales 2001 |
| Sediment | DT50 1.6 d | Swales 2001 |
| Kp 42 mL/g | Spillner & Neuberger 1979 |
| Air | DT50 0.23 d | Nishiyama et al. 2000 |

## 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 25. A full listing of endpoints is provided in Appendix B.

Fenitrothion has moderate toxicity to mammals (LD50 330 mg ac/kg bw, *Rattus norvegicus*) and high toxicity to birds (geomean LD50 45 mg ac/kg bw, three sensitive species) following a single oral dose. Fenitrothion also has high toxicity to birds following short-term dietary exposure (lowest LDD50 68 mg ac/kg bw/d, *Colinus virginianus*). 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]](#footnote-3)

Toxic to birds.

For acute toxicity to birds, the geomean LD50/10 (4.5 mg ac/kg bw) is lower than the lowest LD50 value (23 mg ac/kg bw); therefore, the higher tier RAL can be used for risk assessment (EFSA 2009, 2023).

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 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. 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.

The APVMA is also aware of literature investigating cholinesterase activity and residues in tissues. However, there is currently no clear method for linking these types of observations to field effects. Therefore, such studies have not been considered in depth here nor used to set endpoints for use in risk assessment.

Fenitrothion has moderate toxicity to fish (lowest LC50 1.3 mg ac/L, *Oncorhynchus mykiss*) and algae (ErC50 2.7 mg ac/L, *Pseudorkirchneriella subcapitata*), and high toxicity to aquatic invertebrates (lowest LC50 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 CT95 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 CT95 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 (DT50 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.

The RAL established for the aquatic risk assessment is based on an SSD (BurrliOz v2.0) of acute aquatic invertebrate data. The SSD (see **Error! Reference source not found.**) showed the lower limit HC5 derived from the curve (0.18 µg ac/L) to be less than 1/3 of the median HC5 (0.57 µg ac/L). Additionally, the lower tail 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 HC5 resulting in a RAL of 0.095 µg ac/L.

Fenitrothion has high toxicity to adult bees by contact exposure (LD50 0.16 µg ac/bee, *Apis mellifera*) and oral exposure (LD50 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]](#footnote-4)

Toxic to bees.

For the spray drift assessment, the RAL is 27 g ac/ha based on the contact LD50 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](https://www.apvma.gov.au/registrations-and-permits/data-guidelines/risk-assessment-manuals/sdram) (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]](#footnote-5)

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 Australian plague 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 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 (LC50corr 116 mg ac/kg dry soil, *Eisenia fetida*), the metabolite NMC is also moderately toxic (LC50corr 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.

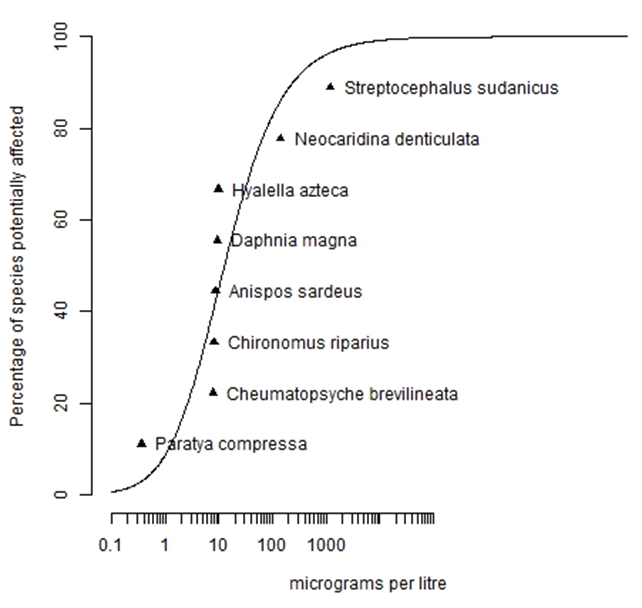
The toxicity of a 40% WP formulation to 6 species of non-target terrestrial plants has been tested following post-emergent exposure in a screening test. All ER25 values are >1,000 g ac/ha. Fenitrothion does not show any fungicidal activity against 7 test diseases (Oguri 2001).

Normal agricultural practice was 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 25: Regulatory acceptable levels for non-target species

| Group | Exposure | Endpoint | AF | RAL | Reference |
| --- | --- | --- | --- | --- | --- |
| Mammals | Acute | LD50 330 mg ac/kg bw | 10 | 33 mg ac/kg bw | Kadota et al. 1972 |
| Chronic | NOEL 2.3 mg ac/kg bw/d | 1 | 2.3 mg ac/kg bw/d | Hoberman 1990 |
| Birds | Acute | LD50 45 mg ac/kg bw | 10 | 4.5 mg ac/kg bw | Fletcher 1971, Grimes & Jaber 1988a, Kadota et al. 1974 |
| Chronic | NOEL 2.3 mg ac/kg bw/d | 1 | 2.3 mg ac/kg bw/d | Beavers et al. 1991 |
| Aquatic species | Acute | HC5 0.57 µg ac/L | 6 | 0.095 µg ac/L | Burke 2011, Burke & Flenley 2011, Burke & Scholey 2011a, Forbis 1987, Lahr et al. 2001, Matsumoto et al. 2009, Shigehisa & Shiraishi 1998, Yokoyama et al. 2009 |
| Adult bees | Acute contact | LD50 0.16 µg ac/bee | 2.5 | 0.064 µg ac/bee | Hoberg 2001 |
| Acute oral | LD50 0.20 µg ac/bee | 2.5 | 0.080 µg ac/bee | Hoberg 2001 |
| Soil macro-organisms | Acute | LC50corr 116 mg ac/kg ds | 10 | 12 mg ac/kg ds | Ellgehausen et al. 1985 |
| Soil micro-organisms | Chronic | NOEC 10 mg ac/kg ds | 1 | 10 mg ac/kg ds | Mikami et al. 1984 |
| Terrestrial plants | Post-emergent | ER25 >1000 g ac/ha | 2 | 500 g ac/ha | Mito 2001 |

Figure 2: Acute aquatic invertebrate species sensitivity distribution



## Risks to non-target species

### Terrestrial vertebrates

For outdoor uses of fenitrothion, risks to terrestrial vertebrates following dietary exposure to contaminated food items were determined by the APVMA as indicated in Appendix C. No outcomes were identified as acceptable for birds (Table 26). The maximum seasonal rate supported for each use pattern is below the lowest label rate for any situation in any of the currently registered fenitrothion products.

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 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 (Table 27). A maximum seasonal rate of 924 g ac/ha was determined to be acceptable to earthworm-eating mammals. After considering potential exposure rates over a 10-hectare area (see Table D1 in Appendix D), any accumulated residues in earthworms will not reach levels harmful to predators.

Table 26: Summary of risk assessment outcomes for terrestrial vertebrates

| Use pattern | Situation | Application rate and frequency | Wild mammal assessment | Bird assessment | Max seasonal rate supported |
| --- | --- | --- | --- | --- | --- |
| Field crops and pasture | Cereals | 3× 550 g ac/ha 14d interval | Acceptable risk | **Not supported** | 78 g ac/ha |
| Soybeans, forage crops | 3× 550 g ac/ha 14d interval | Not acceptable at BBCH 40–49 | **Not supported** | 81 g ac/ha |
| Lucerne | 3× 650 g ac/ha 7d interval | Not acceptable at BBCH 40–49 | **Not supported** | 81 g ac/ha |
| Pasture, pasture seed crops | 1× 1,300 g ac/ha | **Not supported** | **Not supported** | 148 g ac/ha |
| Tree and vine crops | Apples, cherries | 3× 550 g ac/ha 14d interval | Not acceptable up to BBCH 19 | **Not supported** | 96 g ac/ha |
| Grapes | 3× 550 g ac/ha 14d interval | Not acceptable up to BBCH 19 | **Not supported** | 156 g ac/ha |
| Vegetable crops | Tomatoes | 3× 550 g ac/ha 14d interval | Not acceptable at BBCH 10–49 or during fruiting | **Not supported** | 78 g ac/ha |
| Lettuce, cabbage | 3× 550 g ac/ha 14d interval | Not acceptable at BBCH 40–49 | **Not supported** | 50 g ac/ha |

Table 27: 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 | Mammals | 0.142 | 0.000095 | 0.00039 | 2.3 | <0.01 |
| Birds | 0.159 | 0.000095 | 0.00044 | 2.3 | <0.01 |

Shortcut values from EFSA (2009)

PECmedium is:

PECsoil = predicted environmental concentration in soil (mg/kg) = 924 g ac/ha (maximum acceptable seasonal rate to achieve RQ 1.0) /750

PECwater = aquatic RAL (from Table 25)

PECfood = PECmedium \* BCF, where:

BCFearthworm is 1.5 based on [0.84 + 0.012 \* 10^(log Pow 3.3)] / Kf 17 (from Table X)

BCFfish is 29 (Oshima et al. 1988)

DDD = daily dietary dose (mg/kg bw/d) = shortcut value \* PECfood

RAL = regulatory acceptable level (from Table 25)

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

### Aquatic species

For outdoor uses of fenitrothion, runoff risks to aquatic species were determined by the APVMA as indicated in Appendix D. Risks were determined to be acceptable with some restraints required in certain situations. The summary of the runoff assessment outcomes for each use pattern is reported in Table 28. In addition, because the assessment assumes a runoff event occurs 3 days after application, the following restraint is required for fenitrothion product labels that have outdoor uses.[[5]](#footnote-6)

DO NOT apply if heavy rains or storms are forecast within 3 days.

DO NOT irrigate to the point of runoff for at least 3 days after application.

As indicated in Table 25, 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](#_Spray_drift) section, as needed.

Table 28: Fenitrothion – summary of runoff risk assessment outcomes

| Use pattern | Situation | Application rate and frequency | Runoff assessment outcome |
| --- | --- | --- | --- |
| Field crops and pasture | Cereals | 3× 550 g ac/ha 14d interval | Acceptable risk |
| Forage crops | 3× 550 g ac/ha 14d interval | Restrictions required:  Victoria: DO NOT apply from September to May  South Australia: DO NOT apply from September to May  Western Australia: DO NOT apply from December to February |
| Soybeans | 3× 550 g ac/ha 14d interval | Restrictions required:  Victoria: DO NOT apply from December to February  Burdekin: DO NOT apply in October  Mackay/Whitsunday: DO NOT apply from August to December |
| Lucerne | 3× 650 g ac/ha 7d interval | Restrictions required:  DO NOT apply in Victoria  South Australia: DO NOT apply from September to May  Western Australia: DO NOT apply from September to May |
| Pasture, pasture seed crops | 1× 1,300 g ac/ha | Restrictions required:  Victoria: DO NOT apply from September to May  South Australia: DO NOT apply from September to May  Western Australia: DO NOT apply from December to February |
| Tree & vine crops | Apples, cherries | 3× 550 g ac/ha 14d interval | Acceptable risk |
| Grapes | 3× 550 g ac/ha 14d interval | Restrictions required:  Mackay/Whitsunday: DO NOT apply from October to November unless there is pasture inter-row |
| Vegetable crops | Tomatoes | 3× 550 g ac/ha 14d interval | Restrictions required:  Mackay/Whitsunday: DO NOT apply from August to December |
| Lettuce, cabbage | 3× 550 g ac/ha 14d interval | Restrictions required:  Victoria: DO NOT apply from December to February  Burdekin: DO NOT apply in October  Mackay/Whitsunday: DO NOT apply from August to December |

### Bees

Risks to bees are assessed using a tiered approach. A screening level risk assessment assumes the worst-case scenario of a direct overspray of blooming plants that are frequented by bees in order to identify those substances and associated uses that do not pose a risk. Acceptable risks to foraging bees could not be concluded at the lowest application rate of 250 g ac/ha (Table 29). No higher tier information is available and therefore the following protection statement is advised for all outdoor uses of fenitrothion products. [[6]](#footnote-7)

Toxic to bees. DO NOT apply to crops from the onset of flowering until flowering is complete. 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.

As indicated in Table 25, the RAL for the spray drift assessment is 27 g ac/ha for the protection of pollinator areas. Risks of spray drift are assessed separately in the [Spray drift](#_Spray_drift) section, as needed.

Table 29: Screening level assessment of risks to bees

| Life stage | Exposure | Rate (g/ha) | Predicted total dose (µg/bee) | RAL (µg/bee) | RQ |
| --- | --- | --- | --- | --- | --- |
| Highest single rate | | | | | |
| Adults | Acute contact | 1 300 | 3.1 | 0.064 | 49 |
| Acute oral | 1 300 | 37 | 0.080 | 465 |
| Lowest single rate | | | | | |
| Adults | Acute contact | 250 | 0.60 | 0.064 | 9.4 |
| Acute oral | 250 | 7.2 | 0.080 | 89 |

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 25)

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

### 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. [[7]](#footnote-8)

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.

### 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 30). 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 30: Screening level assessment of risks to soil organisms

| Group | Exposure | Rate (g/ha) | PEC (mg/kg dry soil) | RAL (mg/kg dry soil) | RQ |
| --- | --- | --- | --- | --- | --- |
| Macro-organisms | Acute | 1 300 | 1.7 | 12 | 0.14 |
| Micro-organisms | Chronic | 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 25)

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

### Terrestrial plants

As indicated in Table 25, 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](#_Spray_drift) section, as needed.

## Recommendations

Uses supported from the viewpoint of environmental safety are listed in Table 31 with the required protection statements and restraints. Uses that are not supported from the viewpoint of environmental safety are listed in Table 32.

Table 31: 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. |

Table 32: Uses not supported from the viewpoint of environmental safety

| Situation | Basis |
| --- | --- |
| Pasture and pasture seed crops | Unacceptable risk to birds and wild mammals |
| Cereals, soybeans, forage crops, lucerne | Unacceptable risk to birds |
| Apples, cherries, grapes |
| Tomatoes, lettuce, cabbage |

# Efficacy and target safety

## 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 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.

## 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.

# Spray drift

The APVMA’s approach to spray drift management set out in the [APVMA Spray Drift Policy July 2019](https://apvma.gov.au/node/10796) 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 33, which is the maximum amount of spray drift exposure that is not expected to cause undue harm to sensitive areas.

Table 33: 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.

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. Therefore, no spray drift restraints are required for uses of fenitrothion supported by the worker health and safety, residues, trade and environment risk assessments.



Appendix

Appendix A – summary of assessment outcomes

Table 34: Fenitrothion uses supported by all risk assessments

| Crop/host | Pest | Rate | Amended instructions for use\* |
| --- | --- | --- | --- |
| Post-harvest uses | | | |
| Stored cereal grains including malting barley | Stored grain insect pests (excluding *Sitophilus* spp.) | 6 g ac/L  (6 g ac/tonne) 6ppm: 3 months protection  Fenitrothion and S-methoprene combination product | **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. |
| Stored Cereal (uninfested wheat, barley, oats, rice, sorghum and millet) | Stored grain insect pests (excluding lesser grain borer) | 6 g ac/L  (6 g ac/tonne) 6ppm: 3 months protection | **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. |
| 12 g ac/L  12 g ac/tonne grain  12ppm: 6 months protection | **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. |
| 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. |

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

Table 35: 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 m2 | 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 m2 | 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 70m2 | Not supported – safety (worker health and safety concerns) |
| Field crops | | | |
| Pasture, pasture seed crops, forage crops including grazing sorghum, lucerne, cereal 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 |
| 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 |
| 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 |
| 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 B – listing of environmental endpoints

Table B1: 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 m3 mol-1 | | | Okada 2001 |
| Solubility in water | 19 mg/L at 20°C | | | Concha 2000 |
| Partition coefficient | log Pow 3.3 | | | Shepler & Schick 2002 |
| Dissociation constant | No dissociable moieties | | |
| UV-VIS absorption (max) | solution  acidic  neutral  basic  basic | λmax  268 nm  267 nm  264 nm  393 nm | ε (L/mol/cm)  6920  6950  4860  10600 | Yoshida 2000 |

Table B2: Dissipation in animal food items

| Substance | Matrix | Result | Reference |
| --- | --- | --- | --- |
| Fenitrothion | Leaves | White spruce: DT50 20 d | Sundaram 1986 |
| Spruce: DT50 7.9 d  Maize: DT50 3.0 d  Bermuda grass: DT50 2.6 d  Apple: DT50 1.6 d | Willis & McDowell 1987 |
| Cabbage: DT50 6.6 d | Hu et al. 2009 |
| Parsley: DT50 4.1 d  Rocket: DT50 4.0 d | Bahaffi et al. 2005 |
| Grape: DT50 2.5 d | Likas & Tsiropoulos 2007 |
| Pasture: DT50 1.5 d | Gilmour et al. 1999 |
| Tea: DT50 0.50 d | Zongmao & Haibin 1997 |
| Geomean DT50 3.2 d |
| Fruit | Persimmon: DT50 8.3 d | Fernández-Cruz et al. 2004 |
| Apricot: DT50 6.9 d | Cabras et al. 1997 |
| Pear: DT50 6.7 d | Passarella et al. 2009 |
| Fig: DT50 5.6 d  Grape: DT50 2.9 d | Bahaffi et al. 2005 |
| Rice: DT50 4.5 d | Ishii 2004 |
| Grape: DT50 3.8 d | Cabras & Angioni 2000 |
| Tomato: DT50 2.2 d | Malhat et al. 2017 |
| Geomean DT50 4.7 d |

Table B3: Fate and behaviour in soil

| Study | Substance | Result | Reference |
| --- | --- | --- | --- |
| Soil photolysis | Fenitrothion | DT50 85 d (irradiated)  DT50 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: DT50 2.4 d | Cranor & Daly 1989 |
| Sandy loam: DT50 0.62 d  Sandy loam: DT50 1.4 d  Clay loam: DT50 0.74 d  Clay loam: DT50 0.85 d | Yeomans & Swales 2001 |
| Geomean DT50 1.1 d |
| 23–54% mineralisation after 90–122 d  26–70% bound residues after 90–122 d  Max 44% NMC |
| NMC | Sandy loam: DT50 3.3 d | Cranor & Daly 1989, Kodaka et al. 2000 |
| Sandy loam: DT50 2.8 d  Sandy loam: DT50 3.1 d  Clay loam: DT50 3.3 d  Clay loam: DT50 3.0 d | Yeomans & Swales 2001 |
| Geomean DT50 3.1 d |
| Anaerobic laboratory soil | Fenitrothion | Sandy loam DT50 0.80 d  0.1% mineralisation after 122 d  79% bound residues after 122 d | Cranor & Daly 1990, Kodaka et al. 2000 |
| Max 14% NMC, DT50 1.2 d  Max 11% AM-FNT, DT50 16 d  Max 10% AA-FNT, DT50 50 d |
| 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 | Spillner & Neuberger 1979 |
| Mean Kf 17 mL/g, Koc 497 mL/g, 1/n 0.95 (excluding sediment) |
| 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 | Lewis 2001 |
| Mean Kf 5.9 mL/g, Koc 285 mL/g, 1/n 0.76 |

Table B4: Fate and behaviour in water and sediment

| Study | Substance | Result | Reference |
| --- | --- | --- | --- |
| Hydrolysis | Fenitrothion | pH 5, 25°C: DT50 196 d, max 10% DM-FNT  pH 7, 25°C: DT50 183 d, no major degradates  pH 9, 25°C: DT50 101 d, max 15% NMC | Ito et al. 1988 |
| Aqueous photolysis | Fenitrothion | DT50 3.5 d (irradiated)  DT50 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  DT50 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 DT50 0.88 d  Emperor Lake: water DT50 1.3 d  Geomean DT50 1.1 d | Swales 2001 |
| Millstream Pond: sediment DT50 1.1 d |
| Millstream Pond: system DT50 1.6 d  Emperor Lake: system DT50 1.6 d  Geomean DT50 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) |

Table B5: Fate and behaviour in air

| Study | Substance | Result | Reference |
| --- | --- | --- | --- |
| Photochemical oxidative degradation | Fenitrothion | DT50 0.23 d | Nishiyama et al. 2000 |

Table B6: Laboratory studies on terrestrial vertebrates

| Test substance | Group | Exposure | Species | Toxicity value | Reference |
| --- | --- | --- | --- | --- | --- |
| Fenitrothion | Mammals | Acute | *Rattus norvegicus* | LD50 330 mg ac/kg bw | Kadota et al. 1972 |
| LD50 >300 mg ac/kg bw | Moon 2010 |
| Chronic | *Rattus norvegicus* | NOEL 2.3 mg ac/kg bw/d | Hoberman 1990 |
| Birds | Acute | *Colinus virginianus* | LD50 23 mg ac/kg bw | Grimes & Jaber 1988a |
| *Phasianus colcicus* | LD50 35 mg ac/kg bw | Fletcher 1971 |
| *Coturnix japonica* | LD50 115 mg ac/kg bw | Kadota et al. 1974 |
| *Anas platyrhynchos* | LD50 >244 mg ac/kg bw | Grimes & Jaber 1988b |
| Geomean LD50 45 mg ac/kg bw (3 species) | |
| Dietary | *Colinus virginianus* | LDD50 68 mg ac/kg bw/d | Grimes & Jaber 1988c |
| *Anas platyrhynchos* | LDD50 601 mg ac/kg bw/d | Grimes & Jaber 1988d |
| 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 |

Table B7: Field studies on terrestrial vertebrates

| Test substance | Crop | Exposure | Effect | Reference |
| --- | --- | --- | --- | --- |
| Fenitrothion | 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 |

Table B8: Laboratory studies on aquatic species

| Substance | Group | Exposure | Species | Toxicity value | Reference |
| --- | --- | --- | --- | --- | --- |
| Fenitrothion | Fish | Acute | *Oncorhynchus mykiss* | LC50 1.3 mg ac/L | Swigert 1987a |
| *Pseudorasbora parva* | LC50 2.3 mg ac/L | Kagoshima et al. 1974 |
| *Lepomis macrochirus* | LC50 2.5 mg ac/L | Swigert 1987b |
| *Cyprinus carpio* | LC50 4.1 mg ac/L | Kagoshima et al. 1974 |
| Chronic | *Oncorhynchus mykiss* | NOEC 0.088 mg ac/L | Cohle 1988 |
| Invertebrates | Acute | *Paratya compressa* | LC50 0.00036 mg ac/L | Shigehisa & Shiraishi 1998 |
| *Cheumatopsyche brevilineata* | EC50 0.0078 mg ac/L | Yokoyama et al. 2009 |
| *Chironomus riparius* | LC50 0.0081 mg ac/L | Burke & Flenley 2011 |
| *Anisops sardeus* | LC50 0.0086 mg ac/L | Lahr et al. 2001 |
| *Daphnia magna* | EC50 0.0086 mg ac/L | Forbis 1987 |
| EC50 0.010 mg ac/L | Matsumoto et al. 2009 |
| Geomean EC50 0.0093 mg ac/L | |  |
| *Hyalella azteca* | LC50 0.0097 mg ac/L | Burke & Scholey 2011a |
| *Neocaridina denticulata* | LC50 0.14 mg ac/L | Burke 2011 |
| *Streptocephalus sudanicus* | EC50 1.2 mg ac/L | Lahr et al. 2001 |
| Chronic | *Daphnia magna* | NOEC 0.000087 mg ac/L | Burgess 1988 |
| Algae | Chronic | *Pseudokirchneriella*  *subcapitata* | ErC50 2.7 mg ac/L | Burke & Scholey 2011b |
| NMC | Invertebrates | Acute | *Daphnia magna* | EC50 18 mg/L | Putt 2001 |
| AM-FNT | Invertebrates | Acute | *Daphnia magna* | EC50 5.9 mg/L | Gries 2002 |

Table B9: Field studies on aquatic species

| Test substance | Crop | Exposure | Effect | Reference |
| --- | --- | --- | --- | --- |
| EC 500 g/L | 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 |

Table B10: Effects on bees

| Test substance | Species | Life stage | Exposure | Toxicity value | Reference |
| --- | --- | --- | --- | --- | --- |
| Fenitrothion | *Apis mellifera* | Adult | Acute contact | LD50 0.16 µg ac/bee | Hoberg 2001 |
| Acute oral | LD50 0.20 µg ac/bee | Hoberg 2001 |

Table B11: 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 B12: Laboratory studies on soil organisms

| Substance | Group | Exposure | Species/process | Toxicity value | Reference |
| --- | --- | --- | --- | --- | --- |
| Fenitrothion | Macro-organisms | Acute | *Eisenia fetida* | LC50corr 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* | LC50corr 18 mg/kg dry soil | Teixeira 2001 |

Table B13: 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 B14: Effects on non-target terrestrial plants (post-emergent exposure)

| Test substance | Species | ER25 | ER50 | 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 C – terrestrial vertebrate assessments

Risks to terrestrial vertebrates following dietary exposure to contaminated food items are assessed using a tiered approach. Long-term exposure of mammals was determined to be higher risk than acute exposure, while acute exposure of birds was determined to be higher than long-term exposure. Therefore, the assessment in this Appendix focuses only on the long-term risks to wild mammals and acute risks to birds.

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 (Table C1). 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.

Long-term risks to wild mammals are summarised in Table C2; acute risks to birds are summarised in Table C3.

Table C1: Seasonal exposure estimates for fenitrothion in animal food items

| Use pattern | EFSA 2009 crop group | Situation | Application rate and frequency | Seasonal exposure rate (g/ha) | | |
| --- | --- | --- | --- | --- | --- | --- |
| Foliage (DT50 3.2 d) | Fruit (DT50 4.7 d) | Other items (DT50 10 d) |
| Field crops and pasture | Cereals | Cereals | 3× 550 g ac/ha  14d interval | 578 | n/a | 837 |
| Pulses | Soybeans | 3× 550 g ac/ha  14d interval | 578 | n/a | 837 |
| Legume forage | Forage crops | 3× 550 g ac/ha  14d interval | 578 | n/a | 837 |
| Lucerne | 3× 650 g ac/ha  7d interval | 824 | n/a | 964 |
| Grassland | Pasture, pasture seed crops | 1× 1300 g ac/ha | 1300 | n/a | 1300 |
| Tree and vine crops | Orchards | Apples, cherries | 3× 550 g ac/ha  14d interval | 578 | 629 | 837 |
| Vineyards | Grapes | 3× 550 g ac/ha  14d interval | 578 | 629 | 837 |
| Vegetable crops | Fruiting vegetables | Tomatoes | 3× 550 g ac/ha  14d interval | 578 | 629 | 837 |
| Leafy vegetables | Lettuce, cabbage | 3× 550 g ac/ha  14d interval | 578 | n/a | 837 |

Seasonal exposure rates based on indicated application rate, frequency, and DT50

Table C2: Long-term risks of fenitrothion to wild mammals (RAL 2.3 mg/kg bw/d)

| Crop group | Generic focal species | Crop stage | Shortcut  value | Exposure rate  (g/ha) | DDD (mg/kg bw/d) | RQ |
| --- | --- | --- | --- | --- | --- | --- |
| Cereals | | | | | | |
| Cereals | Large herbivore | Early (shoots) | 22.3 | 578 | 1.4 | **0.61** |
| Small omnivore | BBCH 10–29  BBCH 30–39  BBCH ≥40 | 7.8  3.9  2.3 | 837  837  837 | 1.7  0.86  0.41 | **0.75**  **0.37**  **0.22** |
| Small herbivore | BBCH ≥40 | 21.7 | 578 | 1.4 | **0.59** |
| Small insectivore | BBCH 10–19  BBCH ≥20 | 4.2  1.9 | 837  837 | 0.93  0.42 | **0.40**  **0.18** |
| Soybeans | | | | | | |
| Pulses | Small insectivore | BBCH 10–19  BBCH ≥20 | 4.2  1.9 | 837  837 | 0.93  0.42 | **0.40**  **0.18** |
| Small herbivore | BBCH 40–49  BBCH ≥50 | 72.3  21.7 | 578  578 | 4.5  1.4 | **2.0**  **0.59** |
| Large herbivore | BBCH 10–49  BBCH ≥50 | 14.3  4.3 | 578  578 | 0.90  0.27 | **0.39**  **0.12** |
| Small omnivore | BBCH 10–49  BBCH 50–80  BBCH 81–99 | 7.8  2.3  6.6 | 837  837  837 | 1.7  0.41  1.5 | **0.75**  **0.22**  **0.63** |
| Forage crops, lucerne | | | | | | |
| Legume forage | Small insectivore | BBCH 10–19  BBCH ≥20 | 4.2  1.9 | 964  964 | 1.1  0.48 | **0.46**  **0.21** |
| Small herbivore | BBCH 40–49  BBCH ≥50 | 72.3  21.7 | 578  824 | 4.5  1.9 | **2.0**  **0.85** |
| Large herbivore | BBCH 21–49 | 14.3 | 824 | 1.3 | **0.56** |
| Small omnivore | BBCH 10–49  BBCH ≥50 | 7.8  2.3 | 964  964 | 2.0  0.58 | **0.86**  **0.25** |
| Pasture, pasture seed crops | | | | | | |
| Grassland | Small omnivore | Early or late season | 6.6 | 1 300 | 2.3 | **0.98** |
| Large herbivore | All season | 17.3 | 1 300 | 2.4 | **1.1** |
| Small herbivore | All season | 72.3 | 1 300 | 10 | **4.4** |
| Small insectivore | Late season | 1.9 | 1 300 | 0.65 | **0.28** |
| Apples, cherries | | | | | | |
| Orchards | Large herbivore | BBCH <10  BBCH 10–19  BBCH 20–39  BBCH ≥40 | 11.1  6.7  5.5  3.3 | 578  578  578  578 | 0.70  0.42  0.35  0.21 | **0.30**  **0.18**  **0.15**  **0.09** |
| Small insectivore | BBCH 10–19  BBCH ≥20 | 4.2  1.9 | 837  837 | 0.93  0.42 | **0.40**  **0.18** |
| Small herbivore | BBCH <10  BBCH 10–19  BBCH 20–39  BBCH ≥40 | 72.3  43.4  36.1  21.7 | 578  578  578  578 | 4.5  2.7  2.3  1.4 | **2.0**  **1.2**  **0.99**  **0.59** |
| Small omnivore | BBCH <10  BBCH 10–19  BBCH 20–39  BBCH ≥40 | 7.8  4.7  3.9  2.3 | 837  837  837  837 | 1.7  1.0  0.86  0.41 | **0.75**  **0.45**  **0.37**  **0.22** |
| Frugivore | BBCH 71–79 | 22.7 | 629 | 2.2 | **0.96** |
| Grapes | | | | | | |
| Vineyards | Large herbivore | BBCH <10  BBCH 10–19  BBCH 20–39  BBCH ≥40 | 11.1  6.7  5.5  3.3 | 578  578  578  578 | 0.70  0.42  0.35  0.21 | **0.30**  **0.18**  **0.15**  **0.09** |
| Small insectivore | BBCH 10–19  BBCH ≥20 | 4.2  1.9 | 837  837 | 0.93  0.42 | **0.40**  **0.18** |
| Small herbivore | BBCH <10  BBCH 10–19  BBCH 20–39  BBCH ≥40 | 72.3  43.4  36.1  21.7 | 578  578  578  578 | 4.5  2.7  2.3  1.4 | **2.0**  **1.2**  **0.99**  **0.59** |
| Small omnivore | BBCH <10  BBCH 10–19  BBCH 20–39  BBCH ≥40 | 7.8  4.7  3.9  2.3 | 837  837  837  837 | 1.7  1.0  0.86  0.41 | **0.75**  **0.45**  **0.37**  **0.22** |
| Tomatoes | | | | | | |
| Fruiting vegetables | Small insectivore | BBCH 10–19  BBCH ≥20 | 4.2  1.9 | 837  837 | 0.93  0.42 | **0.40**  **0.18** |
| Small herbivore | BBCH 10–49  BBCH ≥50 | 72.3  21.7 | 578  578 | 4.5  1.4 | **2.0**  **0.59** |
| Small omnivore | BBCH 10–49  BBCH ≥50 | 7.8  2.3 | 837  837 | 1.7  0.51 | **0.75**  **0.22** |
| Frugivore | BBCH 71–89 | 25.2 | 629 | 2.4 | **1.1** |
| Lettuce, cabbage | | | | | | |
| Leafy vegetables | Small insectivore | BBCH 10–19  BBCH ≥20 | 4.2  1.9 | 837  837 | 0.93  0.42 | **0.40**  **0.18** |
| Small herbivore | BBCH 40–49  BBCH ≥50 | 72.3  21.7 | 578  578 | 4.5  1.4 | **2.0**  **0.59** |
| Large herbivore | All season | 14.3 | 578 | 0.90 | **0.39** |
| Small omnivore | BBCH 10-49  BBCH ≥50 | 7.8  2.3 | 837  837 | 1.7  0.51 | **0.75**  **0.22** |

Crop groups as indicated in Table C1; generic focal species and shortcut values for indicated crop groups from EFSA (2009)

Seasonal exposure rates selected from Table A1 for the indicated crop groups represent worst-case scenario (if acceptable) or best-case scenario (if not acceptable)

DDD = daily dietary dose (mg/kg bw/d) = shortcut value \* rate (kg ac/ha) \* PT 0.5 \* TWA 0.22 (herbivores) or 0.31 (frugivores) or 0.53 (other)

RAL = regulatory acceptable level = NOEL 2.3 mg/kg bw/d (Hoberman 1990)

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

Table C3: Acute risks of fenitrothion to birds (RAL 4.5 mg/kg bw/d)

| Crop group | Generic focal species | Crop stage | Shortcut value | Exposure rate (g/ha) | DDD (mg/kg bw/d) | RQ |
| --- | --- | --- | --- | --- | --- | --- |
| Cereals | | | | | | |
| Cereals | Large herbivore | BBCH 10–29 | 30.5 | 578 | 18 | **3.9** |
| Small omnivore | BBCH 10–29  BBCH 30–39  BBCH ≥40 | 24.0  12.0  7.2 | 837  837  837 | 20  10  6.0 | **4.5**  **2.2**  **1.3** |
| Small insectivore | BBCH 71–89 | 57.6 | 837 | 48 | **11** |
| Small granivore/insectivore | Late season | 27.0 | 837 | 23 | **5.0** |
| Soybeans | | | | | | |
| Pulses | Small granivore | BBCH 10–49  BBCH ≥50 | 24.7  7.4 | 837  837 | 21  6.2 | **4.6**  **1.4** |
| Small omnivore | BBCH 10–49  BBCH ≥50 | 24.0  7.2 | 837  837 | 20  6.0 | **4.5**  **1.3** |
| Medium herbivore/granivore | BBCH 10–19 | 55.6 | 837 | 47 | **10** |
| Small insectivore | BBCH 10–19  BBCH ≥50 | 26.8  25.2 | 837  837 | 22  21 | **5.0**  **4.7** |
| Forage crops, lucerne | | | | | | |
| Legume forage | Small granivore | BBCH 10–49  BBCH ≥50 | 24.7  7.4 | 837  837 | 21  6.2 | **4.6**  **1.4** |
| Small omnivore | BBCH 10–49  BBCH ≥50 | 24.0  7.2 | 837  837 | 20  6.0 | **4.5**  **1.3** |
| Medium herbivore/granivore | BBCH 21–49 | 55.6 | 837 | 47 | **10** |
| Small insectivore | BBCH 10–19  BBCH ≥20 | 26.8  25.2 | 837  837 | 22  21 | **5.0**  **4.7** |
| Pasture, pasture seed crops | | | | | | |
| Grassland | Small granivore | New sown | 20.4 | 1300 | 27 | **5.9** |
| Large herbivore | Growing shoots | 30.5 | 1300 | 40 | **8.8** |
| Small insectivore | Growing shoots | 26.8 | 1300 | 35 | **7.7** |
| Small granivore | Late season | 24.7 | 1300 | 32 | **7.1** |
| Apples, cherries | | | | | | |
| Orchards | Small insectivore | Spring/summer | 46.8 | 837 | 39 | **8.7** |
| Small insectivore/worm feeder | BBCH <10  BBCH 10–19  BBCH 20–39  BBCH ≥40 | 7.4  5.9  4.4  2.2 | 837  837  837  837 | 6.2  4.9  3.7  1.8 | **1.4**  **1.1**  **0.82**  **0.41** |
| Small granivore | BBCH <10  BBCH 10–19  BBCH 20–39  BBCH ≥40 | 27.4  21.9  16.4  8.2 | 837  837  837  837 | 23  18  14  6.9 | **5.1**  **4.1**  **3.1**  **1.5** |
| Grapes | | | | | | |
| Vineyards | Small insectivore | BBCH 10–19  BBCH ≥20 | 27.4  25.7 | 837  837 | 23  22 | **5.1**  **4.8** |
| Small granivore | BBCH 10–19  BBCH 20–39  BBCH ≥40 | 14.8  12.4  7.4 | 837  837  837 | 12  10  6.2 | **2.8**  **2.3**  **1.4** |
| Small omnivore | BBCH 10–19  BBCH 20–39  BBCH ≥40 | 14.4  12.0  7.2 | 837  837  837 | 12  10  6.0 | **2.7**  **2.2**  **1.3** |
| Frugivore | Ripening | 28.9 | 629 | 18 | **4.0** |
| Tomatoes | | | | | | |
| Fruiting vegetables | Small granivore | BBCH 10–49  BBCH ≥50 | 24.7  7.4 | 837  837 | 21  6.2 | **4.6**  **1.4** |
| Small omnivore | BBCH 10–49  BBCH ≥50 | 24  7.2 | 837  837 | 20  6.0 | **4.5**  **1.3** |
| Small insectivore | BBCH 10–19  BBCH ≥20 | 26.8  25.2 | 837  837 | 22  21 | **5.0**  **4.7** |
| Frugivore (e.g. crow) | BBCH 71–89 | 57.4 | 629 | 36 | **8.0** |
| Frugivore (e.g. starling) | BBCH 71–89 | 49.4 | 629 | 31 | **6.9** |
| Lettuce, cabbage | | | | | | |
| Leafy vegetables | Small granivore | BBCH 10–49  BBCH ≥50 | 27.4  8.2 | 837  837 | 23  6.9 | **5.1**  **1.5** |
| Small omnivore | BBCH 10–49  BBCH ≥50 | 24.0  7.2 | 837  837 | 20  6.0 | **4.5**  **1.3** |
| Medium herbivore/granivore | BBCH 10–19 | 90.6 | 837 | 76 | **17** |
| Small insectivore | BBCH 10–19  BBCH ≥20 | 26.8  25.2 | 837  837 | 22  21 | **5.0**  **4.7** |

Crop groups as indicated in Table A1; generic focal species and shortcut values for indicated crop groups from EFSA (2009)

Seasonal exposure rates selected from Table C1 for the indicated crop groups represent worst-case scenario (if acceptable) or best-case scenario (if not acceptable)

DDD = daily dietary dose (mg/kg bw/d) = shortcut value \* rate (kg ac/ha)

RAL = regulatory acceptable level = LD50 4.5 mg/kg bw/d (Fletcher 1971, Grimes & Jaber 1988a, Kadota et al. 1974) and assessment factor of 10

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

Appendix D – runoff assessments

Assessment scenarios

Runoff has been modelled following the methodology described in Appendix B, aquatic species of the APVMA [Risk Assessment Manual, Environment](https://apvma.gov.au/node/46416). To perform the appropriate high tier calculations, the runoff assessment has been undertaken using the PERAMA[[8]](#footnote-9) 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 D1: 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 | 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 DT50 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. Acceptable risks could not be concluded 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 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. Acceptable risks could not be concluded 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 two 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 km2 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 D2; regions showing unacceptable risks at any time are summarised in Table D3; regions showing acceptable risks with timing restrictions are summarised in Table D4.

Table D2: 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 | | | | | | | | | |
| 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 |
| Apples, cherries | | | | | | | | | |
| Queensland and NT | 1.8 | 0.03 | 14 | Winter | 25  75 | 13  29 | 1.0  2.3 | 0.006  0.023 | >99  >99 |
| NSW and ACT | 1.8 | 0.08 | 31 | Summer | 25  75 | 17  42 | 1.3  2.8 | 0.003  0.017 | >99  >99 |
| Victoria | 1.2 | 0.09 | 38 | Autumn | 25  75 | 18  32 | 1.3  2.9 | 0.002  0.007 | 97  >99 |
| Tasmania | 5.4 | 0.07 | 28 | Winter | 25  75 | 11  21 | 1.3  2.6 | 0.007  0.039 | >99  >99 |
| South Australia | 2.3 | 0.10 | 40 | Summer | 25  75 | 19  34 | 1.3  3.0 | 0.004  0.014 | 92  >99 |
| Western Australia | 1.6 | 0.02 | 8.3 | Summer | 25  75 | 19  28 | 1.3  2.9 | 0.001  0.001 | >99  >99 |
| Grapes | | | | | | | | | |
| NSW and ACT | 1.8 | 0.08 | 33 | Summer | 25  75 | 17  42 | 1.3  2.8 | 0.003  0.016 | >99  >99 |
| Victoria | 1.2 | 0.09 | 40 | Autumn | 25  75 | 18  32 | 1.3  2.9 | 0.002  0.007 | 97  >99 |
| Tasmania | 5.4 | 0.07 | 29 | Winter | 25  75 | 11  21 | 1.3  2.6 | 0.007  0.036 | >99  >99 |
| South Australia | 1.2 | 0.10 | 43 | Summer | 25  75 | 19  34 | 1.3  3.0 | 0.004  0.013 | 95  >99 |
| Western Australia | 1.6 | 0.02 | 8.8 | Summer | 25  75 | 19  28 | 1.3  2.9 | 0.001  0.001 | >99  >99 |
| Wet Tropics | 3.0 | 0.06 | 2.5 | Oct | 25  75 | 12  31 | 0.6  1.4 | 0.009  0.038 | 98  >99 |
| Burdekin | 0.80 | 0.13 | 58 | Oct | 25  75 | 13  36 | 0.8  2.1 | 0.002  0.011 | 96  >99 |
| Mackay/Whitsunday  (pasture inter-row) | 2.0 | 0.28 | 123 | Oct | 25  75 | 14  23 | 0.7  1.1 | 0.003  0.012 | 96  >99 |
| Fitzroy | 1.9 | 0.01 | 3.1 | Apr | 25  75 | 14  43 | 0.8  1.9 | 0.008  0.032 | 98  97 |
| Mary/Burnett | 1.6 | 0.09 | 40 | Oct | 25  75 | 14  35 | 1.0  2.5 | 0.006  0.021 | >99  98 |
| SE Queensland | 1.7 | 0.05 | 20 | Dec | 25  75 | 13  33 | 1.3  3.2 | 0.006  0.021 | 98  96 |
| Northern NSW | 3.4 | 0.04 | 18 | Oct | 25  75 | 13  28 | 1.0  2.2 | 0.011  0.040 | >99  99 |
| Tomatoes | | | | | | | | | |
| NSW and ACT | 1.8 | 0.08 | 37 | Summer | 25  75 | 17  42 | 1.3  2.8 | 0.006  0.024 | >99  >99 |
| Victoria | 1.2 | 0.09 | 44 | Summer | 25  75 | 20  34 | 1.4  3.4 | 0.005  0.012 | 90  >99 |
| Tasmania | 5.4 | 0.07 | 32 | Winter | 25  75 | 11  23 | 1.3  2.6 | 0.021  0.064 | >99  >99 |
| South Australia | 1.2 | 0.10 | 47 | Summer | 25  75 | 19  34 | 1.3  3.0 | 0.004  0.011 | 91  >99 |
| 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 B1 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 D3: 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 B1 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 D4: 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  75 | 18  32 | 1.3  2.9 | 0.007  0.017 | **74**  93 |
| Winter | 25  75 | 17  30 | 1.2  2.1 | 0.007  0.016 | 90  99 |
| Spring | 25  75 | 17  28 | 1.3  2.6 | 0.007  0.015 | **82**  95 |
| Summer | 25  75 | 20  34 | 1.4  3.4 | 0.008  0.019 | **59**  **89** |
| South Australia | 1.3 | 0.63 | 286 | Autumn | 25  75 | 19  31 | 1.4  3.0 | 0.005  0.012 | **79**  95 |
| Winter | 25  75 | 18  26 | 1.3  2.7 | 0.004  0.009 | 92  99 |
| Spring | 25  75 | 19  28 | 1.3  2.7 | 0.005  0.010 | **85**  97 |
| Summer | 25  75 | 19  34 | 1.3  3.0 | 0.005  0.013 | **64**  93 |
| Western Australia | 1.4 | 0.35 | 159 | Autumn | 25  75 | 19  27 | 1.3  3.2 | 0.001  0.004 | **89**  >99 |
| Winter | 25  75 | 19  27 | 1.4  3.0 | 0.001  0.003 | 96  >99 |
| Spring | 25  75 | 18  22 | 1.3  2.6 | 0.001  0.002 | 91  >99 |
| Summer | 25  75 | 19  28 | 1.3  2.9 | 0.001  0.004 | **80**  97 |
| Lucerne | | | | | | | | | |
| South Australia | 1.3 | 0.63 | 342 | Autumn | 25  75 | 19  31 | 1.4  3.0 | 0.005  0.012 | **77**  94 |
| Winter | 25  75 | 18  26 | 1.3  2.7 | 0.004  0.009 | 91  99 |
| Spring | 25  75 | 19  28 | 1.3  2.7 | 0.005  0.010 | **83**  96 |
| Summer | 25  75 | 19  34 | 1.3  3.0 | 0.005  0.013 | **62**  90 |
| Western Australia | 1.4 | 0.35 | 190 | Autumn | 25  75 | 19  27 | 1.3  3.2 | 0.001  0.004 | **87**  >99 |
| Winter | 25  75 | 19  27 | 1.4  3.0 | 0.001  0.004 | 95  >99 |
| Spring | 25  75 | 18  22 | 1.3  2.6 | 0.001  0.002 | **89**  >99 |
| Summer | 25  75 | 19  28 | 1.3  2.9 | 0.001  0.004 | **77**  96 |
| Pasture and pasture seed crops | | | | | | | | | |
| Victoria | 1.7 | 0.63 | 450 | Autumn | 25  75 | 18  32 | 1.3  2.9 | 0.003  0.010 | **73**  91 |
| Winter | 25  75 | 17  30 | 1.2  2.1 | 0.003  0.009 | **89**  98 |
| Spring | 25  75 | 17  28 | 1.3  2.6 | 0.003  0.008 | **82**  94 |
| Summer | 25  75 | 20  34 | 1.4  3.4 | 0.004  0.010 | **58**  **85** |
| South Australia | 1.3 | 0.63 | 450 | Autumn | 25  75 | 19  31 | 1.4  3.0 | 0.002  0.006 | **79**  94 |
| Winter | 25  75 | 18  26 | 1.3  2.7 | 0.002  0.005 | 92  99 |
| Spring | 25  75 | 19  28 | 1.3  2.7 | 0.002  0.005 | **84**  96 |
| Summer | 25  75 | 19  34 | 1.3  3.0 | 0.002  0.007 | **63**  **89** |
| Western Australia | 1.4 | 0.35 | 250 | Autumn | 25  75 | 19  27 | 1.3  3.2 | 0.001  0.002 | 90  >99 |
| Winter | 25  75 | 19  27 | 1.4  3.0 | 0.001  0.002 | 96  >99 |
| Spring | 25  75 | 18  22 | 1.3  2.6 | 0.001  0.001 | 92  >99 |
| Summer | 25  75 | 19  28 | 1.3  2.9 | 0.001  0.002 | **82**  97 |
| Tomatoes | | | | | | | | | |
| Mackay/Whitsunday | 2.0 | 0.28 | 134 | Jan | 25  75 | 14  58 | 0.7  2.8 | 0.014  0.050 | 96  >99 |
| Feb | 25  75 | 16  51 | 0.8  2.4 | 0.016  0.048 | 98  >99 |
| Mar | 25  75 | 16  49 | 0.8  2.4 | 0.017  0.047 | >99  >99 |
| Apr | 25  75 | 13  39 | 0.6  1.9 | 0.012  0.041 | 97  >99 |
| May | 25  75 | 12  24 | 0.6  1.1 | 0.010  0.026 | 93  98 |
| Jun | 25  75 | 14  33 | 0.7  1.6 | 0.013  0.036 | 91  99 |
| Jul | 25  75 | 12  31 | 0.6  1.5 | 0.010  0.034 | 90  >99 |
| Aug | 25  75 | 11  30 | 0.5  1.4 | 0.009  0.033 | **85**  93 |
| Sep | 25  75 | 12  32 | 0.6  1.5 | 0.011  0.035 | **84**  93 |
| Oct | 25  75 | 14  23 | 0.7  1.1 | 0.014  0.025 | **72**  94 |
| Nov | 25  75 | 12  38 | 0.6  1.8 | 0.011  0.040 | **71**  >99 |
| Dec | 25  75 | 14  40 | 0.7  1.9 | 0.014  0.041 | **84**  99 |
| Lettuce and cabbage | | | | | | | | | |
| Victoria | 1.2 | 0.09 | 44 | Autumn | 25  75 | 18  32 | 1.3  2.9 | 0.006  0.013 | 93  >99 |
| Winter | 25  75 | 17  30 | 1.2  2.1 | 0.005  0.012 | 97  >99 |
| Spring | 25  75 | 17  28 | 1.3  2.6 | 0.005  0.011 | 96  >99 |
| Summer | 25  75 | 20  34 | 1.4  3.4 | 0.006  0.014 | **88**  >99 |
| Burdekin | 0.80 | 0.13 | 63 | Jan | 25  75 | 16  50 | 1.0  2.9 | 0.007  0.020 | >99  >99 |
| Feb | 25  75 | 16  53 | 0.9  3.2 | 0.007  0.021 | >99  >99 |
| Mar | 25  75 | 15  50 | 0.9  3.0 | 0.006  0.020 | >99  >99 |
| Apr | 25  75 | 14  39 | 0.8  2.3 | 0.006  0.017 | >99  >99 |
| May | 25  75 | 12  28 | 0.7  1.7 | 0.005  0.013 | >99  >99 |
| Jun | 25  75 | 13  28 | 0.8  1.7 | 0.005  0.014 | >99  >99 |
| Jul | 25  75 | 13  29 | 0.7  1.7 | 0.005  0.014 | >99  >99 |
| Aug | 25  75 | 13  29 | 0.8  1.7 | 0.005  0.014 | >99  >99 |
| Sep | 25  75 | 15  34 | 0.9  2.0 | 0.006  0.016 | 96  >99 |
| Oct | 25  75 | 13  36 | 0.8  2.1 | 0.005  0.017 | **88**  >99 |
| Nov | 25  75 | 14  33 | 0.8  2.0 | 0.006  0.015 | >99  >99 |
| Dec | 25  75 | 14  42 | 0.9  2.5 | 0.006  0.018 | >99  >99 |
| Mackay/Whitsunday | 2.0 | 0.28 | 134 | Jan | 25  75 | 14  58 | 0.7  2.8 | 0.016  0.059 | 95  >99 |
| Feb | 25  75 | 16  51 | 0.8  2.4 | 0.019  0.056 | 98  >99 |
| Mar | 25  75 | 16  49 | 0.8  2.4 | 0.020  0.055 | 99  >99 |
| Apr | 25  75 | 13  39 | 0.6  1.9 | 0.015  0.048 | 96  >99 |
| May | 25  75 | 12  24 | 0.6  1.1 | 0.012  0.031 | 92  98 |
| Jun | 25  75 | 14  33 | 0.7  1.6 | 0.015  0.042 | 90  99 |
| Jul | 25  75 | 12  31 | 0.6  1.5 | 0.012  0.040 | **89**  99 |
| Aug | 25  75 | 11  30 | 0.5  1.4 | 0.011  0.039 | **83**  92 |
| Sep | 25  75 | 12  32 | 0.6  1.5 | 0.013  0.041 | **82**  92 |
| Oct | 25  75 | 14  23 | 0.7  1.1 | 0.016  0.030 | **69**  91 |
| Nov | 25  75 | 12  38 | 0.6  1.8 | 0.013  0.047 | **69**  >99 |
| Dec | 25  75 | 14  40 | 0.7  1.9 | 0.016  0.048 | **82**  99 |
| Grapes | | | | | | | | | |
| Mackay/Whitsunday  (bare soil inter-row) | 2.0 | 0.28 | 123 | Jan | 25  75 | 14  58 | 0.7  2.8 | 0.008  0.041 | 98  >99 |
| Feb | 25  75 | 16  51 | 0.8  2.4 | 0.010  0.038 | >99  >99 |
| Mar | 25  75 | 16  49 | 0.8  2.4 | 0.010  0.037 | >99  >99 |
| Apr | 25  75 | 13  39 | 0.6  1.9 | 0.007  0.31 | 99  >99 |
| May | 25  75 | 12  24 | 0.6  1.1 | 0.005  0.019 | 96  99 |
| Jun | 25  75 | 14  33 | 0.7  1.6 | 0.007  0.027 | 95  >99 |
| Jul | 25  75 | 12  31 | 0.6  1.5 | 0.005  0.025 | 95  >99 |
| Aug | 25  75 | 11  30 | 0.5  1.4 | 0.004  0.024 | 92  95 |
| Sep | 25  75 | 12  32 | 0.6  1.5 | 0.006  0.026 | 91  95 |
| Oct | 25  75 | 14  23 | 0.7  1.1 | 0.008  0.018 | **82**  >99 |
| Nov | 25  75 | 12  38 | 0.6  1.8 | 0.006  0.031 | **83**  >99 |
| Dec | 25  75 | 14  40 | 0.7  1.9 | 0.008  0.032 | 91  >99 |

Seasonal 10 ha exposure rates from Table D1 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 E – 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 DT50 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 DT50 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 DT50 1.6 days), the aquatic toxicity value corresponds to an initial concentration of 0.79 µg ac/L[[9]](#footnote-10), 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); or
* 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 two 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.

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 Chemical Industry |
| BCF | bioconcentration factor |
| BOM | Bureau of Meteorology |
| bw | body weight |
| CA-FNT | carboxyfenitrothion |
| CIPAC | Collaborative International Pesticides Analytical Council |
| cm | centimetre(s) |
| CTX | 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 |
| DTX | period required for X% percent dissipation |
| ECX | concentration causing X% effect (ErCX is used for growth rate; EbCX is used for biomass) |
| EFSA | European Food Safety Authority |
| ERX | 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) |
| HCX | 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) |
| LCX | lethal concentration to X% of the tested population (LCXcorr is a corrected value to account for bioavailability in the test system) |
| LDX | 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 |
| 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 (NOECcorr 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) |
| 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 |
| 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 |
| 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   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 |

References

Australian Grains Industry Post Harvest Chemical Usage Recommendations and Outturn Tolerances (2020/21). <http://www.graintrade.org.au/sites/default/files/Outturn%20Tolerances%20202021%20Final.pdf>

APVMA(NRA) (1999a). Fenitrothion interim review report: Residues. <https://www.apvma.gov.au/sites/default/files/publication/15276-fenitrothion-interim-report-res.pdf> Australian Pesticides and Veterinary medicines Authority, Canberra.

APVMA(NRA) (1999b). Fenitrothion interim review report: OHS assessment. <https://apvma.gov.au/sites/default/files/publication/15266-fenitrothion-interim-report-ohs.pdf> Australian Pesticides and Veterinary medicines Authority, Canberra.

APVMA(NRA) (1999c). Fenitrothion interim review report: Environmental assessment. <https://apvma.gov.au/sites/default/files/publication/15271-fenitrothion-interim-report-env.pdf> Australian Pesticides and Veterinary medicines Authority, Canberra.

APVMA(NRA) (1999d). Fenitrothion interim review report: Toxicology assessment (Evaluation of the mammalian toxicity and metabolism/toxicokinetics. <https://www.apvma.gov.au/sites/default/files/publication/15261-fenitrothion-interim-report-tox.pdf> Australian Pesticides and Veterinary medicines Authority, Canberra.

APVMA(NRA) (1999e). Fenitrothion interim review report: Chemical and agricultural assessment. <https://www.apvma.gov.au/sites/default/files/publication/15256-fenitrothion-interim-report-ag.pdf> Australian Pesticides and Veterinary medicines Authority, Canberra.

APVMA(NRA) (1999f). Fenitrothion interim review report: Summary. <https://www.apvma.gov.au/sites/default/files/publication/15281-fenitrothion-interim-report-summary.pdf> Australian Pesticides and Veterinary medicines Authority, Canberra.

APVMA (2004). Fenitrothion Draft Review report, March 2004. The reconsideration of approvals of the active constituent fenitrothion, registrations of products containing fenitrothion and their associated labels. <https://apvma.gov.au/sites/default/files/publication/15286-fenitrothion_2004.pdf>, Australian Pesticides and Veterinary medicines Authority, Canberra.

APVMA (2018). Spray Drift Risk Assessment Tool (SDRAT) – Version 1.0. Australian Pesticides and Veterinary Medicines Authority. <https://apvma.gov.au/node/28086>

APVMA (2023a). Acceptable Daily intakes for Agricultural and Veterinary Chemicals <https://apvma.gov.au/node/26596>

APVMA (2023b). Acute Reference Doses for Agricultural and Veterinary Chemicals. <https://apvma.gov.au/node/26591>

APVMA (2023c). FAISD Handbook. <https://apvma.gov.au/node/26586>

Bahaffi SOS, Zainy FM, Hamza A, (2005). Dissipation of fenitrothion residues in some fruits and vegetables using high-performance liquid chromatography method. J King Abdulaziz Univ Sci 17(1): 83-88

Beavers JB, Lloyd DS, Jaber M, (1989). Sumithion technical grade: a one-generation reproduction study with the mallard (*Anas platyrhynchos*). Reference no. HW-91-0341

Beavers JB, Ross T, Smith GJ, Lynn SP, Jaber M, (1991). Sumithion technical grade: a one-generation reproduction study with the bobwhite (*Colinus virginianus*). Reference no. HW-11-0435

British Crop Production Council (2016). The Pesticides Manual, 18th Edition.

Burgess D, (1988). Chronic toxicity of fenitrothion technical to *Daphnia magna* under flow-through test conditions. Reference no. HW-81-0326

Burke J, (2011). Fenitrothion: acute toxicity test to *Neocaridina denticulata*. Reference no. 8232356

Burke J, Flenley A, (2011). Fenitrothion: acute toxicity test to *Chironomus riparius*. Reference no. 8232355

Burke J, Scholey A, (2011a). Fenitrothion: acute toxicity test to *Hyalella azteca*. Reference no. 8228973

Burke J, Scholey A, (2011b). Fenitrothion: inhibition of growth to the alga *Pseudokirchneriella subcapitata*. Reference no. 8224519

Cabras P, Angioni A, (2000), Pesticide residues in grapes, wine, and their processing products. J Agric Food Chem 48(4): 967-973

Cabras P, Angioni A, Garau VL, Minelli EV, Cabitza F, Cubeddu M, (1997). Residues of some pesticides in fresh and dried apricots. J Agric Food Chem 45(8): 3221-3222

US Electronic Code of Federal Regulations (2008). Chapter I - ENVIRONMENTAL PROTECTION AGENCY, Subchapter E - PESTICIDE PROGRAMS, Part 180 - TOLERANCES AND EXEMPTIONS FOR PESTICIDE CHEMICAL RESIDUES IN FOOD, Subpart C - Specific Tolerances, Section § 180.540 – Fenitrothion; tolerances for residues. (Cited 10/12/2020) <https://www.govinfo.gov/content/pkg/CFR-2023-title40-vol26/pdf/CFR-2023-title40-vol26-sec180-540.pdf>

Cohle P, (1988). Early life stage toxicity of fenitrothion technical to rainbow trout (*Salmo gairdneri*) in a flow-through system. Reference no. HW-81-0331

Concha M, (2000). Solubility of fenitrothion in water. Reference no. HP-0137

Cranor W, Daly D, (1989). Aerobic soil metabolism of 14C-fenitrothion. Reference no. HM-91-0108

Cranor W, Daly D, (1990). Anaerobic aquatic metabolism of 14C-fenitrothion. Reference no. HM-01-0113

Dykes J, Carpenter M, (1988). Photodegradation study of 14C-fenitrothion on soil surface. Reference no. HM-81-0098

EFSA (European Food Safety Authority) (2006). Conclusion regarding the peer review of the pesticide risk assessment of the active substance fenitrothion. Finalised 13 January 2006.

EFSA (European Food Safety Authority) (2009). Guidance document on risk assessment for birds & mammals on request from EFSA. EFSA Journal 7(12):1438, 358 pp. doi: 10.2903/j.efsa.2009.1438

EFSA (European Food Safety Authority) (2020). Scientific report of EFSA on the ‘repair action’ of the FOCUS surface water scenarios. EFSA Journal 2020;18(6):6119, 301 pp. [doi.org/10.2903/j.efsa.2020.6119](https://doi.org/10.2903/j.efsa.2020.6119)

EFSA (European Food Safety Authority) (2023). Guidance on the risk assessment for birds and mammals. EFSA Journal 21(2):7790, 300 pp. doi: 10.2903/j.efsa.2023.7790

Ellgehausen H, Wuethrich V, Coupy S, (1985). Acute toxicity (LC50) study of sumithion to earthworms. Reference no. HW-51-0215

FAO (2010). FAO Specification for Fenitrothion (<https://www.fao.org/3/ca9650en/ca9650en.pdf>, accessed 10 January 2024)

Fernández-Cruz ML, Villarroya M, Llanos S, Alonso-Prados JL, García-Baudín JM, (2004). Field-incurred fenitrothion residues in kakis: comparison of individual fruits, composite samples, and peeled and cooked fruits. J Agric Food Chem 52(4): 860-863

Fletcher D, (1971). Acute oral toxicity study with sumithion in ringneck pheasants. Reference no. HT-11-0016

Forbis AD, (1987). Acute toxicity of fenitrothion to *Daphnia magna*. Reference no. HW-70-0234

Gilmour AR, McDougall KW, Spurgin P, (1999). The uptake and depletion of fenitrothion in cattle, pasture and soil following spraying of pastures for locust control. Aus J Exp Agric 39(8): 915-922

Gries T, (2002). 14C-amino-fenitrothion: acute immobilisation test with daphnids (*Daphnia magna*) under static conditions. Reference no. HW-0485

Griggs LMP, Jefferson ND, Blair M, Kopplin JR, Richter WR & Spicer EJF (1984). One year dietary toxicity study in dogs. Study No. HT-41-0272. Sponsor: Sumitomo Chemcal Co Ltd, Osaka, Japan. Study Date: April 13, 1984

Grimes J, Jaber M, (1988a). Sumithion technical grade: an acute oral toxicity study with the bobwhite. Reference no. HW-71-0242

Grimes J, Jaber M, (1988b). Sumithion technical grade: an acute oral toxicity study with the mallard. Reference no. HW-71-0243

Grimes J, Jaber M, (1988c). Sumithion technical grade: a dietary LC50 study with the bobwhite. Reference no. HW-81-0254

Grimes J, Jaber M, (1988d). Sumithion technical grade: a dietary LC50 study with the mallard. Reference no. HW-81-0255

Gruetzner I, (2000). Ready biodegradability of fenitrothion in a monometric respirometry test. Reference no. HM-0191

Health (2023). Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP). Legislative Instrument - The Poisons Standard. Australian Federal Government Department of Health and Aged Care. (https://www.tga.gov.au/publication/poisons-standard-susmp)

Hoberg JR, (2001). Fenitrothion: acute contact and oral toxicity tests with honey bees (*Apis mellifera*). Reference no. HW-0481

Hoberman AM, (1990). Reproductive effects of sumithion administered orally in feed to CRL:CD (SD) BR rats for two generations. Reference no. HT-01-0452

Hu R, Gong D, HE L, Li J, (2009). Study on residual degradation of fenitrothion. Hunan Agricultural Sciences 9: 91-93

Ishii Y, (2004). A comparative study of the persistence of organophosphorous and carbamate insecticides in rice plants at harvesting. Bull Natl Inst Agro-Environ Sci 23: 1-14

Ito M, Takahashi N, Mikami N, (1988). Hydrolysis of fenitrothion in water as a function of pH at 25°C. Reference no. HM-80-0094

JMPR (2003). JMPR Periodic Review Residues Evaluation for Fenitrothion, Joint Meeting on Pesticide Residues, FAO/WHO, 2003 (<http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/JMPR/Evaluation03/fenitrothion_2003.pdf>, accessed 24 June 2020), and references therein).

JMPR (2004). FENITROTHION (37). FAO/WHO Joint Meeting on Pesticide Residues. <https://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/JMPR/Evaluation04/Fenitrothion.pdf>. Last accessed: 9/2/2024.

JMPR (2007). Pesticide residues in food 2007. Joint FAO/WHO Meeting on Pesticide Residues, 18-27 September 2007.

JMPS (2009). Fenitrothion FAO/WHO Evaluation Report 35/2009. <https://www.fao.org/3/ca9650en/ca9650en.pdf> . Last accessed 13/2/2024)

Kadota T, Kagoshima M, Yamazaki H, Miyamoto J, (1972). Acute oral, subcutaneous and dermal toxicities of sumithion technical in mice and rats. Reference no. HT-20-0187

Kadota T, Kagoshima M, Miyamoto J, (1974). Acute and sub-acute toxicity of sumithion to Japanese quails. Reference no. HT-40-0050

Kagoshima M, Kadota T, Miyamoto J, (1974). Acute toxicity of sumithion in rainbow trouts, carps and southern top-mouthed minnows. Reference no. HW-40-0101

Katagi T, Takahashi N, Mikami N, (1988). Photodegradation of fenitrothion in water. Reference no. HM-80-0093

Kawabe M, (2010). Skin Sensitization Study of Fenitrothion TG in Guinea Pigs (Buehler Test). Reference no. HT-0604.

Kodaka R, Yoshimara J, Nambu K, Katagi T, Takimoto Y, (2000). Determination of disappearance times (DT50 and DT90) of NMC, AM-FNT and AA-FNT (degradation products of fenitrothion). Reference no. HM-0187

Lahr J, Diallo AO, Gadji B, Diouf PS, Bedaux JJM, Badji A, Ndour KB, Andreasen JE, van Straalen NM, (2000). Ecological effects of experimental insecticide applications on invertebrates in Sahelian temporary ponds. Environ Toxicol Chem 19(5): 1278-1289

Lahr J, Badji, Marquenie S, Schuiling E, Ndour KB, Diallo AO, Everts JW, 2001. Acute toxicity of locust insecticides to two indigenous invertebrates from Sahelian temporary pools. Ecotoxicol Environ Saf 48: 66-75

Lewis CJ, (2001). 14C-NMC (a fenitrothion soil metabolite): adsorption/ desorption in soil. Reference no. HM-0194

Lewis KA, Tzilivakis J, (2017). Development of a data set of pesticide dissipation rates in/on various plant matrices for the pesticide properties database (PPDB). Data 2(20); doi:10.3390/data2030028

L'Haridon J, (2002). Fenitrothion: activated sludge respiration inhibition test. Reference no. HW-0484

Likas DT, Tsiropoulos NG, (2007). Behaviour of fenitrothion residues in leaves and soil of vineyard after treatment with microencapsulate and emulsified formulations. Int J Environ Anal Chem 87(13-14): 927-935

Litzow D (2002). Magnitude of the residue of fenitrothion in cereal straw and grain. Reference no. I03-67836

Malhat F, Boulangé J, Abdelraheem E, Allah OA, El-Hamid RA, El-Salam SA, (2017). Validation of QuEChERS based method for determination of fenitrothion residues in tomatoes by gas chromatography–flame photometric detector: decline pattern and risk assessment. Food Chem 229: 814-819

Martin NA, (1976). Effect of four insecticides on the pasture ecosystem. V. Earthworms (Oligochaeta: Lumbricidea) and Arthropoda extracted by wet sieving and salt flotation. NZ Journal of Agricultural Research 19: 111-115

Martin NA, (1978). Effect of four insecticides on the pasture ecosystem. VI. Arthropoda dry heat-extracted from small soil cores, and conclusions. NZ J Agric Res 21: 307-319

Matsumoto KI, Hosokawa M, Kuroda K, Endo G, (2009). Toxicity of agricultural chemicals in *Daphnia magna*. Osaka City Med J 55(2): 89-97

Mikami N, Yoshimura J, Matsuda T, Miyamoto J, (1984). Effect of fenitrothion on soil respiration and nitrogen transformation. Reference no. HW-40-0206

Mito N, (2001). Evaluation of herbicidal activity of fenitrothion. Reference no. HG-0143

Moon SH, (2010). Acute oral toxicity study of fenitrothion TG in rats (acute toxic class method). Reference no. J09517

Moon SH, (2010b). Acute Dermal Toxicity Study of Fenitrothion TG in Rats. Study No JO9411.

Mullié WC, Keith JO, (1993). The effects of aerially applied fenitrothion and chlorpyrifos on birds in the savannah of Northern Senegal. J Appl Ecol 30: 536-550

Nishiyama M, Nambu K, Katagi T, Takimoto Y, (2000). Stability in air of fenitrothion. Reference no. HP-0131

Nosál M & Hladká A (1968). Determination of the exposure to fenitrothion (O,O-dimethylO/3methyl-4-nitrophenyl/thiophosphate) on the basis of the excretion of p-nitro-m-cresol by the urine of the persons tested. Int Arch Gewerbepathol Gewerbehyg 25:28-38

Oguri Y, 2001. Evaluation of fungicidal activity of fenitrothion. Reference no. HG-0144

Ohshima M, Mikami N, (1990). Characterisation of unidentified metabolites of fenitrothion in bluegill sunfish. Reference no. HM-00-0115

Ohshima M, Takahashi N, Mikami N, Matsuda T, (1988). Accumulation and metabolism of 14C-fenitrothion in bluegill sunfish (*Lepomis macrochirus*). Reference no. HM-80-0095

Ota M (2010a). Primary skin irritation test of Fenitrothion TG in Rabbits. Study No. 4176.

Ota M (2010b). Primary eye irritation test of Fenitrothion TG in Rabbits. Study No. 4177.

Okada Y, (2001). Henry's law constant for fenitrothion. Reference no. HP-0138

Passarella I, Elia I, Guarino B, Bourlot G, Nègre M, (2009). Evaluation of the field dissipation of fungicides and insecticides used on fruit bearing trees in northern Italy. J Environ Sci Health B 44(2): 137-143

PMRA (2004). Re-evaluation Decision Document RRD 2004-13, Fenitrothion. 28 May, 2004.

Putt AE, (2001). 3-methyl-4-nitrophenol (NMC): acute toxicity to daphnids (*Daphnia magna*) under static conditions. Reference no. HW-0482

Ricegrowers Co-operative (2002). Fenitrothion residues in rice.

Schetter JE, (2000). Fenitrothion: vapor pressure. Reference no. HP-0136

Shepler K, Schick M, (2002). Partition coefficient (n-octanol:water) of 14C-fenitrothion. Reference no. HP-0145

Shigehisa H, Shiraishi H, (1998). Biomonitoring with shrimp to detect seasonal change in river water toxicity. Environ Toxicol Chem 17(4): 687-694

Spillner CJ, Neuberger AM, (1979). Adsorption and desorption of sumithion in various soils. Reference no. HW-91-0188

Suetake K, Kakino K, Kamimura H & Ichiki T (1991). 21-day dermal toxicity study in rabbits with Sumithion T.G. Safety Assessment Laboratory, Panapharm Laboratories, Japan. Report date: August 7, 1991.

Sundaram KMS, (1986). A comparative evaluation of dislodgable and penetrated residues, and persistence characteristics of aminocarb and fenitrothion, following application of several formulations onto conifer trees. J Environ Sci Health B 21(6): 539-560

Swales S, (2001). 14C-fenitrothion: degradation and retention in water-sediment system. Reference no. HM-0193

Swigert JP, (1987a). Acute flow-through toxicity of fenitrothion to rainbow trout (*Salmo gairdneri*). Reference no. HW-71-0329

Swigert JP, (1987b). Acute flow-through toxicity of fenitrothion to bluegill sunfish (*Lepomis macrochirus*). Reference no. HW-71-0330

Takahashi N, (1981). Quantum yield of direct phototransformation of fenitrothion. Reference no. HP-0132

Teixeira D, (2001). 3-methyl-4-nitrophenol (NMC): acute toxicity to earthworm (*Eisenia fetida*). Reference no. HW-0483

US EPA (2006). Reregistration Eligibility Decision for Fenitrothion. US EPA Office of Pesticide Programs, July 31, 2006.

US EPA (2021). Occupational Pesticide Handler Exposure Calculator (OPHEC) (version date: May 2021). https://www.epa.gov/sites/production/files/2021-05/opp-hed-occupational-handler-exposure-may-2021.xlsx

US EPA (2021). Occupational Pesticide Re-entry Exposure Calculator (OPREC). https://www.epa.gov/sites/production/files/2021-03/hed\_exposac\_policy\_3\_occupational\_pesticide\_re-entry\_exposure\_calculator\_march2021\_0.xlsx

US EPA (2022). Occupational Pesticide Exposure - Seed Treatment Exposure Calculator (March 2022): https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/occupational-pesticide-exposure-seed-treatment

Walker PW, Story PG, Hose GC, (2016). Comparative effects of pesticides fenitrothion and fipronil applied as ultra-low volume formulations for locust control on non-target invertebrate assemblages in Mitchell grass plains of south-west Queensland Australia. Crop Prot 89: 38-46

Willis GH, McDowell LL, (1987). Pesticide persistence on foliage. Rev Environ Contam Toxicol 100: 23-73

Yeomans P, Swales S, (2001). 14C-fenitrothion: soil metabolism and degradation. Reference no. HM-0192

Yokoyama A, Ohtsu K, Iwafune T, Nagai T, Ishihara S, Kobara Y, Horio T, Endo S, (2009). A useful new insecticide bioassay using first-instar larvae of a net-spinning caddisfly, *Cheumatopsyche brevilineata* (Trichoptera: Hydropsychidae). J Pestic Sci 34(1): 13-20

Yoshida A, (2000). Determination of ultraviolet/ visible absorption spectra of fenitrothion. Reference no. HP-0134

Zongmao C, Haibin W, (1997). Degradation of pesticides on plant surfaces and its prediction - a case study on tea plant. Environ Monit Assess 44(1-3): 303-313

1. excluding bulk stored grain uses where re-entry is not relevant [↑](#footnote-ref-2)
2. Not required for stored grain protection [↑](#footnote-ref-3)
3. Not required for poultry houses or stored grain protection [↑](#footnote-ref-4)
4. Not required for poultry houses or stored grain protection [↑](#footnote-ref-5)
5. Not required for poultry houses or stored grain protection [↑](#footnote-ref-6)
6. Not required for poultry houses or stored grain protection [↑](#footnote-ref-7)
7. Not required for poultry houses or stored grain protection [↑](#footnote-ref-8)
8. © Australian Environment Agency Pty Ltd 2023 [↑](#footnote-ref-9)
9. Initial concentration = mean measured endpoint / (1 - EXP (21 exposure days \* (-ln(2)/DT50 1.6 days))) \* (21 exposure days \* ln(2)/DT50 1.6 days [↑](#footnote-ref-10)