The NRA review of

FENITROTHION

Volume II

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Existing Chemicals Review Program

**National Registration Authority
for Agricultural and Veterinary Chemicals**

**Canberra
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FOREWORD

The National Registration Authority for Agricultural and Veterinary Chemicals (NRA) is an independent statutory authority with responsibility for the regulation of agricultural and veterinary chemicals.

The NRA's Existing Chemicals Review Program (ECRP) systematically examines agricultural and veterinary chemicals registered in the past to determine whether they continue to meet current standards for registration. Chemicals for review are chosen according to pre-determined, publicly available selection criteria. Public participation is a key aspect of this program.

In undertaking reviews, the NRA works in close cooperation with advisory agencies including the Department of Health and Family Services (Chemicals and Non-Prescription Drug Branch), Environment Australia (Risk Assessment and Policy Section), National Occupational Health & Safety Commission (NOHSC) (Chemical Assessment Branch) and State Departments of Agriculture.

The NRA has a policy of encouraging openness and transparency in its activities and community involvement in decision-making. The publication of evaluation documents for all ECRP reviews is a part of that process.

The NRA also makes these reports available to the regulatory agencies of other countries as part of bilateral agreements or as part of the OECD *ad hoc* exchange program. Under the OECD program it has been proposed that countries receiving these reports will not utilise them for registration purposes unless they are also provided with the raw data from the relevant applicant.

This report provides full details of the review of fenitrothion that has been conducted by the NRA and its advisory agencies. The review's findings are based on information collected from a variety of sources, including data packages and information submitted by the registrant, information submitted by members of the public, questionnaires sent to key user/industry groups and government organisations, and literature searches.

The information and technical data required by the NRA to review the safety of both new and existing chemical products must be derived according to accepted scientific principles, as must the methods of assessment undertaken. Details of required data are outlined in various NRA publications.

Other publications explaining the NRA's requirements for registration can also be purchased or obtained by contacting the NRA. Among these are: *Ag Manual: The Requirements Manual for Agricultural Chemicals; Vet Manual: The Requirements Manual for Veterinary Chemicals* and Volume II of *Interim Requirements for the Registration of Agricultural and Veterinary Chemical Products*.

The NRA welcomes comment on this review and the review program. They can be addressed to Manager, Chemical Review, National Registration Authority for Agricultural and Veterinary Chemical, PO Box E240, Kingston ACT 2604, Australia.

CONTENTS

ABBREVIATIONS AND ACRONYMS

ng	Nanogram	**nM**	Nanomolar
µg	Microgram	**mM**	Millimolar
mg	Milligram	**sec**	Second
kg	Kilogram	**min**	Minute
mL	Millilitre	**h**	Hour
L	Litre	**m**	Metre
GI	Gastrointestinal	**SC**	Subcutaneous
IM	Intramuscular	**LH**	Luteinising hormone
IP	Intraperitoneal	**mg/kg bw/day**	mg/kg body weight/day
IV	Intravenous	**ppb**	Parts per billion
PO	Oral	**ppm**	Parts per million

ADI	Acceptable Daily Intake
A/G	Albumin/globulin ratio
AP	Alkaline phosphatase
AST	Aspartate aminotransferase (SGOT)
ALT	Alanine aminotransferase (SGPT)
BUN	Blood urea nitrogen
CCl_4	Carbon tetrachloride
ChE	Cholinesterase
CPK	Creatinine phosphokinase
DDM	4,4'-Diaminodiphenylmethane
DMSO	Dimethyl sulfoxide
EUP	End Use Product
GLP	Good Laboratory Practice
Hb	Haemoglobin
Hct	Haematocrit
LAP	Leucine aminopeptidase
LDH	Lactate dehydrogenase
LOEL	Lowest Observed Effect Level
MCH	Mean corpuscular haemoglobin
MCHC	Mean corpuscular haemoglobin concentration
MCV	Mean corpuscular volume
MRL	Maximum Residue Limit
NOEL	No Observable Effect Level
OP	Organophosphorus pesticide
2-PAM	Pyridine-2-aldoxime methiodide
TGAC	Technical Grade Active Constituent
WBC	White blood cell/leucocyte
ACPH	Advisory Committee on Pesticides and Health
NHMRC	National Health and Medical Research Council
NDPSC	National Drugs and Poisons Scheduling Committee

Section 2

CHEMISTRY ASSESSMENT

1. OVERVIEW

Fenitrothion is an organophosphorous insecticide. It is a non-systemic insecticide with contact and stomach action. Fenitrothion is a cholinestrase inhibitor. It is used in Australian agriculture to control insects in stored cereals and hides and skins, pasture pests and to control locusts. It is also used as an outdoor fogger for control of insects pests (flies, mosquito etc).

Fenitrothion is a moderately toxic organophosphorous ester insecticide. Fenitrothion is included in Schedule 6 of the SUSDP.

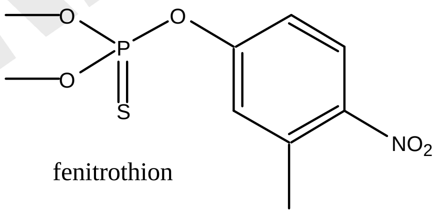
Fenitrothion TGAC manufactured by Sumitomo Chemical Co., Oita, Japan is currently approved in Australia (approval numbers: 44006, 44499).

The chemistry aspects (manufacturing process, quality control procedures, specifications applied to the active ingredient, batch analysis results and analytical methods) of fenitrothion TGAC were evaluated previously and found acceptable.

2. ACTIVE CONSTITUENT

2.1 Chemical identity

Common name:	fenitrothion
IUPAC:	O,O-dimethyl O-(4-nitro-m-tolyl) phosphorothioate
CA:	O,O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate
CAS Registry number:	122-14-5
Structural Formula:	



fenitrothion

Empirical formula:	$C_9H_{12}NO_5PS$
Molecular weight:	277.25
Purity:	Fenitrothion content: not less than 930 g/kg S-methyl fenitrothion: 10 g/kg maximum
Microcontaminants:	The maximum limits for toxic impurities contained in appendix L of the SUSDP (No. 9, October 1994) are: S-methyl fenitrothion is 10 g/kg maximum and fenitrooxon is 100 mg/kg. Fenitrothion TGAC from the approved source comply with the FAO specifications in respect of fenitrothion content and with appendix L limits for S-methyl fenitrothion and fenitrooxon.

Other toxic impurities (N-nitrosamines, halogenated dibenzo-p-dioxins or halogenated dibenzofurans and PCBs etc) are not expected in fenitrothion TGAC due to raw materials and synthetic chemistry used.

2.2 Physical and chemical properties

<u>Pure active constituent</u>

Colour:	yellow-brown to reddish-brown oily liquid with a faint characteristic odour
Melting point:	3.4 ^{o}C(*Pesticide Manual)*
Boiling point:	140-145^{0}C /0.1 mm Hg with decomposition
Flash point:	188^{0}C
Vapour pressure:	18 mPa at 20^{0}C; 6 x 10^{-6} mm Hg at 20^{0}C
Specific gravity/Density:	1.32 - 1.34 at 25^{0}C
Viscosity:	46.3 centipoise at 18^{0}C, 37.6 centipoise at 22^{0}C
n-Octanol/water partition coefficient:	log P = 3.16, 3.43 (20^{o}C) (*Pesticide Manual)*
Hydrolysis:	Relatively stable to hydrolysis under normal conditions. (*Pesticide Manual).* Hydrolysed by alkali, $t_{1/2}$ in 0.01 N NaOH is 272 min.
Photolysis:	No details.
Solubility in water:	14 mg/L at 30^{0}C (practically insoluble in water)
Solubility in organic solvents:	freely soluble in alcohols, esters, ketones and aromatic hydrocarbons; >1000 g/kg in dichloromethane, methanol, xylene; 193 g/kg in 2-propanol; low solubility in aliphatic hydrocarbons, 42 g/kg in hexane at 20-25^{0}C
Stability:	Relatively stable to hydrolysis under normal conditions, hydrolysed by alkali; Half life 12 minutes in 0.1 N NaOH at 30^{0}C; In the presence of sunlight and or ultraviolet radiation, the half-life of fenitrothion in water is less than 24 h. Thermal stability of fenitrothion is also low, when stored at temperatures above 40^{0}C it undergoes isomerization to S-methyl fenitrothion. When heated above 100^{0}C it may decompose explosively. Because of this, overheating of the compound must be avoided both in production and in storage.

<u>Technical material</u>

Purity:	930 g/kg (minimum)
Melting range:	No details.
Stability:	Stable over 2 years under normal storage conditions.
Impurities:	*S*-methyl fenitrothion (maximum 10 g/kg) Fenitrooxon (maximum 100 mg/kg)

Section 3

AGRICULTURAL ASSESSMENT

1. INTRODUCTION

1.1 Performance Questionnaires

The NRA chose to gain information on the agricultural aspects of the use of fenitrothion by surveying various groups involved as advisers, users and registrants of the chemical. This was done by sending Performance Questionnaires to State agricultural authorities, commodity and industry organisations, users and registrants. The purpose of the questionnaire was to gather information on use, performance, changed agricultural practices, adverse effects and trade and residues. The results form part of the agricultural assessment which appears in this section of the report.

1.2 Use Pattern and Justification for Use

An examination of completed performance questionnaires for fenitrothion indicates that use of this chemical is confined to a comparatively narrow use spectrum.

Grain Storage

It is considered by a number of State agricultural authorities to be a pivotal component of pest control strategies for the protection of stored cereal grains and grain storage equipment and structures against insect attack. The grain industry also emphasised the importance of continued availability of this chemical. It is particularly important for the barley and brewing industries, since it is one of the few chemicals approved by the industry for stored product pests in malting barley and the only organophosphate (OP). Although there are other chemicals registered for use in stored cereals, they are not all suitable for use in non-airtight storages. In addition, they do not control all the pests which attack barley, cause tainting in brewed products and/or interfere with the fermentation processes.

Bulk handling authorities in eastern Australia have developed management strategies which involve rotation of components of grain protectant mixtures over 2-4 year cycles. The resistance management strategy relies on resting components after major use for 4-5 years. Chlorpyrifos-methyl is due for resting so the preferred OP may revert to fenitrothion unless an alternative becomes available.

Fenitrothion is an important component of quality assurance and resistance management programs used by the grain industry and is strategically used to prevent development of insect infestation while complying with customer pesticide restrictions. Current requirements of many end users for low residue or residue-free grain have initiated strategies utilising reduced application rates coupled with aeration cooling or gaseous fumigation. The effect of these strategies has been to reduce the annual amount of grain treated with protectants, in some cases, to less than 40%.

Farm storage has become increasingly important in recent years. Many of these facilities are unsealed and for longer term storage, grain protectants are needed for grain to be maintained in an insect free condition. Pilot quality assurance programs are being trialed by grain growers and, if adopted, will provide further confidence that farmers are using fenitrothion in an appropriate way. Nevertheless, advice from state agricultural authorities indicates that while treatment with fenitrothion is not uncommon, it is still not used by the majority of growers.

Information was also received that there is likely to be a continued increase in the use of private and farm storages as the industry continues to diversify and deregulate. Commercial decisions will determine the proportion of sealed storages and the consequent ability to use fumigants or "non grain protectant" techniques. However, as with the central system, grain protectants will continue to be used on a significant portion of stored grain. The industry has thus advised that it is critical that fenitrothion remain available as it fulfils a vital role in the post-harvest sector of the farming, private and central storage systems.

Fenitrothion needs to be used with another specific insecticide to control *Rhyzopertha dominica* and there is widespread resistance in *Oryzaephilus surinamensis*.

Fenitrothion also serves a secondary purpose as a structure and equipment treatment, to remove residual infestations and prevent the establishment of new infestations in grain storages. These treatments generally occur at quarterly intervals throughout the year depending on grain residence time. Other than diatomaceous earth, which does not perform well in high humidity conditions and the highly expensive organophosphate azamethiphos, there are presently no other alternatives for fabric (equipment and structures) treatments available. The Grains Council in their submission to the review also advised that Dr J Desmarchelier has indicated that it may prove to be the most effective chemical treatment of structures for psocid control.

Locust and Grasshopper Control

Fenitrothion in an ultra low volume (ULV) formulation, is the chemical of choice for control of nymphal bands and adult swarms of Australian plague locusts by the Australian Plague Locust Commission (APLC) (member States - Queensland, New South Wales and South Australia) and Western Australia. It is also registered for control of Wingless Grasshopper, Migratory Locust, Spur-Throated Locust and other locust and grasshopper species as per the label in the same situations as Australian Plague Locust. These uses have been nominated as having strategic importance for crop and pasture protection by the States listed above. NSW Agriculture advised that the control of noxious insects is required under the NSW Rural Lands Protection Act 1989. Usage averages around 60-80 tonnes per season with none at all used in some seasons and up to 130 tonnes used in others.

As well as being used on pastures for locust control, it is also registered for use in apples, cherries, grapes, cabbages, lettuce and tomatoes to control locusts and wingless grasshoppers. Advice from the Western Australian Fruitgrowers and the Australian Apple and Pear Growers Association is that only the ground covering vegetation is sprayed for locust or grasshopper control, not the fruit trees themselves. Similarly, grapes are not normally oversprayed with this material since at the time when spraying is required there would be berries on the vines. Thus, vineyards are not sprayed from the air. In vines a baiting program is preferred rather than actual spraying of vines. However, once grasshoppers are past a certain development stage baiting is no longer effective and ground spray application is necessary. The practice at this stage is to spray non-bearing vines. If vines bearing fruit have to be sprayed the fruit is discarded. Treatment is usually carried out between rows or as a perimeter spray with shielded sprayers whenever the pests appear. It is understood that only the surrounds of vegetable crops are sprayed for locusts. This means of control is very regional and irregular ie once in five years.

The APLC has made some examination of the environmental effects of use of fenitrothion and these are covered in detail Section 6 (Environmental Assessment) of the overall report.

In addition, the APLC has done some work demonstrating that it does not contaminate standing wheat crops. The crop was treated by spraying with 267 g ai fenitrothion per hectare. Samples of heads were collected immediately after spraying and at intervals over a period of 14 days. Fenitrothion residues on head samples decreased rapidly from 8.2 mg/kg immediately after spraying, to 0.19 mg/kg after 14 days and no residue (limit of detection 0.1 mg/kg) was detectable on the raw grain at harvest 25 days after treatment. This aspect is covered in detail in the residues assessment.

Poultry Sheds

Fenitrothion is one of two chemicals registered for the control of lesser mealworm (Litter Beetle, Darkling Beetle or Black Beetle) infestations in broiler sheds. Advice from growers indicates that the recommended dose is usually applied twice, 4-6 days apart by boom sprayers and, in some cases, airblast orchard sprayers (for walls). The spray is applied to the cleaned floors of sheds, walls and in a band around the outside of the shed wall and the shed left to dry and air for a couple of days. Litter (usually wood shavings) is then placed in the shed and the shed left to stand for a few more days. Chickens are then introduced and no more chemical is applied during the growing period. A period of 7-10 days normally elapses between the removal of a finished batch of chickens and the introduction of a new batch. Occasionally, farmers will keep part of the litter from the previous batch and this litter is treated in the same operation as the shed floors and walls at the same rate of use and by the same method. Under normal circumstances, there is no treatment of litter at all.

Pastures

Fenitrothion is registered for control of sitona weevil in lucerne and pasture cockchafer, corbie, winter corbie, underground grass grub and oxycanus grass grub in pastures. It is also registered for locust control in these situations.

The majority of these pests are subterranean pests and a chemical which has residual properties is necessary if they are going to be effectively controlled.

Department of Primary Industries and Fisheries (DPIF) in Tasmania has advised that this chemical is used to control two uniquely Tasmanian pests of pasture, corbie (*Oncopera intricata* Walker), and a species of pasture cockchafer (*Aphodius pseudotasmaniae* Given), together with other more widely distributed species such as pasture cockchafer (*Aphodius tasmaniae* Hope), winter corbie (*Oncopera rufobrunnea* Tindale) and wingless grasshopper (*Phaulacridium vittatum* Sjöstedt). The most important of these are the corbies and the cockchafers. Although all of Tasmania's 900,000 ha of pasture may be subject to attack by these insects on an annual basis, in practice, only a comparatively small portion of this pasture (3000 - 6000 ha) is actually significantly effected and requires treatment. Fenitrothion is used at rates between 480-1300 g ai per ha in these situations.

Blackheaded pasture cockchafer, oxycanus grass grub and sitona weevil (lucerne) have been identified by the Victorian Department of Natural Resources and Environment as important pests of pastures in Victoria. Oxycanus grass grub and sitona weevil are sporadic pests, significant outbreaks of which occur every few years when conditions favour the pests. Use of fenitrothion in the control of blackheaded pasture cockchafer is favoured because of its residual activity.

Other Uses

Fenitrothion is also recommended for use for control of hide beetle in hides and skins. Limited information from skin processors suggests that salted hides are packed on pallets and only sprayed once using engine powered mobile sprayers with handheld wands immediately prior to loading into containers for shipping. One processor suggested that the major pests requiring control were not hide beetles, but flies.

Recommended Spray Programs by State Agricultural Authorities

Most State departments have recommended spray programs which include fenitrothion as an intrinsic component. A listing of these programs is presented in the following table.

Spray programs recommended by State agricultural authorities including fenitrothion

State	Spray Program
Tasmania	Control of pasture pests Hazard Resistant Pasture Program Wingless grasshopper control in vineyards
Queensland	Locust control Control of storage insects chiefly insects of cereals
South Australia	Australian Plague Locust Small Plague Grasshopper
Western Australia	Locust control insect pests in stored feed grain
Victoria	Locust control Grasshopper control in grape vines
New South Wales	Control of lesser mealworm in poultry houses Cereal grain protection and structural hygiene treatment Locust and wingless grasshopper control
Northern Territory	Not Recommended
Australian Capital Territory	Not Recommended

In general, State agricultural authorities expect demand to remain static or increase. Queensland however, expects a decrease since resistance to fenitrothion in grain storage is increasing and it is likely that chlorpyrifos-methyl will be substituted to an increasing extent.

Any assessment of usage is dependant on the occurrence of locust plagues (during which demand escalates sharply) and the rotation of storage insecticides in the grain insect resistance management program being undertaken by bulk handling corporations.

Registrants generally expect the demand to be stable or decrease. They attribute the decrease to alternative protectants and more use of fumigant and controlled atmosphere technologies.

1.2.1 Main Use Patterns

By far the major use patterns for fenitrothion in Australia are for grain and grain equipment treatment and locust control.

Grain Storage
Advice received during the review indicates that less than 20% of the intake is now treated with protectant chemicals. This figure encompasses all the protectants used in malting barley, for which there is currently no alternative protectant treatment which is acceptable to the brewing industry and a small amount used on other grains.

The Grains Council indicates that treatment rates used are as per registered labels ie 6 mg/kg for up to three months storage and 12 mg/kg for three to nine months storage (this application rate may be restricted to 10 mg/kg with cool, dry grain).

These protectant applications typically occur once each year during the grain harvest (November to February) and are usually applied to the grain as it is conveyed into the storage. Additional treatments are avoided due to resistance concerns and cost, but may be necessary in years with substantial grain carryover (such treatments would be conducted in October to November).

Fenitrothion also serves a secondary purpose as a fabric (equipment/structural) treatment, in which case it is used to disinfest grain storages of residual infestation and to prevent the establishment of new infestations. These treatments normally occur at quarterly intervals throughout the year, depending on grain residence time.

Only small quantities of the powder formulation are used, with almost all of this being used in on-farm storages.

The controlled gas formulation is also only rarely used for grain treatment, if at all, in the eastern States and is only used to any degree in Western Australia. The Flour Millers' Council of Australia (FMCA) in contrast, indicates that some mills use the fenitrothion/CO_2 formulation as a space treatment of the mill itself and as a residual insecticide sprayed onto mill structures and in some cases externally onto machinery. However, the major controlled gas formulation used is CO_2 and dichlorvos. Mills have become more reliant on these types of treatments because the previous practice of an annual whole site fumigation has diminished, particularly with the phaseout of methyl bromide for environmental reasons.

Locust Control
The area dose of fenitrothion ULV (1270 g/L fenitrothion) specified for the Australian plague locust is 300-400 mL/ha (Sumithion ULV currently used by APLC). However, in recent years the APLC has been applying 210 mL (267 g ai)/ha, and obtaining excellent control. A maximum rate of 400 mL (508 g ai)/ha is used only if there is some reason to suspect that the lower dose may not be effective, for example in tall, dense vegetation. Use of the lower area dose has cost and environmental benefits. Control of swarms /bands is achieved with a single spray and repeat sprays are not necessary.

1.2.2 Methods of Application

Grain Storage and Fabric Treatments
Fenitrothion is usually applied to grain at label rates as a coarse spray as it is conveyed into the storage subsequent to harvest. Additional treatments are avoided where possible because of resistance concerns and cost, but may be necessary in years with substantial grain carryover. The treatment normally takes place inside that portion of the augers/elevators which is inside the silos. Where spray is applied to grain on conveyor belts, it is usually applied as a shielded spray.

In situations where grain treatment is required on farm, fenitrothion would normally be used. However only a small proportion of grain is treated in this way. Application equipment used on farm are usually more open than those used for augers/elevators into major bulk storage facilities.

Fenitrothion is also used as an on farm treatment for machinery and empty storages. It is applied at label rates using knapsack or other portable spraying equipment directed at the infestations or places of potential infestations. Where on farm grain 'bins' are used as storages, the spray is normally introduced through hatches at the bottom of the 'bins'.

Locust Control
The APLC applies fenitrothion only as a ULV formulation by aircraft using Cessna 185 or similar aircraft fitted with two Micronair AU5000 rotary atomisers, and an incremental spraying technique. Standard operating parameters are a flying height of 10 m, a track spacing of 100 m, a flow rate of 7 L/min/Micronair and a Micronair blade angle of 50°. Advice from the APLC suggests that where other government agencies carry out locust control using aerial application (the APLC does not cover all of Australia or all areas in all member States) they do so in accordance with APLC practices. This type of application is mainly to native pastures. In this regard, NSW Agriculture advises that in their control operations, 94% of spray is applied using boom spraying, 1% by misters and 5% by spot spraying. Aerial application is rarely used because NSW Agriculture operates mainly in higher populated, intensive agriculture areas compared to the APLC.

Landholders normally treat their own properties and altogether can treat up to ten times the area treated by the APLC and State land protection agencies, should locusts reach plague proportions. However, it should be noted that other registered chemicals such as monocrotophos, diazinon and synthetic pyrethroids are also used by landholders. Where fenitrothion is used for protection of crops against locust attack, advice has been received that in Queensland the major method of application is misters mounted on four wheel drive utilities which blow the mist up to 100 metres into the crops. Label recommended rates per hectare are used in 20-40 L of water per hectare. The misters also facilitate control of locusts in bush and undergrowth. For spot spraying, landholders tend to target areas where the insects congregate using small area spraying techniques such as hand held boom sprays, knapsack sprayers or small boomsprayers mounted on ATVs (All Terrain Vehicles).

Advice from Tasmania indicates that significant quantities have not been sprayed on pastures from the air for 10 years. Application is by boom sprayers and is currently split evenly between farmers and ground spray contractors primarily to high value pasture carrying cattle (mostly dairy).

Poultry Sheds and Hides and Skins
Hand held wands, boomsprayers and orchard sprayers are used in poultry sheds to cover walls and floors, while hand held wands appear to be used for hides and skins.

2. EFFICACY ASSESSMENT

2.1 Background

One aspect of the contemporary assessment standards with which chemicals must comply in order to achieve and maintain registration is that use of products containing the chemical in accordance with the recommendations approved by the NRA for its use must be effective according to criteria determined by the NRA for the product.

Growers, commodity organisations, State agricultural authorities and the chemical industry have been surveyed for information on the performance of the chemical in the field, addressing aspects such as management strategies, methods of application and chemical failures. In particular, information has been sought on whether the way in which the chemical is presently used is the same as when it was first registered and whether the present label directions are still applicable.

These matters have been examined and the results presented in the following section of this report.

2.2. Current Usage

Registration Status
Fenitrothion is registered in a number of countries throughout the world.

There are 16 products containing fenitrothion currently registered in Australia by 9 registrants and these are listed in the following table.

Registered products containing fenitrothion*

NCRIS	Product Name	Applicant
32096	Fenitrogard Liquid Insecticide	AgrEvo Pty Ltd
48078	Tugon Poultry Shed & Storage Pest Insecticide	Bayer Australia Ltd
32983	Insectigas F Fenitrothion Insecticide	BOC Gases Australia Limited
42237	Insectigas FP Fenitrothion Insecticide	BOC Gases Australia Limited
42272	David Grays Fenitrothion 1000	David Gray & Co Pty Ltd
42038	David Grays Outdoor Fogger	David Gray & Co Pty Ltd
32984	Davison Fenitrothion 1000 Insecticide	Davison Industries an activity of Joyce Rural Pty Ltd
42612	Davison Fenitrothion 1280 ULV Insecticide	Davison Industries an activity of Joyce Rural Pty Ltd
47210	Farmoz Fenitrothion 1000 Insecticide	Farmoz Pty Ltd
40062	Synergen F Insecticide	Gibson Chemicals Ltd
52034	Nevweb Fenitrothion 1000 Grain Protectant	Australian Generics Pty Ltd
32986	Nufarm Fenitrothion 1000 Insecticide	Nufarm Limited
32091	Nufarm Fenitrothion Grain Protectant Powder Insecticide	Nufarm Limited
41502	Nufarm Fenitrothion ULV Insecticide	Nufarm Limited
46127	Rentokil Fenitrothion 1000 Insecticide	Rentokil Pty Ltd
39242	SJ Fenitrothion Insecticide	S. Jay Industries Pty Ltd
32992	Sumithion ULV Premium Grade Insecticide	Sumitomo Australia Ltd
45267	Sumithion 1000EC Insecticide	Sumitomo Australia Ltd
50775	Sumithion 1000EC insecticide	Sumitomo Chemical Australia Pty Ltd
50774	Sumitomo Sumithion ULV Premium Grade Insecticide	Sumitomo Chemical Australia Pty Ltd

*Note: This list does not include those products which have not been renewed by applicants but which are still permitted to be sold for two years to clear stocks.

ACTIVE CONSTITUENTS

NCRIS	Active Constituent	Approval Holder
44006	Fenitrothion	Sumitomo Australia Ltd
44499	Fenitrothion	Sumitomo Chemical Australia Pty Ltd

Crops/situations appearing on currently registered product labels have been listed in the following table.

Crops/Situations in which fenitrothion is registered

Grain storage facilities and equipment	Pasture & forage crops including lucerne and grazing sorghum
Insects infesting hides and skins	Lucerne
Insects in storage areas	Hides and skins
Broiler poultry house litter, walls, roof and feed sheds	Storage areas for hides and skins
Pastures and cereal crops	Pastures, pasture seed crops including grazing sorghum and lucerne, soybeans, also apples, cabbages, cherries, grapes, lettuce, tomatoes
Stored cereal grains (except seed sorghum)	Flying and crawling insects in outdoor living areas
Grain storage bins, headers, grain elevators, and grain	Stored cereal (uninfested wheat, barley, oats, rice,

handling machinery	sorghum and millet)

Supply and use of fenitrothion is also permitted by the NRA in certain circumstances such as minor and/or emergency uses and for trial purposes. Current permits which have been issued by the NRA for fenitrothion are presented in the following table.

Permits issued for fenitrothion*

Crops	Pests	State/Authority
Grain Sorghum, Maize	Spur-throated Locusts	QDPI
Grassland Pastoral Country (not leguminous pasture)	Spur-throated locust	Australian Plague Locust Commission
Pinus Radiata Plantation (0-2 years old)	Wingless grasshoppers	State Forests of NSW
Forestry Experimental Plots & Native Flower Crops	Spur-throated locust	QDPI

*Note: These crops may appear on registered labels but not for rates, pests etc nominated in permits. Permits may also be for trial purposes.

Registration Trends

During 1996-97, an amount of technical grade fenitrothion (both formulated and unformulated) of the order of 45 tonnes was imported into Australia. Since this material is formulated into 1000g/L or 1270 g/L products, it is apparent that just over 40000 L of fenitrothion could have been formulated in this period.

Advice from NSW Agriculture indicates that average usage by that department for locust control over the past 3 years has been of the order of 900 L of the EC formulation, of which 94% is applied by boom spray, 5% spot spraying and approximately 1% misters. The Queensland Department of Natural Resources advised that for the 1997-98 season an amount of approximately 1000 L of the EC formulation was used. In the same period in Queensland, an amount of almost 900 L was used by landholders and 1500 L by the APLC. However, NSW Agriculture notes that these have been years of low locust populations and further notes that usage in past plague years has reached as high as 30000 L.

Tasmanian authorities advised that 3200 - 4000 L was used in pastures in that State in 1997-98.

Most participants in the review do not anticipate any alteration in the current registration profile for fenitrothion. None of the registrants indicate any intention of extending registration of this chemical into new crops/situations and some registrants foresee a substantial reduction in the necessity for this chemical. None of the registrants indicated any intention to undertake any further research into use of this chemical.

Of the State agricultural authorities, only Queensland and New South Wales advised of current or intended trialwork with fenitrothion.

NSW is undertaking trials to assess the effectiveness of methoprene on malting barley. Fenitrothion is required for control of *Sitophilus spp* since methacrifos is not registered. Other alternatives are not acceptable to the malting and brewing industry. Future trials may also require fenitrothion for this usage. New South Wales also advised that it had undertaken APLC research projects and trialed new grain protectant mixtures for the National Working Party on Grain Protection.

In Queensland, current trialwork relates to ongoing monitoring of usage in stored cereals to maximise resistance management strategies and to detect any changes in levels of resistance in stored product pests. Queensland also advised that it had previously undertaken research in relation to the development of fenitrothion as a grain protectant, collection of residue data and efficacy of locust control.

Tasmania indicated that trials had been carried out in the past in relation to development of appropriate application rates and timing for control of corbie and cockchafer in pastures.

In South Australia trials had been undertaken in the past relating to control of sitona weevil in pastures and studies for the APLC relating to environmental matters and reduced rates of use.

2.3 Evaluation of Efficacy

Information contained in the performance questionnaires from all sectors of the rural industry surveyed in relation to this chemical indicated that it was still efficacious for the purposes claimed.

Registrants indicated that they did not have any information on any reduction in efficacy and had not received any complaints from growers in relation to failure to control nominated pests using this chemical.

All sectors noted that there is continuing difficulty with fenitrothion resistance in *Rhyzopertha dominica* and *Oryzaephilus surinamensis* in relation to grain protectant treatments. However, this difficulty is currently being overcome by the inclusion of other insecticides during treatment.

Alternatives

Stored Grain

It is possible that the use patterns currently specified on labels for protection of stored grain and grain products could be altered since commercial users such as bulk handling authorities and the Flour Millers' Council have agreements on use patterns which limit residues to well below the levels which would otherwise eventuate.

Chlorpyrifos-methyl or pirimiphos-methyl could be considered in some use situations as an alternative to fenitrothion. However, there are a number of drawbacks in relation to these chemicals. As well as being double the cost, chlorpyrifos-methyl is due for rotation in the resistance management strategy of bulk handling authorities. Resistance management would be more difficult if chlorpyrifos-methyl use had to be continued. Pirimiphos-methyl may not be as effective against all pests as fenitrothion and has longer lived residues. Neither of these chemicals can be used on malting barley.

Other grain protectant strategies which can also be used but which are not applicable in all situations include:

Aeration - widely used in the bulk handling system in conjunction with regular checking. On-farm aeration systems are practical alternatives to non-sealable silos but insect infestations may be delayed rather than controlled.

Flow-through fumigation - marketed to large scale users outside the bulk handling authorities for storage where sealing is incomplete but adequate at the base of the structure.

Single dose fumigation - recommended where silos are sealed to a high degree of gas tightness. It is usually uneconomic to retro seal existing silos.

Locust Control
The APLC has been successfully trialing lower rates of use for plague locust control than those recommended on the labels of registered products and it would appear that the rates of use, at least in this instance, could be lowered to 210 - 300 mL/ha.

There is currently no effective non-chemical treatment commercially available. Biological control using the fungi *Metarhizium anisopilae* is currently being investigated. However, this is unlikely to be an effective control mechanism, particularly in swarms or bands, because of the time taken (10-14 days) to kill the locusts.

To be judged appropriate for control of locust bands and swarms, an insecticide must give a predictable and high level of control under operational conditions, be as innocuous as possible to the environment and human users and the cost/ha must be acceptable.

The APLC has trialed a number of alternatives such as chlorpyrifos, maldison, lindane, carbaryl, a combination of fenitrothion and esfenvalerate and deltamethrin. The combination of residual activity, efficacy and safety to non-target species exhibited by fenitrothion continues to be superior to the chemicals tested to date. Fenitrothion has also proved to be more economical than other insecticides. In recent years initial trial work with fipronil has shown some potential. Further trial work, including investigation of environmental side effects, will be undertaken once fipronil is registered for locust control, provided the registered use pattern is acceptable in terms of withholding periods etc.

Poultry Sheds
Although adult lesser meal worm may lodge in the throats of young chicks and thereby cause physical harm to birds, the main problems are the damage larvae do to the building insulation and the potential for tapeworm transmission. Physical barriers and decoy pupation sites (to avoid larvae tunnelling into insulation) are possible alternative control strategies but these have not been taken up by producers.

Because fenitrothion has proved satisfactory in this situation, there does not appear to have been any trial work undertaken to find alternative chemical treatments . However, advice has been received during the review that the Queensland Department of Primary Industries has commenced a project to investigate control of lesser mealworm in poultry housing (including use of fenitrothion) which is scheduled o be completed in mid-2000.

Pastures
Attempts have been made in Tasmania to reduce the need for chemical intervention for control of corbie and cockchafer through a Hazard Resistant Pasture Program and unsuccessful research on a potential biological control agent. While the Hazard Resistant Pasture Program was partially successful, there will be a continuing need for the use of fenitrothion in control of corbie especially in pastures predominantly of ryegrass and clover.

One other chemical is important for this program and that is chlorfenvinphos. Apart from this alternative, some limited trial work has been carried out with synthetic pyrethroids which has suggested that they are not as effective against the corbies as the OPs.

2.4 Phytotoxicity

Phytotoxicity has been recorded in some sorghum varieties in Australia, and in cotton and brassica crops overseas. Injury has been recorded in certain fruit crops at high rates. Certain apple varieties may be russeted.

Phytotoxicity, in general, is not seen to be a major difficulty in relation to the current usage of fenitrothion for locust control in an agricultural or horticultural context. In fact, in most cases control can be achieved by application of the chemical between rows and around the perimeter of the crop using shielded and/or ground directed sprayers.

2.5 Resistance Management

Grain Protection
Resistance to fenitrothion is reported to be widespread in *Rhyzopertha dominica* and *Oryzaephilus surinamensis*. This is currently managed by incorporating a second chemical component such as bioresmethrin or phenothrin for control of resistant *R. dominica*, or methoprene growth regulator for control of resistant *O. surinamensis*. Alternative OPs, chlorpyrifos-methyl and pirimiphos-methyl, may be substituted in some, but not all situations. Fenitrothion or one of the OPs is currently required for control of *Sitophilus spp* and *Tribolium spp* as well as grain moths.

In cereal grain protection, bulk handling authorities in eastern Australia have developed management strategies of rotation of components of grain protectant mixtures over 2-4 year cycles. The resistance management strategy relies on resting components after major use for 4-5 years. Chlorpyrifos-methyl is due for resting so the preferred OP may revert to fenitrothion unless an alternative becomes available.

Poultry Sheds
Resistance is reported against lesser mealworm in poultry sheds. However, resistance is the first and only reason perceived by producers for control failures. These may be due to too

much reliance on insecticides and not enough litter management prior to spraying, rather than resistance in the insect.

2.6 Summary of Efficacy

In order to ascertain whether fenitrothion complies with contemporary assessment standards for efficacy, the NRA decided to survey groups in the community who supply, provide technical advice on the use of, or use, this chemical. Performance questionnaires were therefore designed for large and small scale users of the chemicals, commodity organizations, State agricultural authorities and the chemical industry.
Fenitrothion is an important chemical for insect control in a number of key areas of Australian agriculture.

Grain Storage
One of its main applications is in the control of insect pests of stored grain and associated equipment and structures. It is one of the few OP chemicals which is registered for control of insects in this situation and is used in rotation with other chemicals in a resistance management strategy by the grain handling industry. It is also the only protectant (as opposed to fumigant etc.) chemical approved by the industry for use in malting barley because it does not cause tainting of beer or interfere with fermentation processes.

Although there is resistance to fenitrothion in some species of grain insect pests, this resistance can be overcome by using other chemicals which target the resistant species in combination with fenitrothion. Bioresmethrin is one such chemical which is used in this way. The insect growth regulator, methoprene, can also be used.

The grain industry is extremely export oriented and has been highly conscious of the necessity to market grain which complies with the residue requirements of importing countries. It has therefore instituted its own patterns of use which result in effective control of the respective pests but produce minimal residues in grains.

Locust Control
The second major application of fenitrothion is its use for control of locusts in Australia, particularly through the Australian Plague Locust Commission (APLC) which is responsible for this activity in areas of Queensland, NSW, Victoria and South Australia. It has been used for this purpose since the early 1970's when the APLC was formed. It is also used for this purpose in Western Australia and in areas of member States not covered by the APLC. Use patterns employed for locust control by other government land protection agencies reflect those used by the APLC.

Usage of fenitrothion for this purpose varies from season to season and in some years no control at all is required. However, the amount of fenitrothion utilised by APLC is usually of the order of 60 - 80 tonnes per year, with a peak of approximately 130 tonnes being used in 1992-93 and none at all being used in 1982-83, 1988-89 and 1994-95. Advice from NSW Agriculture indicates that average usage by that department over the past 3 years has been of the order of 900 L of EC while the Queensland Department of Natural Resources advised that for the 1997-98 season they used approximately 1000 L of EC. In the same period in

Queensland, an amount of almost 900 L was used by landholders and 1500 L by the APLC. Tasmanian authorities advised that 3200 - 4000 L was used in pastures in that State..

The APLC has maintained a follow-up of all its control operations to assess the environmental effects and efficacy of the chemical. It has found that as well as continuing to be highly effective, the environmental consequences of using fenitrothion are less than could be expected from use of other pesticides. In this regard, the APLC has trialed a number of alternatives such as chlorpyrifos, maldison, lindane, carbaryl, a combination of fenitrothion and esfenvalerate and deltamethrin. The combination of residual activity, efficacy and safety to non-target species exhibited by fenitrothion continues to be superior to the chemicals tested to date. Fenitrothion has also proved to be more economical that other insecticides. In recent years initial trial work with fipronil has shown some potential. Further trial work, including investigation of environmental side effects, will be undertaken once fipronil is registered for locust control, provided the registered use pattern is acceptable in terms of factors such as withholding periods.

Other

Advice from the Tasmanian Department of Primary Industries and Fisheries is that fenitrothion is a critical component of pest control strategies used in Tasmania's pastures. Tasmania has two unique pasture pests, as well as those common to other Australian States, which threaten Tasmania's pastoral industries. Attempts have been made to establish a program which is less reliant on chemicals and which uses different chemicals. However, these have only been partially successful, and use of fenitrothion remains pivotal for preservation of Tasmania's pastures.

Fenitrothion is also the major chemical used for control of lesser mealworm in poultry litter. This use has been nominated as critical for the poultry industry by a number of States.

3. TRADE ASSESSMENT

3.1 Background

Another aspect of the contemporary assessment standards with which chemicals must comply in order to achieve and maintain registration is that use of the chemical must not result in any unacceptable risk to trade between Australia and other countries.

To evaluate the risk to trade when reviewing a product, matters taken into consideration include the following:
Compatibility of MRLs with trading partners (including whether or not MRLs have actually been set in the importing country, compatibility of use patterns etc.)
Registration status in the importing countries (including whether or not the material is banned or restricted in those countries)
Review status in recognized international forums (such as the Codex Alimentarius Commission) and whether the importing country is a member of the reviewing organisations or recognizes those organisations
Detection of violative residues by the National Residue Survey
Detection of violative residues in domestic produce which may indicate problems with overall use patterns
Violations of importing countries' residue limits detected as a result of any residue monitoring carried out by the respective importing countries.

These matters have been examined and the results follow.

3.2 Registration Status

See Section 2.2 (Current Usage - Registration Status) and Section 3.6 (Overseas Registration Status)

3.3 Exports to Other Countries:

3.3.1 Grains

Use of fenitrothion in Australian agriculture has the potential to significantly impact on Australia's trade with other countries in that it is considered to be critically important for the protection of stored grain and associated equipment and structures from insect attack. Although this is the only use for which fenitrothion is registered which significantly impacts on trade, its importance to the industry is such that it has been nominated by all grain producing States as critical for control of stored product pests.

This status has been maintained although reliance on grain protectant chemicals such as fenitrothion has been diminishing in recent years in favour of controlled atmosphere and fumigation technologies.

The Australian grains industry is an extremely important sector of the Australian economy.

Wheat is the most significant of the grains produced followed by barley, rice, sorghum and oats. Grain legumes and oilseeds are not subject to the same protective strategies in storage as the grains listed above. Hence, among these crops, fenitrothion is only registered for use in soybeans for locust control.

An average of approximately 12.5 million tonnes of wheat worth in the order of $2.9 billion (including flour exports) were exported in the 1995-96 and 1996-97 seasons. Barley exports averaged 2.7 million tonnes during the same period with an approximate value of $578 million (including malting barley and malt). Rice production was worth approximately $370 million, with sorghum and oats $35 and $25 million respectively.

Australia's major markets for wheat exports are China, the Commonwealth of Independent States (CIS), Japan, India, South Korea, Taiwan, Indonesia, Malaysia, Singapore, Iraq, Iran, Egypt and Yemen.

3.3.2 Grapes (fresh and dried) and Wine

Production of grapes for export may also be affected by changes in the registration status of fenitrothion. In this regard, it is noted that fenitrothion is registered on grapes for control of locusts and wingless grasshopper and that this use has been identified as very important for the industry by a number of State agricultural authorities. It should also be noted that the effect on this industry in relation to trade is not primarily in relation to residue issues but in relation to ability to supply the market. Locusts and grasshoppers attack the vines and therefore preventative spraying of areas surrounding vineyards and between the rows of vines is the usual method of control of these pests.

With this in mind, production of both dried fruit (mainly sultanas and currants) and fresh table grapes could be affected. Exports of table grapes were valued at around $33 million in 1995-96, 1996-97, and although there is a general trend upwards in exports, they tend to reflect good or difficult production seasons.

Wine is also a valuable export commodity which potentially could be affected by use of fenitrothion in the production of grapes used in wine making. ABARE indicates that exports of wine were valued at more than $470 million during the 1996-97 season.

Export markets which are or have recently become important include Singapore, Malaysia, Indonesia, Hong Kong, United Kingdom and New Zealand. There are other markets of interest to the industry which have problems with quarantine restrictions or other trade impediments. These markets include Japan, Taiwan and Korea.

In 1996-97, dried grapes worth approximately $41 million were exported from Australia. Germany, the United Kingdom, Canada, Japan and New Zealand are the major overseas markets accounting for about 80% of Australia's exports. The remainder is sold to other parts of Europe and Asia.

3.3.3 Other

Fenitrothion is also registered for control of locusts and wingless grasshoppers in apples, cherries, cabbages, lettuce and tomatoes. Advice from the APLC is that in orchards, the insects rarely attack the trees themselves, but the other vegetation in the orchards. Thus, spraying of the trees in orchards is not normally necessary and certainly is not carried out by air. Fenitrothion would not therefore be normally sprayed on cherries or apples and would not pose any possibility of residue violations. In addition, only spur throated locusts attack orchard trees with serious damage from this pest only occurring every 20-30 years. The availability of fenitrothion for these situations is unlikely to be significant from a trade perspective.

It is commented that a small amount of dressed poultry is exported and that there are no Codex MRLs for fenitrothion for poultry meat or offal. It is also noted that the industry is seeking to develop markets in Asia for processed products. It is possible that this could be a difficulty if residues of fenitrothion were detected in poultry products as a result of its use in poultry sheds (or as a result of consumption of grain treated with fenitrothion). However, the use pattern in this instance, where contact between the birds and the spray does not occur, would appear to rule out this difficulty. Further evidence that this aspect is unlikely to affect trade can be seen in the fact that fenitrothion has not been detected in poultry products in any of the residue surveys.

3.4. Potential Trade Problems

Potential trade problems could arise from the use of fenitrothion as a protectant insecticide for stored cereal grains. It is possible that residues which are unsatisfactory to importing countries could arise from such use.

However, it is clear that the grains industry in Australia has taken management steps to ensure that Australian grain complies with the market requirements of the importing countries and residue violations are now extremely rare. Among the management options exercised by the industry is a voluntary industry residue limit of half of the Australian MRL.

A comparison of some trading partner MRLs follows:

Comparison of selected MRLs for fenitrothion

Commodity	Countries' MRL/Tolerance for fenitrothion (mg/kg)				
	Australia	Singapore	Japan	United States	Codex
Cereal grains	10	10	MRL not set		10
Wheat bran (unprocessed)	20	20	MRL not set		20
Wheat germ	20	MRL not set	MRL not set		MRL not set
Wheat flour	MRL not set	2	1		2
Wheat bran (processed)	MRL not set	2	MRL not set	No food or feed uses	2
Wheat (wholemeal)	MRL not set	5	MRL not set		5

White bread	MRL not set	0.2	MRL not set		0.2
Rice	See cereal grains	1 (polished)	0.2		1 (polished)
Wheat	See cereal grains	See cereal grains	10		See cereal grains
Barley	See cereal grains	See cereal grains	5		See cereal grains
Other Grains	See cereal grains	See cereal grains	1		See cereal grains

Residue detections have been made by the National Residue Survey in several export grain commodities, some examples of which are listed in the following tables.

These results have been extracted from the grains industry submission to the review. They show clearly that the industry quality assurance programs (in place 1993-94), in conjunction with a revised monitoring program by the National Residue Survey (NRS), have had a marked effect in reducing residue detections. Perhaps not so clear, but just as significant, is the fact that there was only one sample with a residue in excess of the respective MRL in the 1994-97 period.

Residues of fenitrothion detected in export grains by the National Residue Survey*

Commodity	**% of samples with fenitrothion residues****
barley	63
oats	25
sorghum	62
wheat	55
wheat bran	67

* Period 1988-94
** <1% (in most cases <0.5%) exceeded MRL

Residues of fenitrothion detected in export grains by the National Residue Survey*

Commodity	**% of samples with fenitrothion residues****
barley	36
oats	10
sorghum	2.25
wheat	17.5
wheat bran	45

* Period 1994-97
** Only one incident (in barley) of residues above MRL was recorded in all grains for the period

Another possible trade problem relates to crop damage and a consequent inability to supply markets. This relates to the inroads which locusts can make if unchecked. However, such a problem has not arisen in recent years and early intervention continues to ensure that locust plagues do not affect Australian agricultural industries.

3.5 Advantages of product

Advice from the grains council is that this product is highly effective and has a useful residual life which is necessary for control of grain storage pests. Resistance has been recorded in two species (*Rhyzopertha dominica* and *Oryzaephilus surinamensis*) for some time and the level of resistance is gradually increasing. Despite this, fenitrothion is still a valuable tool to the grain industry when used in combination with insecticides or insect growth regulators which control the resistant species.

Snelson (Grain Protectants, Snelson JT, ACIAR, Canberra, 1987, p147) notes that there is "...minimal penetration of fenitrothion into the grain so that the deposit is mostly removed in bran of wheat and husks of rice. Less than 10% of the applied dose is carried over into flour where it is degraded in storage, preparation and cooking until only 1-2% of the residue in the grain remains in white bread. The residues in bran are readily destroyed in the industrial processes used for preparing breakfast cereals. Residues on brown rice and milled rice are reduced 60-80% by cooking, leaving only a small residue in cooked rice."

Advice from the APLC indicates that although a number of insecticides have been tested, fenitrothion is the insecticide of choice because of its superior efficacy and longer residual life. It has also proved to have less environmental side effects than any of the alternatives tested. These factors have also been identified as being important to its usefulness in controlling pasture pests such as corbies and cockchafers.

The poultry industry has also commented that the residual life of fenitrothion coupled with its effectiveness are significant advantages in relation to use of this chemical in broiler sheds.

3.6. Overseas Registration Status

Fenitrothion is registered in many countries including those listed in the following table. To date, no information has been discovered which suggests that action has been taken in any country to ban this chemical.

However, it is noted that the US EPA's RED Facts Sheet lists only ornamental (including trees) and public health applications for fenitrothion and records that no food or feed uses are registered.

Finland	The Netherlands
Denmark	Austria
Ireland	France
United Kingdom	Spain
Belgium	Italy
Greece	Japan
United States	China
India	Indonesia

Trade names for products containing fenitrothion which are registered in overseas countries include Accothion, Cyfen, Cytel, Dicofen, Fenstan, Folithion, Kaleit, Mep, Metathion, Micrommite, Novathion, Nuvanol, Pestroy, Sumanone, Sumithion and Verthion.

It is formulated overseas into dusts, emulsifiable concentrates, flowables, fogging concentrates, granules, ULVs, oil-based liquid sprays and wettable powders.

In some countries, for example Japan, it appears to be extensively used as an alternative/replacement for parathion.

3.6.1. Use Patterns in Relevant Countries Overseas

Detailed information on use patterns in overseas countries is not readily available. However, information from the United States indicates that fenitrothion is used in that country for control of chewing and sucking insects (including locusts and grasshoppers) in forest trees, indoor and outdoor mosquito control, nursery stock, ornamentals and trees. In other countries it is used on tobacco, rice, mulberry, rape, orchards, grapes, forests, pastures, tea, cocoa, sugar beet, citrus, field and vegetable crops, cotton, cereals, coffee, soybeans and sugarcane. It is also used as a public health and stored product insecticide in Europe.

The World Health Organization (WHO) confirms its effectiveness as a vector control agent for malaria and as a control chemical for its list of nuisance insects.

It is also commented that the spectrum of insecticidal activity of fenitrothion is very similar to that of parathion and some countries, for example Japan, use fenitrothion extensively as an alternative to parathion which has limited use due to regulatory activity.

Snelson indicates that fenitrothion has been widely used for grain protection in a number of countries at similar rates to those used in Australia (Grain Protectants, Snelson JT, ACIAR, Canberra, 1987, p 147). He also notes that it has proved to be suitable for use under tribal storage conditions where it is usually applied in the form of a dilute dust.

3.6.2 MRLs in Overseas Countries

(See also Table 4 - Section 2.2.4)

The major concern in relation to MRLs in overseas countries relates to residues in grains. Advice from the Grains Council of Australia indicates that most countries which import grains from Australia accept Codex MRLs. These limits have been consistently met. The grains industry takes specific measures to ensure grain is supplied in an appropriate condition to the few markets which have pesticide residue MRLs set below the Codex and Australian MRLs. It also ensures grain is supplied to contractual standards where those are lower than the Codex and Australian MRLs.

3.6.3. Codex MRLs

A comparison of Australian and Codex MRLs reveals a number of inconsistencies, only one of which may be significant for trade. This is the 'soya bean (dry)' MRL for which the Codex MRL is 0.1 mg/kg while the corresponding Australian MRL is 0.3 mg/kg.

This is not likely to be a problem as soya bean and other grain legumes are generally not treated with protectant chemicals in storage. However, the labels for fenitrothion products include soya bean as a crop which may be treated for control of locusts and it is therefore possible that residues may arise in this way.

Other incompatibilities include Australian MRLs for sugar cane, tree nuts, fruit, vegetables and some of the animal produce MRLs for which there are no Codex equivalents. However, some of the Australian MRLs are incompatible with the registration status of the chemical. For example, fenitrothion is not registered in sugar cane or tree nuts.

A complete examination of the residue situation is contained in the Residues section of the report.

3.7. Export Slaughter Intervals

Export slaughter intervals have not been developed for this chemical although it is likely that grain treated with fenitrothion will be fed to beef and dairy cattle. However, fenitrothion does not accumulate in animal tissues and it is unlikely that action will be required on this matter. It is also noted that any grain from central storages will be subject to the same residue minimisation strategies adopted by bulk grain handling authorities. Residues in meat and milk should therefore remain within the set MRLs without the necessity of an export slaughter interval.

Further discussion of residues in animal commodities is contained within the section on residues.

3.8. Labelling Related to Trade

Specific labelling related to trade has not been proposed for this product. However, the grains industry has adopted use patterns which are designed to enable all grain treated with this chemical to comply with half the currently set Australian MRL. This action has been taken to ensure that Australian grain does not contain excessive residues in relation to overseas MRLs. Some consideration may be given to lowering the MRL and altering use patterns to reflect current industry practice.

3.9. Data Submitted to Support Compliance with Overseas MRLs

Data have not been submitted to support compliance with overseas MRLs. It would appear that the Australian MRLs have simply been adopted from the Codex MRLs, with little effort to take into account respective use patterns.

The grain industry submission indicated that Australia has been able to comply with the requirements of its customers in terms of residues of fenitrothion without any difficulties. Some of these markets insist on pesticide free grain, while others require residues below those required for compliance with Australian MRLs. The industry has adopted a voluntary residue limit which is half of the Australian MRL and has adopted management strategies which have enabled them to comply with this limit. Data from the National Residue Survey show that there has been a significant reduction in the number of detections of fenitrothion since the strategies were adopted in the early 1990s.

The residues section of the overall report deals more fully with this matter.

3.10. Authorities and Grower Views on Use

All groups represented during the survey of the current usage of fenitrothion indicated that this chemical was a critical component of pest control strategies used in their respective farming situation or the situations which they represented. Following is a table with the situations considered to be pivotal by respective State authorities:

Table 6 - Uses advised as critical by State agricultural authorities*

Crops/Situations	State / Critical Uses						
	Qld	NSW	Vic	SA	WA	Tas	NT	ACT
Stored Malting Barley	Stored product insects	Stored product insects	Stored product insects	Stored product insects	Stored product insects	Stored product insects		
Pastures, crops, horticulture (apples, cherries, cabbages, lettuce, tomatoes)	Wingless grasshopper, Locusts	Wingless grasshopper, Locusts	Wingless grasshopper, Locusts	various pests, sitona weevil (lucerne)	Wingless grasshopper, Locusts	Wingless grasshopper, corbie (*Oncopera intricata* Walker, *Oncopera rufobrunnea* Tindale), pasture cockchafer (*Aphodius pseudotasmaniae* Given, *Aphodius tasmaniae* Hope)		
On-farm hygiene (fabric) treatments					Stored product insects			
Stored cereal grain (including feed grain)	Stored product insects	Stored product insects	Stored product insects	Stored product insects	Stored product insects	Stored product insects		
Poultry houses		Lesser mealworm						

*** Note: These uses may be considered critical although there are other products registered for the nominated pests. This may be because fenitrothion is considered to be an critical part of a resistance management strategy or an integrated pest management strategy.**

3.11. Other

The most recent Australian Market Basket Survey provides the following information on fenitrothion in the Australian diet.

The ADI for fenitrothion is 3 μg/kg bw/day

The estimated intake in diets based on the average energy intake range from 0.0923 μg/kg for an adult female to 0.3011 μg/kg for a child aged 2.

The estimated intake based on the 95th percentile energy intake range from 0.1534 μg/kg for an adult female up to 0.3534 μg/kg for a child aged 2.

The maximum levels of fenitrothion found in Australian foods in the most recent Market Basket Survey are:

Biscuits, sweet	0.11 mg/kg
Biscuits, wholemeal	0.03 mg/kg
wheat	1.20 mg/kg
Bread, white	0.08 mg/kg
Bread, wholemeal	0.31 mg/kg
Cheese, cheddar	0.01 mg/kg
Chocolate flavoured cereals	0.02 mg/kg
Cornflakes	0.01 mg/kg
Muesli, untoasted	0.11 mg/kg
Oats, rolled	0.07 mg/kg
Oil, canola	0.02 mg/kg
Pasta, spaghetti	0.05 mg/kg
Sausages	0.07 mg/kg
Semolina	0.04 mg/kg

It is commented that all residue detections, apart from the canola oil, can be related to use of fenitrothion in the protection of stored grain from insect attack.

Fenitrothion residues have also been detected in several export commodities by the National Residue Survey (See Section 2.2.4). In most cases, these residues have been well below the MRLs for these commodities.

3.12 Summary of Trade

There does not appear to be any overseas regulatory activity in relation to fenitrothion which could cause difficulties with overseas trade in produce treated with or containing legal residues of the chemical.

In addition, although there are some incompatibilities between Australian maximum residue limits and those of some trading partners, the respective industry bodies have introduced appropriate self-regulation. It is noted in this context that there are no food or animal feed uses approve for fenitrothion in the USA and consequently no tolerances for these uses.

Grain Protection

There is thus only one area of Australia's trade with other countries which may be affected if there were any change to the current conditions under which fenitrothion is available to agricultural industries in Australia. This is the protection of stored grain, grain storage facilities and equipment from grain storage insect pests.

However, it clear from the submission from the Grains Council, as well as the results of the National Residue Survey and the Market Basket Survey, that in general, residues of fenitrothion in grain and other associated products such as wheat bran and wheat germ are well below Australian maximum residue limits and comply with the stringent limits imposed by some other countries which demand residue free or very low residue produce. This situation may be directly attributed to self imposed residue standards, use patterns and management options adopted by the grains industry. These changes in the industry have resulted in a steady decline in the use of fenitrothion and other protectant insecticides in grain storage. Thus, in the 1996-97 crop year, information from the Australian Wheat Board indicates that the quantity of wheat estimated to be treated with grain protectants on a State by State basis varies from 0% to 54.3%.

It is therefore also clear that fenitrothion plays a significant role in Australia's grain industry in relation to protection of grain and equipment and structure treatments. Of particular importance are protection of stored grain in non-sealed central storages and on-farm storages, as well as protection of malting barley. It is also an integral part of resistance management strategies where it is used as part of the chemical rotation.

Locust and Grasshopper Control

Although the labels of fenitrothion products provide directions for control of locusts and wingless grasshopper for several other crops with significant export markets, it is not usual for the produce from these crops to be sprayed. For example, information from the Australian Plague Locust Commission (APLC) indicates that orchards are not oversprayed for locust control. Control is accomplished by spraying the verges of orchards and the ground vegetation within the orchards. Similarly, although fenitrothion is registered for locust/wingless grasshopper control in vineyards, the use pattern employed usually involves spraying locusts in the surrounds of the vineyards before they reach the vines or baiting, to prevent damage. Some overspraying of young vines may occur but there is no spraying of fruit.

Other

Other uses such as control of hide beetle in skins and hides and control of litter beetle in poultry houses have little or no effect on Australia's trade with other countries. It is worth noting however, that although only 1.4% of Australia's current production of poultry meat (worth $11 million) is exported, the industry is seeking to expand in this area. Of particular significance are processed products for the Asian market.