Section 5

OCCUPATIONAL HEALTH AND SAFETY ASSESSMENT

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1. INTRODUCTION

The following sources of information were used in this review of fenitrothion:

National Registration Authority for Agricultural and Veterinary Chemicals (NRA) Performance Questionnaires initiated as part of the review;

Toxicology report

Environment report;

Industry registrants;

Efficacy Assessment;

Public submissions; and

Field trips.

2. TOXICOLOGY

2.1 Toxic end points

The following information is derived from the DHFS Report "Review of the Mammalian Toxicology and Metabolism/Toxicokinetics of Fenitrothion" (DHFS, 1998). This section describes the toxic end points relevant to the occupational risk assessment.

Technical fenitrothion is of moderate oral and dermal toxicity and low to very low inhalation toxicity. The lowest oral LD_{50} is 235 mg/kg bw (rat, female), lowest dermal LD_{50} is 890 mg/kg bw (rat, male) and lowest inhalation toxicity is >2210 mg/m^3 (4 hr, rat, male & female). It is not a skin or eye irritant in rabbits nor a skin sensitiser in guinea pigs.

In mammals, fenitrothion is rapidly detoxified and excreted mainly in urine, as desmethylfenitrothion, desmethylfenitrooxon and 3-methyl-4-nitrophenol (NMC). Urinary excretion is almost complete within 24 hours of exposure. NMC is commonly used in biological monitoring for fenitrothion exposure. The main metabolite in the blood is fenitrooxon.

The acute oral toxicity of the parent compound, the metabolites and the s-methyl isomer, an impurity of the technical grade active constituent (TGAC), are presented in Table 1. The toxicity of these compounds is dependent on the vehicle and species.

Table 1: Toxicity of fenitrothion, its metabolites and the S-methyl isomer

Acute toxicity	Fenitrothion	Fenitrooxon	3-methyl-4-nitrophenol/*p*-nitro-*m*-cresol (NMC)	S-methyl isomer of fenitrothion
Oral LD50 (rat)	235 mg/kg bw-1050 mg/kg bw	3.3 mg/kg bw	1200-2300 mg/kg bw	315-540 mg/kg bw

Exposure to UV radiation may increase the toxic potential of fenitrothion in the environment because of the formation of uncharacterised breakdown products with greater toxicity than the parent compound.

Fenitrothion was applied dermally at 0, 3, 10, 50 or 250 mg/kg bw/day on rabbits for 3 weeks. At 250 mg/kg bw/day, 5/5 males and 2/5 females died or were moribund and sacrificed during the treatment period. No treatment-related haematological or biochemical changes were observed at any dose. A no-observed-effect-level (NOEL) of 3 mg/kg bw/day was determined, based on the inhibition of serum and brain cholinesterase (ChE) activity at higher doses.

A NOEL of 0.3 mg/kg bw/day (5 ppm) was determined from a 92 week dietary study in rats based on a significant inhibition of plasma ChE at the next highest dose of 10 ppm.

Fenitrothion administered orally to dogs at 0, 5, 10 or 50 ppm for 12 months demonstrated inhibition of plasma ChE at 50 ppm in males and 10 ppm in females. Erythrocyte (RBC) ChE inhibition was seen only in males only, at 50 ppm. No histopathological examination of tissues was carried out. The NOEL for this study was 5 ppm (equivalent to 0.2 mg/kg bw/d) based on plasma ChE inhibition in females. This is the most conservative NOEL for fenitrothion in laboratory species. This NOEL is used in the risk assessment.

There is no clear hierachy between plasma, RBC and brain ChE inhibition in experimental species. Brain ChE is generally depressed in concert with RBC and plasma ChE. Plasma, RBC or brain ChE levels are used in biological monitoring studies to determine exposure to fenitrothion.

Fenitrothion is not genotoxic, carcinogenic or teratogenic. It is not a reproductive or ocular toxin.

A single dose of fenitrothion of 500 mg/kg bw administered orally to hens to induce delayed neurotoxicity produced symptoms of ataxia, balance loss, spontaneous motor activity loss, leg weakness and an irregular respiratory rate. No leg paralysis or histopathological evidence of sciatic nerve degeneration or demyelination was noted. The DHFS conclude that there was no evidence of delayed neurotoxicity.

There is some evidence to suggest neurotoxicity following repeated oral dosing of rats and rabbits, after a 4 or 8-week exposure to relatively high doses (impaired sciatic nerve conduction velocity, axonopathy and slowed conditioned avoidance reflex). However, the DHFS conclude that this study was inadequate for regulatory purposes.

There is some evidence to suggest that chronic exposure to low doses of organophosphates (OPs) produces cumulative poisoning with subclinical effects initially, but with increased susceptibility to further toxic assault and progressive neuropathy (DHFS, 1998). Most repeat dose studies available for fenitrothion conducted in laboratory species did not specifically examine the neuropathic potential of the chemical.

Summary of human clinical studies

Two studies were conducted in volunteers.

In the first study, Nosal and Hladka (1968) (cited by DHFS, 1998) investigated plasma and RBC ChE activity and the urinary excretion of NMC in 2 groups of volunteers. The first group of twenty four volunteers received a single oral dose of 0.042-0.33 mg/kg bw fenitrothion. Oral doses of 0.04-0.08 mg/kg bw of fenitrothion were given for four consecutive days to a second group of five volunteers. Results of the first group revealed complete excretion of the urinary metabolite NMC after twenty four hours. Neither mean plasma nor RBC ChE activities were depressed much below normal (<10% depression was considered to be normal) in this group. Results of the second group revealed almost complete excretion of NMC in the urine within twelve hours. Neither plasma nor RBC ChE activity was affected by repeated dosing.

In the second study, a group of 6 volunteers was given oral fenitrothion at 0.1 mg/kg bw by capsule. Six-seven days later, the same emulsion was applied topically at the identical dose. Doses of 0.5 and 0.1 mg/kg bw were reapplied to the skin on the 2nd and 3rd day after initial topical application, respectively. A second group of 6 volunteers was given fenitrothion orally at 0.5 mg/kg bw, and the dose was repeated 2-3 days later. No treatment related clinical signs nor significant plasma or RBC ChE inhibition was noted in either group (Shelanski et al., 1977 - cited by DHFS, 1998).

Fenitrothion has been reported to cause Intermediate Syndrome in humans. This is a neuromuscular condition characterised by muscular weakness affecting the neck, proximal limbs and respiratory muscles, which occurs 24-96 h after exposure. A retrospective study (Groszek et al., 1995 - cited by DHFS, 1998) examined 16 cases of fenitrothion poisoning (oral ingestion, 9 attempted suicides and 7 accidental). The individuals had consumed 50-100 mL of a 50% fenitrothion solution (25-50 g fenitrothion). Six died within 5-22 days after ingestion. The cause of death is not documented. Plasma fenitrothion concentrations in fatal cases ranged from 0.47-8.35 µg/mL. Of the 10 survivors, 7 developed Intermediate Syndrome. Plasma fenitrothion concentrations in patients who developed the Intermediate Syndrome and those who did not were 0.18-3.02 µg/mL and 0.096-0.36 µg/mL, respectively.

A published report (Wadia et al., 1977 - cited by DHFS, 1998), described the clinical outcome of 48 patients who had ingested fenitrothion. One death occurred after ingestion of 3 g of the chemical. Paralysis was observed in 11 individuals at the following dose levels: 6 g (2/3 patients), 3 g (7/20 patients), 1.5 g (2/16 patients). On average, the onset of paralysis was seen approximately 10 hrs (range 2-60 hrs) after ingestion. ChE inhibition in these 11 patients was >80% depression (7 patients), 60-80% depression (2 patients), 40-60% depression (1 patient). No comment is made on the ChE levels of the remaining patient. No paralysis was observed in 9 patients who had ingested <1.5 g of fenitrothion.

Conclusion

The animal and human volunteer studies for neuropathic changes are not conclusive as to the effects of fenitrothion exposure in workers. Clinical case reports suggest that ingestion by humans can lead to paralysis and Intermediate Syndrome. The DHFS has concluded that further studies are warranted to specifically examine the neuropathic potential of fenitrothion.

Acute Reference Dose (RfD)

The significance of the acute RfD is to determine safe or acceptable exposure from a single or short exposure to fenitrothion. The DHFS has determined the acute RfD from one human and one animal study.

In a human volunteer study, no plasma or RBC ChE depression was noted at a single dose of 0.33 mg/kg bw. Using a 10-fold safety factor, the acute RfD in humans is 0.03 mg/kg bw.

An acute RfD based on a 1-month rat study is 0.025 mg/kg bw derived from the NOEL of 2.5 mg/kg bw for ChE inhibition and a 100-fold safety factor. This value supports the acute RfD of 0.03 mg/kg bw/day in humans.

Dermal absorption

Measurement of plasma fenitrothion in rats dermally treated on the back with fenitrothion at 0.73 g/kg bw, indicated that it was readily absorbed through the skin. Significant blood levels of fenitrothion were found two hours post-application and peaked at 8 hours. The concentration of fenitrothion in the blood correlated with increasing inhibition of ChE. After 24 hours, 55% ± 4.5% of the chemical remained on the skin. In another experiment, there was a 19.6% inhibition of ChE activity after a single dermal dose (0.1mL/0.73 g/kg bw) of fenitrothion to rats. The inhibition increased to 64% following 3 applications and 100% following 5 applications of the same dose. Results indicate that increasing amounts of fenitrothion can be absorbed by repeated dermal application (Kohli et al., 1974).

Anand et al. (1977) conducted a study in rats following a single dermal application of fenitrothion on the back at 750 mg/kg. The concentration of brain acetylcholine, blood and brain acetylcholinesterase activity and the concentration of fenitrothion in plasma were determined. Significant amounts of fenitrothion were present in the plasma one hour after dermal application. This corresponded to approximately 75% inhibition in brain ChE activity. Plasma fenithrothion levels increased with time, reached a maximum at 4 hours, and showed a continuous decline at 16 and 24 hours. Results showed that fenitrothion was readily absorbed through rat skin.

Moody & Franklin (1987) compared the percutaneous absorption of radiolabelled fenitrothion in rats and monkeys, by measuring radioactivity of urine following topical application of ^{14}C-labeled compound. An equivalent dose of radiolabeled compound was given intramuscularly (im) to measure the amount retained in the body or excreted via other routes. Rats were dosed with 1 μCi either by im injection into the gastrocnemius muscle or by dermal application to a shaved area in the midlumbosacral region. Monkeys were dosed with 1 μCi either by im injection into the upper exterio-lateral thigh or by dermal application to the forearm or forehead.

In the rat, 69% of the im dose and 84% of the dermal dose was excreted in the urine after 7 days. In the monkey, 95% of the im dose and 70% of the dermal dose (49% following application to the forehead & 21% to forearm) was excreted after 7 days. The study authors conclude that the higher estimation of absorption seen in the rat, coupled with the significantly lower urinary excretion following im dosing, indicate that caution should be exercised when considering the rat as a useful model for predicting dermal penetration of chemicals in humans.

Tos-Luty et al. (1994) studied the dermal penetration of fenitrothion in rats exposed to concentrations of 0.2%-4% (3.97-100.09 mg fenitrothion/g of rat tail tissue) applied to tail skin for 4 hours. A fenitrothion:ethanol solution was applied to the area of direct exposure and covered with absorptive fabric and aluminium foil. The site of direct exposure and the site adjacent to the exposure zone were restricted by an application of collodium which constituted a preventive barrier against the diffusion of the liquid. Results indicated that the highest penetration of fenitrothion occurred at the lowest concentration of 0.2% (3.97 mg/g). After the 4 hour exposure, the amount of fenitrothion found in the rat tail skin was 6.47% of the dermal dose at the exposure site and 0.55% in the adjacent area. This study could not confirm whether fenitrothion penetrated through the skin appendices, namely, hair follicles, sebaceous glands or sweat glands.

<u>Conclusion</u>

Based on above information, it appears that fenitrothion is readily and rapidly absorbed through the skin of experimental animals (Kohli, 1974; Anand, 1977). Evidence suggests that fenitrothion continues to be absorbed with repeated exposure (Kohli, 1974). Some studies indicate a species difference in dermal penetration (Moody and Franklin, 1987) and differing absorption based on the concentration of fenitrothion applied to the skin (Tos-Luty, 1994).

None of the above studies provides a reliable indication of the percentage of dermal penetration of fenitrothion in humans. A default value of 10% is used in the risk assessment, although it is recognised that this may be an underestimate.

2.2 Hazard classification

Active constituent

Fenitrothion is listed in the NOHSC List of Designated Hazardous Substances (NOHSC, 1994a). Substances containing fenitrothion are classified as hazardous at concentrations greater than or equal to 25%. The risk phrase assigned to fenitrothion is as follows:

Risk phrase

R22 Harmful if swallowed

NOHSC (1994a) does not include any safety phrases for fenitrothion.

The revised European Commission classification has included the following additional risk and safety phrases (European Commission Directive 96/54/EC, 1996).

R50 Very toxic to aquatic organisms

R53 May cause long term effects in the aquatic environment.

S2 Keep out of reach of children

S60 This material and its container must be disposed of as hazardous waste

S61 Avoid release to the environment. Refer to special instructions/safety data sheets

End use products

All emulsifiable concentrate (EC) and ultra low volume (ULV) formulations of fenitrothion registered in Australia are determined to be hazardous substances, based on the approximately 100% concentration of active constituent in the products (1 kg/L in EC formulations and 1.27 kg/L in ULV formulations). The grain protectant powder products, all containing 2% fenitrothion, cannot be determined to be hazardous based on the concentration of the active constituent alone.

3. OCCUPATIONAL EXPOSURE

3.1 Handling prior to end use

The following information was provided by the registrants.

Davison Fenitrothion 1000 Insecticide and Fenitrothion 1280 ULV are formulated in Australia from imported TGAC. They are packed in 1 L and 5 L steel cans and 20 L and 200 L steel drums.

Sumitomo Sumithion 1000 EC is formulated in Australia from imported TGAC. It is packed in 5 L containers.

Nufarm Fenitrothion Grain Protectant Powder Insecticide and Fenitrocarb Grain Protectant Powder Insecticide are formulated in Australia from imported TGAC. They are packed in 15 kg plastic bags in plastic pails. Fenitrothion 1000 Insecticide and Fenitrothion ULV are formulated in Australia from imported TGAC and packed in 500 mL and 2.4 L tin cans and 20 L steel drums.

Fenitrogard Liquid Insecticide is formulated in Australia from locally manufactured TGAC. It is packed in 1 L and 20 L steel drums.

David Gray Fenitrothion 1000 is formulated in Australia from imported TGAC and packed in 20 L round drums with bung and cap.

Manufacture of TGAC and formulation of fenitrothion products takes place in Australia. No local worker exposure data are available for manufacture or formulation processes. Employer responsibilities exist under hazardous substances regulations for fenitrothion products.

Manufacturing and formulation workers require personal protective equipment (PPE) where sufficient engineering controls are not in place. Transport and storage workers only handle the packaged active ingredient and end use product (EUP). These workers and retailers could only be exposed to fenitrothion if packaging was breached.

3.2 Use pattern of the end use products

Fenitrothion is used all year round in agricultural and non-agricultural situations. Peak use is in summer.

Fenitrothion is recommended for use in many State pest/disease control programs and resistance management strategies across Australia. State chemical co-ordinators did not indicate that it is included in State Integrated Pest Management (IPM) programs.

Various State agricultural authorities have outlined essential uses of fenitrothion (refer Table 2).

Table 2: Uses advised as important by State agricultural authorities

Crops/Situations	QLD	NSW	Vic	SA	WA	Tas
Stored malting barley/ stored cereal grain (including feed grain)	Stored product insects	Stored product insects	Stored product insects	Stored product insects	Stored product insects	Stored product insects
Pastures, horticulture (apples, cherries, cabbages, lettuce, tomatoes)	Wingless grasshopper, Locusts	Wingless grasshopper, Locusts	Wingless grasshopper, Locusts	Various pests	Wingless grasshopper, Locusts	Wingless grasshopper, corbie, pasture cockchafer
On-farm hygiene (fabric) treatments					Stored product insects	
Poultry houses		Lesser mealworm				

Fenitrothion products are available in the following formulation types: EC formulations, ULV formulations, Powder grain protectants, Controlled gas formulation, and an aerosol formulation. Details of formulation types, registered use, product rate/ha, dilution/spray volumes, and witholding periods (WHP) are summarised in Table 3.

Information on the Australian use pattern of fenitrothion was obtained from registered product labels, Performance Questionnaires obtained through the NRA Existing Chemicals Review Program 1997 covering the Large Scale Users (PQ No. 1), Small Scale Users (PQ No. 2), State Chemical Co-ordinators (PQ No. 4), Chemical Industry (PQ No. 5), Commodity/Grower Groups (PQ No. 6) and the NRA site visits. This information is summarised in Tables 4 and 5 (EC, and other formulations, respectively).

Table 3: Formulation types, registered uses, product rate/ha, spray volumes, and witholding periods (WHP)

Formulation types	Registered uses	Product rate/ha (or other)	Dilution*/spray volume**	WHP
EC	Stored cereal grain	1 L/tonne	1.2 L Product/100 L (1.2% ai)*	
	Grain storage facilities & equipment	1.0 L/200 m^2	1 L Product /100L (1% ai)	
	Animal hides & skins & associated storage areas	30-60 mL/skin	1.1 L Product /100 L water (1.1% ai)*	
	Poultry housing & litter	10 L/70 m^2	1 L Product /100 L water (1% ai)*	
	Broadacre and horticultural crops (ground spraying)	250 mL - 1.3 L/ha	20-40 L water/ha (misters - 6.5% ai)** 100 L/ha (boomspray – 1.3% ai)**	7 days
ULV	Broadacre and horticultural crops (aerial or ground spraying)	200 mL-1 L/ha	Applied undiluted (100% ai)	7-14 days
Powder grain protectant	Stored grain	300 g/tonne - 1 kg/tonne		
Fenitrothion				3 months
Fenitrothion + Carbaryl				3 months
Controlled gas Formulation	Storage bins, grain elevators and grain handling machinery	50 g/300 m^3		
Aerosol (Outdoor fogger)	Control of flying and crawling insects in outdoor living areas. Used as a surface spray			

* dilution rates from product labels
** spray volume rates from information supplied by the NRA
ai: active ingredient

Table 4: Use pattern for fenitrothion EC products (1000 g/L ai) obtained from product labels, Performance Questionnaires and the NRA

Crop/situation	Label information		Information from Performance Questionnaires		NRA advice
	Application rate (concentration of ai in spray)	**Comments**	**Application method**	**Critical comments, application rates, application frequency**	
Grain storage facilities and equipment	1 L product per 100 L water (1% ai)	Applied before grain is stored. 10 L spray will treat 200 m^2. Re-apply at 1-2 month intervals in warm weather and 3-month intervals in cold weather. Treat bags to point of run-off	Hand spray from truck	Silos treated approximately every 3-4 months. Work rate approximately 2 silos per day	Treatment carried out at quarterly intervals depending on grain residence time
Stored cereal grain Supplementary surface treatment of grain stacks	1.2 L product per 100 L water (for 3-6 month protection, 1.2% ai, 12 ppm) 0.6 L per 100 L water (for <3 months protection, 0.6% ai, 6 ppm) 10 mL product per 1 L water (1% ai)	Apply 1 L diluted spray per tonne of grain. Calibrate spray in L/hr to equal augur or elevator uptake in tonnes/hr. Spray to be applied through specialised grain spraying equipment 5 L spray sufficient to spray 100 m^2 surface. Re-apply every 1-2 months during summer and at 2-3 month intervals during winter	Utility pump with spray lines equipped with flow meter and jet nozzle and cam-operated on/off tap to grain conveyor Hand spray from truck	Work rate 5-3600 tonnes grain per hour, depending on spray equipment. Usually one spray application Applied at 2 monthly intervals	Treatment rates are 6 mg/kg for up to 3 months storage, and 12 mg/kg for 3-9 months storage. Protectant applications typically occur once each year during grain harvest (November-February). Additional treatments may be necessary in years with substantial grain carryover. These would occur from October to November Knapsack or other portable spraying equipment is used to apply the chemical direct to site of infestation
Animal hides and skins	1.1 L product per 100 L water (1.1% ai)	Apply as a fine spray at a rate of 30-60 mL per skin. Re-treatment not specified	Mobile 3 spray unit-200 L capacity. Backpack sprayer with hand-held wand	One spray per skin. Work rate is 100 skins per hour	Limited information is available for this use of fenitrothion. Skins are treated once only, using a mobile sprayer
Storage area for hides and skins		Pressed bales and storage areas may be treated every 3-4 weeks, depending on weather and pest activity		Spray as required, every 3-4 months in warm weather	

Table 4: Use pattern for fenitrothion EC products (1000 g/L ai) obtained from product labels, Performance Questionnaires and the NRA (Contd)

Crop/situation	Label information		Information from Performance Questionnaires		NRA advice
	Application rate (concentration of ai in spray)	**Comments**	**Application method**	**Critical comments, application rates, application frequency**	
Poultry housing and litter	1 L product per 100 L water (1% ai)	Apply to litter, walls and roof of shed at a rate of 10 L per 70 m^2. Treat new litter before spreading. Spray sheds when each batch of poultry is removed and before re-stocking.	Hand-held wand, tractor driven pump, boom sprayer, high pressure sprayers or pneumatic hand sprayers	Three x 2000 sq ft sheds can be treated per hour. Apply every 9-10 weeks before re-stocking sheds. Rearing sheds are sprayed every 6 months and laying sheds every 18 - 24 months.	Label application rates are used. Two spray applications are made 4-6 days apart. Boom sprayers, or airblast equipment is used to treat entire walls, roof and floor and around the outside of the shed. Under normal circumstances there is no treatment of litter. If litter is reused, it is treated by boom sprayers or hand held sprayers.
Broadacre and horticultural crops (Ground spraying)	250 mL - 1.3 L per ha (misters - 6.5% ai boomspray-1.3% ai)	Spray volumes are not specified. Spray when pests are present in damaging numbers. Up to three sprays per season in cereal crops.	Boom sprayer, mister	Work rate is 20 ha/hour (boom spray) and 45 ha/hour (mister) 1 - 2 applications per year (max of 3 sprays) Spray interval 7-10 days	Label application rates are used. Spray is applied using misters to treat locusts in broadacre and horticultural crops and surrounding vegetation. Crops are usually sprayed from the edges. Misters use 20-40 L water/ha. In Tasmanian pastures it is applied at 100 L/ha by boom spray. Small area spraying may also occur using hand-held boom sprayers, knapsack sprayers or small boom sprayers mounted on vehicles.

ha: hectare

Table 5: Use pattern for other formulations of fenitrothion obtained from product labels, Performance Questionnaires and the NRA

Crop/situation	**Label information**		**Information from Performance Questionnaires**		**NRA advice**
	Application rate	**Comments**	**Application method**	**Critical comments, application rates, application frequency**	
ULV formulations (1.28 kg ai/L) Broadacre and horticultural crops (apples, cabbages, cherries, grapes, lettuce, tomatoes)	200 mL - 1 L per ha	For undiluted application through ULV spray equipment or mister only. Application in Summer and Autumn.		Applied undiluted at 250 - 400 mL/ha	Australian Plague Locust Commission (APLC) are currently using rates of 210-300 mL/ha.
Powder grain protectant Stored cereal grain On farms and central grain holding locations Fenitrothion -20 g/kg Fenitrothion 12 g/kg, carbaryl 8 g/kg	300 g per tonne of grain (for up to 3 months protection, 6 ppm) 600 g per tonne of grain (for up to 6 months protection, 12 ppm) 500 g per tonne (for up to 3 months protection) 1 kg per tonne (for 3-9 months protection)	Apply as a powder when grain is being transferred to silo, truck or bags or in grain harvester. The product is added to the hopper at the base of the auger as the grain is elevated into the silo or bin. Used post-harvest or for disinfection prior to harvest		Applied as grain is being transferred to silo, truck or bags or in grain harvester. Can be introduced to hopper at base of augur as grain is elevated into silo.	Use of the powder formulation in stored cereal grain is limited.

Table 5: Use pattern for other formulations of fenitrothion obtained from product labels, Performance Questionnaires and the NRA (Contd)

Crop/situation	Label information		Information from Performance Questionnaires		NRA advice
	Application rate	**Comments**	**Application method**	**Critical comments, application rates, application frequency**	
Outdoor Fogger (Contains 1.0% fenitrothion pyrethrins and piperonyl butoxide)		Applied as an aerosol to control flies, mosquitoes and other flying insects in outdoor living areas. Also used as surface spray in patios and picnic areas	Aerosol	Used as an aerosol. Spray for 3-5 seconds. Repeat when necessary	
Controlled gas formulation	50 g/300 m^3 (16 sec/300 m^3) 50 g/300 m^3 (4 sec/300 m^3)	Sprayed into empty bin using the kit spray Using the probe nozzle spray into the empty bin. Using the probe nozzle spray into access of header, grain elevators and grain handling machinery until spray can be seen emerging from the furthest exit			Rarely used for grain treatment in most states

The Agricultural and Veterinary Chemicals Section, NOHSC, visited the Australian Plague Locust Commission (APLC) Narromine Field Base, NSW in October 1997, the GrainCorp Operations Ltd storage areas in Moree, NSW in November 1997, and the Appin poultry farm complex, NSW in January 1998. Details of the three visits are provided in Attachments 2 & 3 and 4 respectively.

3.2.1 Description of use pattern and work practices for each category of fenitrothion use

Stored cereal grain

Fenitrothion application to stored grain complies with the Australian Wheat Board standards. Currently, <20% of stored grain is treated with fenitrothion. Bulk grain handling authorities in eastern Australia rest chemicals after 4-5 years of major use as grain protectants. Use of fenitrothion as a grain protectant is projected to increase in the near future. Grain is treated as it comes in for storage and may be re-treated during storage, if necessary. The frequency with which grain storage facilities/equipment and stored grain are treated depends on the efficiency of the application equipment and grain residence time. Treatments generally occur at quarterly intervals. Pest Control Officers provide instructions on application dose, spray volume and elevator speed at the commencement of the harvest season. Grain is treated with fenitrothion as a coarse shielded spray as it comes into the silo on a conveyor belt for storage. Grain applicator equipment operators may handle fenitrothion for up to 12 hours per day, 7 days per week over the harvest period of about 2 months. During this period, mixing times may occupy up to 1 hour per day. Under normal operating conditions, workers may be exposed to the chemical during mixing/loading of spray tanks only as they do not need to be present continuously to supervise spray application. Re-application is avoided where possible, due to resistance concerns and cost.

Workers wear PPE as recommended on product labels. No special exposure mitigation methods or environmental monitoring takes place within silos. However, workers are not expected to enter silos, except for grain sampling which takes place once during the storage period. Horizontal silos are sampled using probes. Vertical silos are sampled off the belt or out of augurs when grain is turned. Silo workers are subjected to regular ChE monitoring.

In recent years, the requirement for low residue or residue free grain has resulted in the use of lower fenitrothion application rates coupled with aeration cooling or gaseous fumigation.

Fenitrothion is also used to treat a small proportion of grain on farms. Application equipment on farms may be less contained than those in major bulk storage facilities.

The controlled gas formulation is rarely used for grain treatment.

Only small quantities of the powder formulation are used in on-farm storage.

A site visit to a grain storage site in NSW (details provided in Attachment 3) revealed that mixing/loading and storage of chemicals occurs outside the silo. Trained operators wearing PPE measure the required amount of chemical and add it to a mixing vat. The grain is sprayed with the chemical as it travels along a conveyor belt. Workers are not directly exposed as they do not enter the silos during the spraying. No worker exposure is expected during grain sampling in vertical silos. In horizontal storage, workers are required to walk through the grain, using long probes to sample the grain and worker exposure is possible.

Grain storage facilities and equipment

Fenitrothion is also used to treat and prevent infestation of grain storage areas. The outer and inner surfaces of the silo and surrounds can be treated. In bulk storages, spraying is carried out from a truck using open mixing and hand-held equipment. Workers involved in spraying fenitrothion to bulk storage are trained in handling chemicals and wear PPE as specified on product labels.

Spraying to the outer surface of a horizontal silo and surrounding ground was demonstrated at a site visit to a grain storage facility (details provided in Attachment 3).

On-farm empty storages (bins) are treated with fenitrothion at label rates using knapsack or other portable spray equipment. Bins are treated by introducing the spray through hatches at the bottom of the bin. Farm equipment used for grain handling, such as tractors, harvesters and trucks would be treated once per year, usually in November, in preparation for harvesting and receiving grain.

Poultry housing and litter

Poultry growers in Australia work mainly under contract to processing companies who provide the chemical.

The cycle for broiler chickens is approximately 10 weeks. As each batch of chickens is removed, the litter is removed and the shed cleaned. According to NRA information, fenitrothion is applied twice, 4-6 days apart, to the entire walls, roof and floor and in a band around the outside of the shed, using boomsprayers or airblast sprayers. Hand-held sprayers may be used to treat crevices and cracks. The shed is left to dry and air for a couple of days. Litter (usually wood shavings) is then placed in the shed (details of work practices during laying of litter is not available). Chickens are introduced a few days later and no further chemical treatment undertaken. A period of 7-10 days normally elapses between the removal of one batch of chickens and introduction of a new batch.

Under normal circumstances, there is no litter treatment in the poultry industry. Occasionally, the litter may be treated and re-used. It is treated in the same operation as the shed, floors and walls, at the same treatment rate and by the same method.

Spraying of a poultry shed was demonstrated during a site visit to a poultry farm (details provided in Attachment 4). The shed was washed after the chickens were removed. During fenitrothion treatment, the product was mechanically siphoned into the spray tank via a probe and diluted with water. The walls, roof and floor of the shed were sprayed with fenitrothion using a cabless tractor with airblast sprayer. The actual spraying operation was not viewed. Cabless tractors are used to enable easy manouvreability within the shed. The operator wore a full plastic suit, impervious gloves, boots and full face respirator, while loading the product and during spray application. He used an outdoor shower to wash himself (whilst wearing all PPE) and tractor after the shed was sprayed. Workers do not need to re-enter the treated sheds until 2-3 days later when they disinfect it with liquid formaldehyde. The litter is laid and chickens are introduced a few days later.

Animal hides and skins and associated storage areas

Limited information was available for assessment. Responses to the Performance Questionnaires indicated that fenitrothion is applied as a fine spray (1.1% ai) to skins. Workers can treat approximately 100 skins per day using backpack or other mobile sprayers and a hand-held wand. Re-treatment of skins is not indicated.

Pressed bales and storage areas may be treated repeatedly at 3 week to 4 month intervals, depending on weather and pest activity.

Outdoor Fogger

Fenitrothion is registered for use as an aerosol (Outdoor Fogger) at 1.0% for outdoor living areas. There is no information that it is used by pest control operators for outdoor fogging operations. Therefore, it is not considered further in this report.

Broadacre and horticultural crops

According to NRA advice, the ULV formulation is not applied using ground based equipment. Workers mixing/loading for ground spraying may use the open-pour method. Most aerial mixer/loaders automatically dispense the product directly into the aircraft from bulk containers. Mixer/loaders are expected to wear PPE as recommended on product labels. Applicator exposure may occur during ground spraying but is expected to be minimal during aerial spraying. Ground applicators are expected to wear the PPE specified on product labels.

a.) Locust control

Pastures: Landholders/farmers normally treat their own properties. For locust control in pastures, landholders use the EC formulation and target areas where the insects congregate using spraying techniques such as hand-held boom sprayers, knapsack sprayers or small booms mounted on all terrain vehicles (ATVs). Aerial spraying using the ULV formulation to control locusts in pastures may be organised by individual farmers or on a larger scale by the APLC and relevant State Departments. According to the NRA the ULV formulation is not used on pastures in Tasmania.

Other broadacre crops: Locust control in other broadacre crops is carried out by ground or aerial spraying. ULV formulations of fenitrothion are used for aerial spraying. Misters are used for perimeter spraying of the EC formulation in broadacre crops, using a spray volume of 20-40 L/ha.

Horticultural crops: Horticultural crops are not directly sprayed with fenitrothion. Protection is accomplished by either spraying the locusts at a remote location before they threaten the crops, or if required, spraying only the inter-row vegetation in the orchard. Spot spraying between rows and around the perimeter is carried out if necessary. Growers use normal orchard sprayers directed to the ground.

Australian vineyards are not aerially sprayed with fenitrothion. Ground spraying can occur, between rows or on the perimeter, with shielded sprayers (usually small boom sprayers) when pests appear. Only one spray application is required and program spraying does not occur.

Use of fenitrothion by the APLC

The APLC (member States: NSW, Queensland, South Australia and Victoria) uses fenitrothion ULV, applied by aircraft, for the control of locust bands and swarms. Fenitrothion is used against locusts in cereal and forage crops, pasture, lucerne and soybeans.

Aerial application was demonstrated at a site visit to the APLC field base at Narromine (details provided in Attachment 2). Loading of the aircraft was carried out by pumping the chemical (water in this demonstration) from bulk containers directly into the aircraft tank by means of a portable petrol driven pump. Mixer/loaders wore overalls, rubber aprons, elbow-length chemical-resistant gloves, rubber boots and hats.

The pilot had the area mapped out. Manual flagging was not used as spraying was done during the day using Geographic Positioning System (GPS). The pilot wore no protective equipment.

Worker exposure is possible post-spraying when field officers assess the sprayed area for dead locusts 24-48 hrs later.

b) Non-locust control

In horticultural crops, pests other than locusts are controlled using the EC formulation with ground-directed orchard spraying equipment No direct spraying of the crops occurs. Spraying is done on the perimeters and in between rows using shielded sprayers.

Cockchafer and corbie infestations in Tasmanian pastures are controlled by boomspray application of the EC formulation, using a spray volume of 100 L/ha.

Permits

Permits are currently issued for off label uses of fenitrothion in maize, grain sorghum, pastures, forests, and forestry experimental plots and native flower crops. Most permits are for locust control. Details of permit uses are presented in Table 6.

Table 6: Use pattern information for permit use of fenitrothion

Crop/Situation	Concentration of ai in product	Formulation and application method	Rate and frequency of application	Witholding period	Comments
Maize (locust control)	1280 g/L	ULV-aerial	400-600 mL/ha maximum 3 applications - 7 days apart	14 days	Within label claims for broadacre crops
Grain sorghum (locust control)	1280 g/L 1000 g/L	ULV EC (boom spray)	400-600 mL/ha 400-500 mL/ha minimum interval between spraying - 14 days	14 days 7 days	Within label claims for pastures and broadacre crops
Pastures (locust control) (non-leguminous)	1280 g/L	ULV Aerial	300 mL/ha minimum interval between spraying - 14 days	Nil	Within label claims for pastures and broadacre crops
Forest application (Pinus Radiata plantation) (grasshopper control)	1000 g/L	EC Aerial	25 mL/ha (dilution not specified)	7 days	Not registered for forestry use in Australia. No label claims for aerial use of EC products
Forestry experimental plots & native flower crops (locust control)	1000 g/L	EC Ground application	500 mL/ha (dilution not specified)		

3.3 Exposure information

3.3.1 Poisoning incidents and illness reports involving workers

There is no information available on fenitrothion poisoning of agricultural or other workers in Australia. There are a few literature reports documenting poisoning following occupational exposure to fenitrothion.

Ecobichon et al. (1977) reported on a case of accidental poisoning with fenitrothion. A 33 year old female laboratory technician wiped up an accidental spill of fenitrothion using bare hands and facial tissues. Within 2 days of exposure she experienced symptoms of poisoning including blurred vision, nausea and diarrhoea, muscle weakness, mental confusion and tremors. Plasma and RBC ChE levels were inhibited by 44% and 14% respectively, at this time. Over the next 3 days, somatic and psychiatric symptoms intensified. She gradually responded to treatment but on the 17th day symptoms including fatigue, lethargy, nausea, frequent headaches, inability to concentrate and muscle weakness recurred, although ChE levels were nearly normal. Fatigue and muscle weakness, increasing on exertion, recurred over the next 2-3 months. Plasma and RBC ChE levels remained normal during this period except after a period of dieting. The study authors linked this to a possible mobilization of adipose tissue releasing the stored chemical.

Matsushita et al. (1980) investigated 216 workers (mainly farmers) who developed contact dermatitis from pesticide exposure in Japan. Of these 7.4% had been exposed to fenitrothion. The incidence of dermatitis was high in covered areas of skin.

Matsushita et al. (1985) investigated 202 workers (mainly farmers) who had developed contact dermatitis when exposed to OP insecticides. The hierarchy of areas affected were the fingers > face > forearm > neck > chest and back > shank. Of the total number of patients, 3 were exposed to fenitrothion alone and 24 to fenitrothion in combination with other OPs. About 25.2% of the total number of cases (202) demonstrated symptoms of acute OP poisoning, however, the number of poisoning cases relating to fenitrothion exposure is unknown.

3.3.2 Health effects resulting from occupational exposure

There are a number of studies where ChE levels have been monitored in workers handling fenitrothion under normal work conditions. The studies covered production workers as well as agricultural workers.

Two studies in production workers (Liska et al., 1982; and Hermanowicz & Kossman, 1984), readily demonstrated depressed ChE and increased urinary metabolites following exposure to fenitrothion.

Studies in agricultural crop spraying workers have been conducted in developing countries (Warren et al., 1985 a, b; Abiola et al.,` 1988, 1991; Wan, 1990; Fakhri, 1993). All demonstrated depressed ChE in normal workers. The use patterns and spray practices in these studies are not necessarily indicative of those used in Australia; however the studies show the influence of tank mixing, the role of protective clothing, work practice and duration of exposure on ChE depression. One study conducted in Australia on grain treatment with fenitrothion (Gun et al., 1988) also demonstrated how attention to equipment maintenance and engineering controls could reduce the extent of ChE depression.

There are no monitoring studies of health effects, including monitoring of symptoms, ChE activity or urinary excretion, of Australian workers currently using fenitrothion.

An epidemiological study of fenitrothion production workers was conducted in Czechoslovakia (Liska et al., 1982). The study involved 25 male production workers and 15 female packers. The duration of exposure ranged from 1-10 years for the production workers (average 5.9 years) and 1 - 9 years for the packers (average 2.5 years). No details are available on the protective measures adopted by these workers or exposure mitigation methods in the workplace. Air concentration of fenitrothion ranged from 0.028 mg/m^3-0.118 mg/m^3. There is no Australian exposure standard for fenitrothion so comparisons cannot be made. ChE levels were depressed from individual baselines in both worker categories. Extrapolation from urinary NMC excretion in study subjects was compared with the average 24 hour urinary values in volunteers orally dosed with fenitrothion. The study authors concluded that workers excreted quantities of urinary NMC corresponding to an intake of approximately 15 mg fenitrothion/person/day (production workers) and 20 mg or more/person/day (packers).

Hermanowicz and Kossman (1984) studied neutrophil function and prevalence of infection in 85 production workers exposed to OPs including fenitrothion, and compared these with age-and sex-matched healthy controls. Serum and RBC ChE activity was used as a marker of OP toxicity. The exposed workers were divided into three subgroups, ie production workers (group 1), personnel operating machines that filled containers with the pesticide (group 2) and miscellaneous workers (group 3). Serum and RBC ChE activity was depressed in all three groups. The largest decrease of ChE activity was observed in group 1, the group observed to have the highest potential exposure. Impaired neutrophil chemotaxis and a 68.8% increase in respiratory tract infections was noted in workers compared to controls. The study authors suggest that this may be due to a local effect of the inhaled pesticides and solvents. The recurrence of infections was related to the duration of exposure to the pesticide.

Warren et al. (1985a) measured blood ChE activity in 22 workers exposed to fenitrothion in a malaria control programme in Haiti, in 2 separate phases in 1978. Workers in the first phase applied fenitrothion five days a week and wore hats, uniforms, gloves and shoes. Despite the PPE, ChE activity in 2 workers was 50% of that in a non-exposed subject, in the second week of spraying. During the third week, 6 workers had ChE activity of $\leq$ 50% of that in a non-exposed subject. The authors suggested that the excessive exposure to fenitrothion may have been due to faulty protective gear (gloves and hats). In the second phase, spraying was restarted after a break of about 6 weeks using the same subjects wearing uniforms and shoes but with new hats and gloves. Spraying was carried out five days a week. ChE activity in 3 workers was reduced to 37.5% of that in a non-exposed subject, at the end of the first week. Six other workers had a ChE activity of ≤ 50% at the end of the second week. Results indicated that blood ChE activity may not have fully recovered during the “rest” period. According to the authors, the practice of safety measures needed to be more rigidly enforced.

The above programme was reviewed in 1979 (Warren et al., 1985b). Blood ChE activity and urinary NMC levels were measured in 23 spraymen exposed to fenitrothion for one week. Results showed that only 3 out of 23 spraymen had ChE activity of 50% or below that of the non-exposed control at the end of the week’s spraying. After 2 days free of exposure to fenitrothion, their ChE activity rose to 62.5% of that of the non-exposed control and urinary concentrations of NMC were reduced from 10.5 mg/L to 0.67 mg/L. The authors conclude that this study emphasises the importance of maintaining an accurate monitoring system of the metabolites in determining exposure to fenitrothion.

Abiola et al. (1988) conducted two experiments, the first involving 8 experienced crop protection workers (experiment 1) and the second involving 7 such workers (experiment 2). Mean plasma and RBC ChE activity (pre-exposure levels) were recorded. In experiment 1, fenitrothion (500 g/L) was applied by ULV for 6 hours/day for 7 days. In experiment 2, a combination of fenitrothion (250 g/L) and fenvalerate (a pyrethroid insecticide, 50 g/L) was applied for 7 hours /day for 13 days. PPE was worn by workers in both experiments (details not available). Plasma and RBC ChE levels were estimated 24 hours after application (experiment 1), and 1 hour after application (experiment 2). No depression of plasma or RBC ChE was seen when fenitrothion was used alone (experiment 1). There was significant and progressive depression of plasma and RBC ChE (38% to 75%, and 6% to 23% respectively) when fenitrothion was combined with fenvalerate. The authors suggest a synergistic effect when fenitrothion is used in combination with fenvalerate. They do not comment on the effect of the time of testing in relation to exposure, ie. 24 hrs in experiment 1 and 1 hr in experiment 2.

Abiola et al. (1991) investigating ChE inhibition and lipid metabolism in pesticide workers in Africa confirmed the above findings. In order to validate the results the authors suggested that it was necessary to compare results of ChE activity of these workers using the same spraying equipment for both EC and ULV formulations for the same period of time. Again, results using fenitrothion alone (ULV formulation) or in combination with fenvalerate were compared. Results suggested (1) greater ChE inhibition when fenitrothion was used with fenvalerate and (2) greater ChE inhibition with the ULV than the EC formulation of fenitrothion. The study authors suggest that carriers in the ULV formulation promote OP penetration of the RBC more readily, however, the findings are not conclusive.

Gun et al. (1988) studied the potential sources of exposure during ULV applications of fenitrothion to stored grain in Australia. In the early 1980s spraying of high volumes of diluted pesticide to grain was replaced by drip feeding small volumes of ULV concentrate. The potential sources of exposure were identified as when changing the plastic hoses in the metering pumps and unblocking the nozzles of the dispensers. RBC ChE depression was measured to indicate the degree of dermal exposure to fenitrothion. Improvements in pump and nozzle maintenance reduced the extent of RBC ChE depression originally seen in workers.

Wan (1990) estimated pesticide exposure of six applicators working in tea plantations in China. Fenitrothion (1000 g ai/ha) and cypermethrin (40 g ai/ha) (synthetic pyrethroid) were sprayed using back-pack type hand sprayers, under local working conditions (details not available). The distribution of exposure on the body was measured. Exposure to residues increased from head to foot. Contamination was markedly greater when spraying taller crops.

Fakhri (1993) studied the effect of fenitrothion on ChE activity in 17 workers involved in a range of activities, including mixing and spraying, and 3 control workers in the malaria control program in Sudan. None of the workers had any prior exposure to fenitrothion for 6 months. Fenitrothion was mixed manually and sprayed on the room walls. All workers wore hats, goggles and cotton uniforms. Most subjects exhibited ChE depression and some developed signs and symptoms of OP toxicity of varying severity, coupled with depressed ChE. Suggested influencing factors were the degree of exposure, improper use of protective clothes, type of formulation and its concentration, actual exposure time, route of entry, personal behaviour and/or other factors including hot humid working conditions.

3.3.3 Measured worker exposure studies

No measured worker exposure studies were submitted. Worker exposure studies from scientific literature were not aimed at measuring fenitrothion exposure, either directly or indirectly, and could not be used to estimate exposure margins and risk. In addition, none of the worker studies was relevant to the current Australian use pattern.

3.3.4 Predicted worker exposure

UK POEM

The UK Predictive Operator Exposure Model (POEM) was used to estimate mixer/loader and applicator exposure to the EC formulation of fenitrothion during boom spraying of pastures. This model could not be used to estimate applicator exposure for the other use patterns because they are not included in the model.

The following assumptions were used to estimate exposure using Vehicle mounted (with cab) hydraulic nozzles (V-Nozzle) for EC formulations of fenitrothion.

Concentration of active ingredient:	1000 g/L
Spray volume	100 L/ha (value submitted by the NRA)
Work rate	50 ha/day (default value)*

Container size	20 L
Hand contamination	0.5 mL/operation
NOEL	0.2 mg/kg/d (oral, dog)
Dermal absorption	10% (default value)
Inhalation absorption	100% (default value)
Average body weight	60 kg
Application time	6 hours
Product rate	0.25 L/ha (Estimate 1) 1.3 L/ha (Estimate 2)

*The POEM default value of 50 ha/d for the work rate is selected over the work rate of 20 ha/hr obtained through the Performance Questionnaires as it is more reflective of the area covered by boom spraying under Australian conditions.

Predicted worker exposure and risk is given in Section 4.3.2. Estimates are provided in Attachment 1.

PHED

The Pesticide Handlers Exposure Database (PHED) was used by one registrant to estimate exposure for mixer/loader, applicator and mixer/loader/applicators involved in ground boom spraying of broadacre crops and hand spraying of poultry houses with EC fenitrothion. For each scenario, the registrant considered open versus closed mixing, glove versus no glove use, and open cab versus closed cab application. Exposure estimates were not presented for other fenitrothion uses.

The assumptions used to estimate exposure were:

Ground boom application

Application rate	350 g ai/100 L water
Spray volume	100 L/ha
Work rate	20 ha/hr (120 ha/day)
Application time	6 hours

Mixer/loader prepares enough spray for one day

NOEL	0.2 mg/kg bw/d (oral) 3 mg/kg bw/d (dermal)
Dermal absorption	10%

Poultry house application – hand spray from truck

Application rate	1000 g ai/100 L water, 10 L/70 m^2
Work rate	557.4 m^2/hour
Application time	6 hours

Mixer/loader and application by one individual

NOEL	0.2 mg/kg/d (oral) 3 mg/kg/d (dermal)
Dermal absorption	10%

Only exposure estimates obtained from PHED and the assumptions used in each case were provided. No PHED printouts were submitted.

Predicted worker exposure and risk is given in Section 4.3.2.

3.3.5 Re-entry exposure

A re-entry period (REP) is not specified on any fenitrothion product label.

3.3.6 Measured worker exposure during re-entry

A quantitative estimation of worker exposure during re-entry is not possible as no re-entry worker exposure studies were submitted.

Workers may be exposed to fenitrothion during re-entry/re-handling situations such as the following:

- assessing the immediate impact of aerial or ground spraying on locust mortality;
- sampling treated grain in horizontal silos at bulk handling facilities and maybe on farms;
- handling treated hides and skins, and re-entering storage areas for hides and skins;
- checking for presence of pests, quality of fruit and thinning in horticultural crops;

- re-entering treated poultry housing; and
- re-entering fields for harvesting of crops and handling harvested crops;

3.4 Study on protective clothing

Wan (1991) studied the removal of fenitrothion residues from fabric composed of either 100% cotton or cotton-polyester by handwashing techniques. Three treatment regimes were tested, namely soaking in detergent and water, scrubbing with detergent, and scrubbing with soap. The most effective method was soaking contaminated fabric in detergent and water. It is not possible to compare this with domestic or commercial machine washing techniques which would be most commonly used in Australia.

4. RISK ASSESSMENT

The potential routes of occupational exposure to fenitrothion will be dermal and inhalation. The vapour pressure of fenitrothion is 2.85 x 10^{-11} kPa (low). Therefore, inhalation exposure to vapour is unlikely. Inhalation of spray mist may occur especially during fenitrothion applications by misters. Dermal exposure is expected to be the most important route of occupational exposure.

4.1 Acute toxic potential

The main acute hazards of fenitrothion are moderate oral, and dermal toxicity. It does not present an irritant or sensitisation hazard. Fenitrothion has been reported to cause Intermediate Syndrome in humans after oral ingestion and death after consumption of 50-100 mL of a 50% fenitrothion solution (25-50 g fenitrothion) (details in Section 2.1).

The APLC Report on fenitrothion (1997) gives a probable oral lethal dose of 50-500 mg/kg. However, information leading to this conclusion has not been assessed by the DHFS.

The acute dermal LD_{50} for fenitrothion in rats is 890 mg/kg bw. For an average 60 kg worker this dose is equivalent to skin contamination with 53.4 g fenitrothion, 53.4 mL of the EC formulation, 821mL of the most concentrated spray (6.5% ai) or 42 mL of the ULV formulation. This theoretical calculation does not include a safety factor.

The acute RfD for fenitrothion is 0.03 mg/kg bw. Assuming 60 kg body weight and 10% dermal absorption this dose is equivalent to skin contamination with 18 mg fenitrothion, 0.018 mL of the EC formulation, 0.28 mL of the most concentrated spray (6.5% ai), or 0.014 mL of the ULV formulation. This theoretical calculation does not include a safety factor.

4.2 Repeat dose toxic potential

The main health effect of repeated exposure to fenitrothion would be toxic symptoms resulting from ChE inhibition. There is inconclusive evidence of neurological changes following repeated exposure to fenitrothion.

The NOEL of 0.2 mg/kg bw/d for plasma ChE depression from a 1 year oral dog study is used to assess the risk to workers repeatedly exposed to fenitrothion.

Assuming an average 60 kg body weight and 10% dermal absorption, a worker would need to be dermally exposed to 120 mg fenitrothion, 0.12 mL/day of the EC formulation, 1.8 mL mL/day of the most concentrated spray (6.5% ai) or 0.09 mL of the ULV formulation, to reach this level. This theoretical calculation does not include a safety factor.

4.3 Assessment of end use exposure and risk

4.3.1 Measured worker exposure and risk

Quantitative assessment of worker risk was not possible because measured worker exposure data was not available for any uses of fenitrothion.

4.3.2 Predicted worker exposure and risk

UK POEM

Margins of exposure (MOE) are calculated by comparing the most appropriate NOEL with exposure data obtained from predicted exposure modelling (Table 7). Parameters used are described in Section 3.3.4. The NOEL of 0.2 mg/kg/d from a 1 year dog study is used in the risk assessment. Considering the intra-species variability, MOE of approximately 100 or above are considered to be acceptable.

The application rate for pastures ranges from 0.25 L/ha - 1.3 L/ha. At the lower application rate, MOE are unacceptable for mixer/loaders open-mixing wearing gloves (2), applicators in closed cabs wearing gloves and one layer of clothing (6) and workers performing combined functions under conditions specified above (<2).

PHED

The registrant presented MOE calculated from exposure data obtained from PHED (Table 8) and the oral NOEL of 0.2 mg/kg/d from a 1 year dog study with 10% dermal absorption, and a dermal NOEL of 3 mg/kg/d from a 21 day dermal study. Parameters used are described in Section 3.3.4.

The MOE calculated using the dermal NOEL cannot be considered because this study did not specifically examine the neuropathic potential of fenitrothion. MOE of approximately 100 or above are considered acceptable when determined using the oral NOEL of 0.2 mg/kg/d and 10% dermal absorption.

Table 7: Predicted exposure and MOE from POEM estimates for different application rates

Application method	Product rate	Spray volume	M/L* absorbed dose[1] (mg/kg bw/d) without gloves	M/L absorbed dose[1] (mg/kg bw/d) with gloves	Applicator absorbed dose[2] (mg/kg/d) without gloves	Applicator absorbed dose[2] (mg/kgbw/d) with gloves	M/L/A** absorbed dose[2] (mg/kg bw/d without gloves	M/L/A absorbed dose[2] (mg/kg bw/d) with gloves and one layer of protective clothing	MOE[3] M/L with gloves	MOE[3] applicator with gloves and one layer of protective clothing	MOE[3] M/L/A with gloves and one layer of protective clothing
Vehicle mounted with cab hydraulic nozzles Estimate (1)	0.25 L/ha	100 L/ha	0.833	0.083	0.176	0.03	1.009	0.113	2	6	<2
Vehicle mounted with cab hydraulic nozzles Estimate (2)	1.3 L/ha	100 L/ha	3.333	0.333	0.913	0.153	4.246	0.486	<1	4	<1

Exposures for the minimum (0.25 L/ha) and maximum (1.3 L/ha) application rates are presented
*M/L mixer/loader
**M/L/A mixer/loader/applicator
Only MOE for all categories of workers wearing PPE are presented in this report
[1]only dermal exposure considered during mixing/loading
[2]dermal and inhalation exposure considered during application
(inhalation absorption contributes 1.7% to the total absorbed dose)
[3]MOE calculated using oral NOEL of 0.2 mg/kgbw/day

Table 8: Predicted exposure and MOE from PHED estimates for groundboom and hand-held applications

Type of application	Exposure* (mg/kg bw/day)	Margin of Exposure** (NOEL 0.2 mg/kg bw/day)
Groundboom (at 350 g ai/ha) Mixer/loader, open mixing, no gloves	28.38	0.07
Mixer/loading, open mixing, gloves	3.10	0.65
Mixer/loader, closed mixing, no gloves	No data	
Mixer/loader, closed mixing, gloves	0.01	259.89
Applicator, open cab, no gloves	0.12	16.99
Applicator/open cab, gloves	0.06	34.41
Applicator, closed cab, no gloves	0.03	73.19
Applicator, closed cab, Gloves	0.04	45.79
Mixer/loader/applicator, open mixing, no gloves	0.10	20.00
Hand-held application (at 1000 g ai/100 L water) Mixer/loader/applicator, open mixing, no gloves	0.01	233.88

Exposure estimates for for an application rate of 350 g ai/ha and 1000 g ai/1000 L water are presented
MOE for all categories of workers wearing long pants and long sleeved shirts
* Only dermal exposure considered for mixer/loader/applicators
** MOE calculated using oral NOEL of 0.2 mg/kg bw/day and 10% dermal absorption

Ground boom application

The registrant provided exposure estimates for an application rate of 350 g ai/ha. Australian fenitrothion labels specify an application rate of between 250 mL-1.3 L product per hectare (250 to 1300 g ai/ha). The maximum label application rate is approximately 4 times the rate modelled.

The registrant also modelled a work rate of 20 ha per hour. Given that a work day is considered to be 6 hours spraying time, this value is not considered to be representative of Australian work practices.

MOE calculated using exposure estimates from PHED, the registrant's assumptions, an oral NOEL of 0.2 mg/kg/d and a 10% dermal penetration for fenitrothion indicated acceptable risk only for mixer/loaders wearing gloves and using closed mixing systems. The risk to all other categories of workers was unacceptable.

Conclusion – *Considering that the MOE are unacceptable for all workers except mixer/loaders wearing gloves and using closed systems and that the maximum application rate in broadacre crops in Australia can be approximately 4 times greater than that used to estimate worker exposure, the exposure estimates and MOE obtained for PHED are not considered further in the risk assessment.*

Poultry housing

The registrant provided an exposure estimate for mixer/loader/applicators using open mixing and "spraying from hand spray from truck" only. It is unclear whether exposure estimates were obtained for indoor or outdoor situations. Based on available information, spraying of poultry housing in large establishments in Australia is mainly using cabless airblast or boom spray equipment. In large establishments, hand spraying is used to treat cracks and crevices only. However, it is possible that smaller poultry sheds may be treated by hand spraying alone.

MOE calculated for mixer/loader/applicators using the assumptions specified in Section 3.3.4 were acceptable.

Conclusion – *Hand-held application alone is not considered to be representative of poultry house spraying of fenitrothion under Australian conditions. Therefore the PHED exposure estimates and MOE are not considered further in the risk assessment.*

4.3.3 End use exposure and qualitative risk assessment

A qualitative risk assessment was necessary for most use patterns because there was no measured worker exposure data. Predictive exposure modelling using the Predictive Operator Exposure Model (POEM) was used to estimate exposure and risk for pasture uses.

<u>Stored cereal grain</u>

Grain treatment is carried out between November and February every year. In bulk storage facilities, grain is treated upon receival at a maximum concentration of 1.2% ai. The application dose and instruction on spray volume and elevator speed are provided by Pest Control Officers in accordance with Wheat Board standards. Silo operators are trained in the handling of chemicals. All PPE is provided and maintained by the employer. Information obtained from the NRA and site visit indicate that worker exposure may occur during mixing/loading (which is by the open-pour method), cleaning up spills and during maintenance work on grain spraying equipment. In large silos, worker exposure is not likely during spray application as this is a mechanised process. Daily exposure of bulk silo operators is likely during the grain harvest period. It is estimated that mixing/loading will take place for one hour per day, 7 days per week for the harvest period of about two months per year. These workers are periodically tested for ChE depression. They can request ChE monitoring in the event of accidental exposure and have access to medical facilities. Re-application of fenitrothion to stored grain is not common in bulk storage.

A small portion of Australian grain is stored on farms. Fenitrothion EC and powder formulations may be used on farms. The EC products are applied as a dilute spray (1% ai) by an automated delivery system. Powder products are applied undiluted, as grain is being transferred to silo, truck, bags or grain harvester. Available information indicates that the use of powder grain protectants is limited in Australia. The level of training of farmers and farm employees with regard to handling chemicals is variable.

The controlled gas formulation of fenitrothion is rarely used for the treatment of grain in Australia. The label states that its use is restricted to licensed or other authorised personnel only.

Re-treatment of stored grain depends on grain residence time and presence of pests.

<u>Grain storage facilities and equipment</u>

The inner and outer surfaces of storage areas and surrounds are treated with fenitrothion, at a concentration of 1% ai in the spray.

Workers treating bulk handling facilities are trained in handling chemicals. All PPE is provided and maintained by the employer. Information obtained through the Performance Questionnaires suggest that a worker can treat approximately 2 silos per day, every 3-4 months. Spraying is carried out from a truck using open mixing and hand-held equipment. During outdoor spraying, environmental conditions can have an impact on worker exposure. These workers are periodically tested for ChE activity. They can request ChE monitoring in the event of accidental exposure and have access to medical facilities.

On farms, grain stacks, bags and bins may be treated annually in preparation for harvest. Workers spraying farm storage bins and farm equipment may be exposed to fenitrothion during mixing/loading, spray application and during clean up of spills and equipment. Spray application is commonly carried out using hose and hand-held equipment. Environmental conditions can have an impact on applicator exposure. In addition, the level of training of farm workers would be variable.

Poultry housing and litter

The site visit indicated that spraying of poultry houses on broiler farms takes place all year round, at approximately 10 week intervals. The spray is applied at a 1% concentration of active ingredient, after a batch of chickens is removed and before re-stocking. Information obtained through the Performance Questionnaires indicate that rearing sheds are sprayed every 6 months and laying sheds every 18-24 months.

The large farm complex visited for this review is taken as being representative of other large broiler or laying hen operations in the poultry industry. Uses by smaller, individual growers may not be directly comparable. On the farm visited, trained workers wear protective equipment in excess of label requirements, when carrying out spray operations. All PPE is provided and maintained by the employer. The product is mechanically siphoned from the container and into the spray tank, resulting in minimal handling of the concentrate during mixing/loading. The spray is applied to walls, roof and floor using tractor driven cabless boom or airblast sprayers. Hand-held equipment may be used to treat cracks and crevices. The requirement for thorough spray coverage of surfaces can result in substantial worker exposure during spray application. However, each shed is sprayed in approximately 3-4 minutes and the worker and equipment is thoroughly washed down immediately afterwards. Worker exposure may occur during clean up of spills and equipment. Sufficient maintenance of PPE, adequate washing facilities and sound work practices were noted during the visit to the large farm complex. No litter treatment takes place in commercial enterprises as litter is rarely re-used.

Several smaller contract farms use fenitrothion for the treatment of poultry housing in Australia. The processing company provides the chemical and trains workers on these farms. Occasional “spot inspections” are undertaken by the processing company. Workers would use the open-pour method to mix fenitrothion. Spray application would be using cabless tractors or hand-held equipment. If litter is reused, it is sprayed in the same operation as the shed. Worker exposure may occur during mixing/loading, spray application and cleaning up spills and equipment. Worker exposure can vary with the size of the farm and availability of workers to share the task. However, given the smaller number of poultry sheds on contract farms, worker exposure would still be substantial yet less intensive for individual workers than for those on large farms.

Animal hides and skins and associated storage areas

Limited use pattern information was obtained through the Performance Questionnaires. Fenitrothion use in treating animal hides/skins may be intensive and frequent. No details were provided on the frequency of use, work practices, worker controls or exposure mitigation methods in place for this use pattern.

Broadacre and horticultural crops

Broadacre crops: ground application

Workers may be exposed to fenitrothion when opening containers, preparing spray, cleaning up spills and maintaining equipment. Mixing is by open-pour from 20 L containers. Exposure to the diluted solution can occur during spray application.

In targetted locust control in pastures, ground spraying is usually carried out using hand-held boom sprayers, knapsack sprayers or small booms mounted on ATVs. Misters are used for perimeter spraying of other broadacre crops. Exposure and risk for these workers could not be quantified.

Predicted exposure using POEM for ground spraying of entire pastures in Tasmania indicates a high risk for workers performing combined tasks of mixing/loading/application. The high risk was found for open mixing, with closed cabs, across the range of application rates and while workers used PPE.

Spraying for insect control in crops is seasonal and normally involves one to two applications. Spraying for locust control is normally carried out only when insects are present in damaging numbers.

Broadacre crops: aerial spraying

Worker exposure during aerial spraying may occur during loading operations, cleaning up equipment, drums or spills. No exposure during mixing is expected for aerial applications as the undiluted ULV formulation is used. Pilots are protected against direct contamination with spray mist. The risk of exposure in the event of a spill will be high as the product is loaded and applied undiluted. No manual flagging is carried out in APLC operations as pilots use GPS.

Horticultural crops

Horticultural and vineyard spraying of fenitrothion for both locust and other insect control does not involve blanket spraying of the orchard trees or vines. It is restricted to perimeter or inter-row spraying. Misters or ground directed orchard sprayers are used. Worker exposure would occur during the normal operations of mixing, loading and spraying. Exposure and risk for these workers could not be quantified.

<u>Tank mixing</u>

Current fenitrothion labels do not include tank mixing or compatibility statements using other anticholinesterase agricultural chemicals.

The additional (unquantified) risk of tank mixing of fenitrothion and other anticholinesterase chemicals is not acceptable on occupational health and safety grounds.

4.4 Re-entry exposure and risk

No information on worker exposure during re-entry was submitted by the registrants. No relevant fenitrothion dissipation data or airborne residue data was provided.

<u>Stored cereal grain</u>

Grain can be sampled during storage; this usually occurs once during stored life. In vertical silos, sampling is carried out using long probes and substantial worker exposure is not likely. Information obtained during the site visit indicates that in horizontal storage, workers are required to walk through grain to obtain samples using probes. As these workers are in direct contact with treated grain, they may experience substantial exposure. Usually these workers do not wear protective clothing. Information obtained during the site visit suggested that wearing of only short pants and singlet was not unusual. The exposure and risk has not been quantified.

<u>Grain storage facilities and equipment</u>

The risk has not been quantified. However, no re-entry exposure is expected in grain storage facilities and of treated equipment as no re-entry or re-handling occurs shortly after spraying.

<u>Poultry housing and litter</u>

Re-entry exposure and risk has not been quantified. It is not considered high as the product is diluted to 1% before spraying. The next activity carried out in the sheds, namely disinfection, does not occur until 2-3 days after spraying.

<u>Animal hides and skins and associated storage areas</u>

No information is available on exposure while re-handling treated hides and skins, or on re-entry to storage areas. The use pattern suggests exposure could be substantial. The risk cannot be quantified.

Broadacre and horticultural crops

Broadacre use – ground and aerial application

Sprayed areas may be entered for crop checking, including checking the success of locust kills. These activities are expected to be of a short duration and intermittent in nature when spraying has been carried out by individual farmers. APLC employees could experience more frequent and longer duration exposure. They need to check the success or otherwise of locust kills, and also check for any associated impacts on the environment. APLC workers carry out this task 24-48 hours after spraying. Exposure and risk has not been quantified.

Exposure to fenitrothion residues may occur during harvest. However as this is a mechanical activity, exposure and risk are not anticipated to be high.

Horticulture

Horticulture and vineyard sprays do not cover the trees or vines, but are restricted to perimeter or inter row areas. Workers entering orchards or vineyards may experience some exposure, but this should not result from handling of trees or vines. Re-entry exposure and risk at harvest should not be high, for the same reason.

5. OCCUPATIONAL CONTROLS

5.1 Statement of hazardous nature

Fenitrothion and all fenitrothion EC and ULV formulations are determined to be hazardous substances according to NOHSC criteria. Hazardous substances are subject to the workplace controls outlined in the NOHSC Control of Workplace Hazardous Substances (NOHSC, 1994b).

The grain protectant powder products cannot be determined to be hazardous, considering only the concentration of fenitrothion they contain.

5.2 Safety Directions

The current safety directions for fenitrothion in the Handbook of First Aid Instructions and Safety Directions (1996) are as follows:

EC 1000g/L or less: more than 1 g/L. ULV 1280 g/L or less. DU 20 g/kg or less. WP 12 g/kg or less.	
Product is poisonous if	120, 130
Absorbed by skin contact, inhaled or swallowed.	131, 132, 133
Repeated minor exposure may have a cumulative poisoning effect.	190
Avoid contact with eyes and skin.	210, 211
Do not inhale dust (DU, WP) or spray mist	220, 221 (DU, WP) 223
When opening the container, preparing spray and using the prepared spray, wear cotton overalls buttoned to the neck and wrist and a washable hat, elbow-length PVC gloves and face shield	279, 280, 281, 282 290, 292 294, 296
When using in enclosed areas wear goggles, half facepiece respirator with combined dust and gas cartridge	279, 284, 290, 297, 300, 303
If product on skin, immediately wash area with soap and water	340, 342
After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water	350
After each days use, wash gloves, face shield, goggles respirator and if rubber wash with detergent and warm water, and contaminated clothing	360, 361, 362, 363 364, 366
Obtain an emergency supply of atropine tablets 0.6 mg	373
AE 50 g/kg or less	
Avoid contact with eyes and skin	210, 211
Do not inhale vapour. Wash hands after use	220, 222, 351
EC 1 g/L or less	
Avoid contact with eyes and skin	210, 211
Wash hands after use	351

The following formulations need to be deleted from the Handbook of First Aid Instructions and Safety Directions (1996) as no products with these formulations were submitted for review.

Fenitrothion EC 1 g/L or less and WP 12 g/L or less.

Inadequate exposure data exists for most uses of fenitrothion. Therefore, this assessment does not recommend revision of the existing Safety Directions for fenitrothion at this stage. Additional data are requested for certain uses of fenitrothion products. Assessment of this data may result in revision of Safety Directions.

5.3 Information provision

5.3.1 Labels

Technical grade fenitrothion and all EC and ULV products are determined to be hazardous substances according to NOHSC criteria.

The label for technical grade fenitrothion should be in accordance with the NOHSC Code of Practice (NOHSC, 1994c). All EC and ULV products require a reference to the Material Safety Data Sheet (MSDS) for further information.

5.3.2 Material Safety Data Sheet (MSDS)

The active ingredient and all EC and ULV products require MSDS in accordance with the NOHSC Code of Practice (NOHSC, 1994d).

5.4 Occupational Exposure Monitoring

5.4.1. Atmospheric monitoring

NOHSC has not established an exposure standard for fenitrothion.

This review does not recommend that a NOHSC exposure standard be assigned at this stage.

5.4.2. Health Surveillance

NOHSC has placed OP pesticides on the Schedule for Health Surveillance (Schedule 3 Hazardous Substances for which Health Surveillance is Required). Guidelines for monitoring OP pesticides have been endorsed by NOHSC (NOHSC, 1995). The employer is responsible for providing health surveillance where a requirement has been established as a result of the workplace assessment process.

The NOHSC guidelines recommend one, or preferably two pre-exposure tests at least 3 days apart, to establish baseline ChE activity (an average if two samples are obtained).

It is also recommended that a period of 4 weeks elapse between last exposure to OP pesticides and testing to establish baseline levels.

The NOHSC guidelines require estimation of RBC and plasma ChE levels. It is preferable if testing is carried out in the latter half of the working day when OP pesticides are used. If a 20% depression in ChE activity is seen, the worker should be re-tested. If ChE levels fall by 40% or more, the worker should be removed from exposure to OP pesticides until such time as the level returns to baseline level.

6. CONCLUSIONS

Worker exposure during end use

Stored cereal grain

In bulk storage facilities, grain is treated via a largely mechanical process. Re-application is not common. Workers are trained and operate under Australian Wheat Board standards. Based on the evaluation of available information including a site visit, the risk to workers in bulk storage facilities is acceptable under current practices and standards. Farm workers may be at higher risk than employees in bulk handling facilities because of the risk of open spraying, the use of powder formulations and the lack of risk mitigation methods on farms. However, the quantity of grain stored on Australian farms is relatively small. It is recommended that all farm workers handling fenitrothion be adequately trained (refer below for details), wear PPE recommended on the product labels and adopt work practices that minimise dermal and inhalation exposure to fenitrothion.

The continued use of the controlled gas formulation is acceptable, as long as it remains available only to licensed and authorised personnel. The continued use of powder formulations of fenitrothion needs to be justified, as powder products inherently involve higher exposures than liquid formulations.

As the risk to workers treating stored grain with fenitrothion products could not be quantified the following risk mitigation methods are needed:

1 development of enclosed mixing/loading systems, particularly for bulk handling facilities.

2 farm chemical user training, via an appropriate mechanism, for all workers handling fenitrothion to treat stored cereal grain.

3 justification for the use of fenitrothion powder formulations over liquids, in the treatment of grain on farms.

4 audit of ChE monitoring procedures conducted by the relevant State grain handling authorities and an annual reporting system for ChE monitoring results.

Grain storage facilities and equipment

As the risk for workers treating grain storage facilities and equipment by hand directed methods could not be quantified, the following risk mitigation actions are needed:

1. development of enclosed mixing/loading systems, particularly for bulk handling facilities.

2. farm chemical user training, via an appropriate mechanism, for all workers handling fenitrothion to treat grain storages and equipment.

3. audit of ChE monitoring procedures conducted by the relevant State grain handling authorities and an annual reporting system for ChE monitoring results.

Poultry housing

The potential exposure and risk to workers involved in spraying poultry houses is high. Although there may be a period of some weeks between use and exposure episodes, at the time when fenitrothion spraying takes place, its use is intensive. The use observed in the large poultry complex is determined to be acceptable because all workers were adequately trained, extensive protective clothing, including water proof clothing, was worn, and the "worker/PPE/tractor" was washed together under a shower after each shed was sprayed.

Hand-held spraying restricted to treating crevices and cracks would not involve the same high potential risk.

A workplace assessment should be conducted to determine the need for ChE monitoring.

Work practices when treating broiler sheds on small contract farms are unlikely to be dissimilar to large farms. The level of worker training and exposure mitigation methods may vary between farms. However, given the smaller number of sheds on small farms, worker exposure is likely to be less frequent.

As the risk could not be quantified, the following risk mitigation actions are needed:

1. development of industry-wide standard (safe) operating procedures for using fenitrothion to treat poultry housing. Health surveillance is to be included.

2. farm chemical user training, via an appropriate mechanism, for all workers handling fenitrothion to treat poultry houses.

Animal hides and skins and associated storage areas

Inadequate data was presented to assess the risk to workers involved in treating animal skins and storage areas. The data obtained suggests that there is the potential for high and frequent exposure to fenitrothion in workplaces. This exposure may not be adequately controlled. Further data is required to support this use of fenitrothion.

A workplace risk assessment is likely to find a need for ChE monitoring.

In an interim period, pending data collection and assessment, the following risk mitigation activity is needed.

1. farm chemical training, via an appropriate mechanism, for all workers handling fenitrothion to treat animal hides and skins and storage areas;

In anticipation of:

2. study of a representative number of workers and sites to establish fenitrothion exposure and the risk to workers.

<u>Broadacre and horticultural crops</u>

Broadacre – ground and aerial application

There was no measured worker exposure data for aerial spraying of fenitrothion for locust or other insect control in broadacre crops or pastures.

The qualitative risk assessment for aerial spraying of fenitrothion, based on data provided by the registrants, the NRA, and a visit to the APLC field base, indicates that the existing control measures are sufficient to enable continued use of fenitrothion by this method.

There was no measured worker exposure data for ground spraying of fenitrothion for locust or other insect control in broadacre crops or pastures. Predicted Operator Exposure Modelling (POEM) was used to estimate exposure and risk for ground spraying for cockchafer and corbie control in Tasmanian pastures.

The risk for workers applying fenitrothion by boom sprayer in Tasmania, based on predicted exposure using POEM, was high and unacceptable, even when closed cabs were used. The risk was high and unacceptable even if mixer/loader exposure were eliminated. The risk to workers applying fenitrothion to pastures (excluding Tasmanian pastures) and other broadacre crops using hand-held boom sprayers, knapsack sprayers, small booms mounted on ATVs and misters could not be quantified. Considering the unacceptable risk to groundboom sprayers obtained for Tasmanian pasture use, it is likely that other ground or hand directed fenitrothion users are also at risk. Measured worker exposure data is needed to quantify this risk.

Based on the qualitative and quantitative risk assessment, the following risk mitigation activities are needed:

1. farm chemical training, via an appropriate mechanism, for all workers handling fenitrothion to treat broadacre crops.

2. collection and assessment of measured worker exposure data for all fenitrothion uses by ground and hand directed spraying. Data collection to be adequate to assess the influence of enclosed mixing/loading and enclosed cabs.

Horticulture

No measured or predicted worker exposure data was available for horticulture use of fenitrothion. Available information indicates that horticultural crops per se are not sprayed directly but rather perimeter or ground-directed spraying of inter-row vegetation is carried out to control locusts or other insects. Given the targetted nature of spraying, ie dependent on pest pressure and location, continued use for this purpose is acceptable, with the following risk mitigation activities:

- farm chemical training, via an appropriate mechanism, for all workers handling fenitrothion to treat perimeter or inter-row vegetation in horticultural crops.

Permit use

The permit uses identified are similar to uses under existing label claims, with the exception of forestry use, including aerial spraying of EC products, which is not similar to an existing use pattern.

No information or measured worker exposure data was provided to enable an OHS quantitative risk assessment for any of the permit uses.

Permit uses need to be examined to ascertain the need to continue the permit use. Time periods should be specified for permit approvals. Aerial spraying under permit is likely to involve similar acceptable risks to those identified for other uses. However, the use of EC products over ULV products should be justified by the forestry industry. Ground spraying under permit is likely to involve similar risks to those identified for other uses. Permits for ground spraying will need to be reconsidered, when data on ground spraying and hand-directed spraying collected for broadacre crop use, is assessed.

Worker exposure during re-entry or re-handling

The following categories of workers are determined to be at risk from re-entry or re-handling fenitrothion residues.

Stored cereal grain

Workers walking through treated grain to collect grain samples may experience fenitrothion exposure. As the risk could not be quantified, the following risk mitigation measures are needed:

1 standard operating procedures for this activity should include the use of protective clothing particularly for leg, torso and arms.

2 audit of ChE monitoring procedures conducted by the relevant State grain handling authorities and an annual reporting system for ChE monitoring results.

3 study of dissipation of fenitrothion residues in treated grain, followed by a worker exposure study, if required.

<u>Poultry housing and litter</u>

Direct exposure to fenitrothion residues is not expected, however airborne monitoring of fenitrothion would establish the level of inhalation exposure and risk. As the re-entry risk could not be quantified, the following risk mitigation actions are needed:

1 study of a representative number of poultry farms to establish airborne fenitrothion residues and the risk to workers.

2 on the basis of (1), further risk reduction measures may be required.

<u>Animal hides and skins and associated storage areas</u>

No information is available on exposure while re-handling treated hides and skins, or on re-entry exposure in storage areas.

As the re-handling or re-entry risk could not be quantified, the following risk mitigation actions are needed:

1 study of representative workers to establish the exposure to fenitrothion residues and the risk to workers handling treated skins.

2 study of dissipation of fenitrothion residues on treated skins.

3 on the basis of (1) and (2), specific risk reduction measures may be required.

<u>Broadacre and horticulture use</u>

Re-entry exposure and risk for workers spending substantial time checking locust and other kills soon after spraying could not be be quantified. Re-entry following other broadacre and horticulture use is not likely to be frequent or of long duration. The following risk mitigation methods are needed:

1 audit of ChE monitoring procedures and an annual reporting system for ChE monitoring results.

2 study of a representative number of workers to establish the exposure to fenitrothion residues and a time period after spraying when the risk is acceptable to conduct this activity.

Information provision

Labels

Fenitrothion is a hazardous substance. Fenitrothion TGAC labels, EC, and ULV product (containing 100% fenitrothion) labels should be in accordance with the NOHSC Code of Practice (NOHSC, 1994c).

Safety directions

NOHSC does not recommend revision of the existing Safety Directions for fenitrothion at this stage. Revision of the Safety Directions may be required when the additional data requested for certain uses of fenitrothion are received and assessed.

Health surveillance

Health surveillance is required for OP pesticides under existing hazardous substances regulations. Health surveillance should be conducted in accordance with the NOHSC Guidelines for Health Surveillance (NOHSC, 1995) and Control of Workplace Hazardous Substances (NOHSC, 1994b).

ATTACHMENT 1: Site visit to Australian Plague Locust Commission (APLC), Narromine, NSW

The Agricultural and Veterinary Chemicals Section, National Occupational Health and Safety Commission (NOHSC) attended an aerial control demonstration (mock demonstration) at Narromine, NSW on 22 October 1997. The APLC use fenitrothion ULV, containing 1.27 kg/L fenitrothion, for the control of locust bands and swarms in cereal and forage crops, pasture, lucerne and soybean.

The decision to launch a control program in a particular area is based on the number of locust targets, size of each target, area of hatching visible from the air, location of infestation and the presence of beekeepers.

Prior notice of spraying is circulated to local residents, farmers and owners of affected properties via the media, local councils, Work Cover Authority and door knocking. Equipment and transport, licensed in transport of dangerous goods and owned by APLC may be brought in at short notice.

Fenitrothion is stored in bulk containers in a well-ventilated shed. The storage area contained a bund for collection of washings and waste water. An emergency shower was provided in case of accidental contamination of workers. The personal protective equipment worn while transporting and loading of fenitrothion were laundered by the operators themselves.

The control campaign consists of either band (nymph) control and/or swarm (adult) control. Spraying is carried out using fixed wing light aircraft for ground hatchings and helicopters for flying swarms. Flying heights are adjusted for the different targets and wind speed. Flying heights range from 5-10 m for band control, to just above the swarm for swarm control. A buffer zone of 1.5 km is maintained between a sprayed target and a sensitive area (dwellings, dams, rivers).

The aircraft was loaded by pumping the chemical (water was used in this demonstration) from the containers directly into the aircraft tank, using a portable petrol driven pump. Staff loading the aircraft tank wore overalls, rubber aprons, elbow-length chemical-resistant gloves, rubber boots, and hats. Face shields and respirators were provided but were not worn. The pilot wore no protective equipment.

The pilot had the field mapped out. He was in constant radio contact with the Operations Manager who constantly monitored the wind speed from the ground. The pilot usually waits for the desired wind speed before commencing aerial spraying. No manual flagging is carried out as pilots use Geographic Positioning System (GPS).

Post-spray sampling is carried out 24-48 hours after spraying (not viewed during visit). Light weight overalls, rubber boots, gloves and a hat are worn during sampling.

All APLC employees are trained and licensed. All personal protective equipment is provided by APLC to employees including the pilot. The protective equipment is laundered by individuals after use. The aircraft, obtained under contract, is returned to base after spraying operations. Pumps and gear are cleaned and washings taken to Canberra for disposal. Drums are crushed and buried.

Worker exposure may occur during loading operations, cleaning up equipment, drums or spills.

Staff have blood tests for erythrocyte and plasma cholinesterase activity at various times, including pre-determined periods, 2-3 months after any possible exposure to fenitrothion, after each control campaign, and immediately if contamination is believed to have occurred. Records are maintained by APLC.

All staff are trained in first aid.

ATTACHMENT 2: Site visit to grain storage facilities in the Moree area, NSW

The Agricultural and Veterinary Chemicals Section, National Occupational Health and Safety Commission (NOHSC), visited the GrainCorp Operations Ltd storage areas in Moree, NSW, in November 1997.

Types of storage (bunker, vertical silos and horizontal storage), weighing, sampling and grading of grain was observed.

Grain treatment is carried out during the harvest period, ie. November to February each year. GrainCorp Operations Ltd is currently not using fenitrothion in their silos. A combination of chlorpyrifos-methyl and methoprene is used instead. Chemical treatment of grain takes place only once upon receival. If re-treatment is required, fumigation is the preferred option.

Chemical treatment of grain

The quantities of the pesticide to be used is determined by Pest Control Officers at the commencement of the season. Label specified application rates are used. All mixing/loading and storage of chemicals occurs in a shed outside the silo. Actual mixing and loading was not viewed during the visit. Trained GrainCorp silo operators measure the required amount of chemical using a measuring jug or bucket and pour this into the mixing vat situated in the shed. All silo operators wear cotton overalls, impervious gloves, boots and a half-face respirator when handling chemicals.

In vertical silos and horizontal storage, chemical is sprayed onto the grain as it travels along the conveyor/elevator by an automated delivery system. Calibration of the flow is carried out by the silo operator at the beginning of receivals (the spray volume depending on the intake of the elevator) and checked periodically. Workers do not enter the silo under normal working conditions.

Stored grain is periodically sampled for pests. Sampling activities were not viewed during the site visit. In vertical silos, sampling is carried out using long probes and no worker contact with treated grain is likely. In horizontal storage, workers are required to walk through the grain, sampling at intervals using long probes.

Worker exposure

Potential worker exposure can only occur during the following activities: mixing and loading chemicals, carrying out maintenance operations on the automatic delivery system and manual sampling of grain.

Chemical treatment of storage structures

Outer and inner surfaces of silos and surrounds can be treated with chemical as required. Spray application to the outer surface of a horizontal silo and surrounding ground was demonstrated. The chemical and all necessary equipment was carried on a truck. A trained GrainCorp Operations Ltd worker measured the required amount of chemical using a measuring jug, poured it into the mixing vat situated on the truck, added water and applied the chemical using hose and hand-held equipment. The worker wore cotton overalls, impervious gloves, boots and a half-face respirator.

Worker exposure

Worker exposure is possible during mixing/loading, spray application and cleaning up equipment. Environmental conditions may have a significant impact during hand spraying.

Training and education

All workers involved in chemical treatment of stored grain are trained by GrainCorp Operations Ltd. They are provided with a GrainCorp pesticide Procedures Manual, which details safe handling and use of chemicals, personal protective equipment, personal hygiene practices, symptoms and signs of poisoning and first-aid treatment.

Health Surveillance

Regular cholinesterase testing is carried out on GrainCorp Operations Ltd employees. Workers can also request testing if they feel unwell or following a spill. No incidents of poisoning or undue concern over cholinesterase levels have been reported.

ATTACHMENT 3: Site visit to Appin farm complex, (Inghams Enterprises Pty Ltd), Campbelltown, NSW

The Agricultural and Veterinary Chemicals Section, National Occupational Health and Safety Commission (NOHSC), visited the Appin broiler farm complex in Campbelltown, NSW, on 28 January 1998.

Appin farm complex is the largest broiler growing site in Australia. There are 6 farms each containing 16 sheds (total 96 sheds). Each shed is approximately 1400 sq m in size. The farms share the same equipment but the workers operate independently. In addition, there are 80 contract broiler growers and a total of 324 sheds throughout NSW.

Fenitrothion is the main pesticide used for black beetle control. Pyrethrum is an alternative. The black beetle or lesser mealworm destroys the shed insulation and feeds on dead birds.

After the chickens are removed from a shed, the used litter, consisting of paper and wood shavings, is taken away to be recycled and used as organic manure. The shed is swept and the walls and floor washed with water and detergent.

The walls, roof, and floor are sprayed with fenitrothion using a cabless airblast sprayer (Silvan Orchard Sprayer). Mixing/loading is usually done indoors. The product is mechanically siphoned into the spray tank using a probe and powered by the PTO of the tractor. The required quantity of water is manually added to the spray tank. The sprayer is calibrated to deliver the pesticide at 600 psi and 100 L/min. Spraying is usually carried out early morning with the operator spending approximately 3 1/2 minutes in each shed. Sixteen sheds are treated in approximately two days. If necessary, as in heavy infestation, directed spraying is carried out using a hose connected to a sprayer and a hand wand. Workers are not required to re-enter shed until formaldehyde spraying is carried out 2-3 days later. While spraying, the operator wears a full plastic suit, impervious gloves, boots and full face respirator (PPE).

After spraying the “worker/PPE/tractor” complex is washed using a portable shower. The overalls are laundered on the premises and the respirators taken home by the operator. The respirators are cleaned and reused, with the cartridges being replaced if necessary.

Two to three days later the sheds are disinfected with liquid formaldehyde using an orchard sprayer which produces a fine mist. The doors of the sheds are locked and a no-entry sign put up. Twenty four hours later a worker with full personal protective gear - plastic suit, impervious gloves, boots and self-contained breathing apparatus, enters the shed to check the atmospheric levels of formaldehyde. If the reading is < 0.3 ppm, the litter is laid and the chicks are introduced. The litter is not treated with fenitrothion.

While the first eight sheds are being sprayed and disinfected the remaining eight sheds are cleaned and washed with detergent.

Workers enter the sheds periodically to rearrange the litter, move the chicken fences, and remove the dead chicks. Sheds are not sprayed when chickens are present. Each broiler cycle is approximately 70 days.

No chemicals are stored on the premises. They are delivered when needed and the remaining chemical sent to other farms. Contractors are supplied with the chemical by the suppliers. In-house training is provided by qualifed company staff and Material Safety Data Sheets (MSDS) supplied. Four Area Managers monitor the spray applications.

Health Surveillance

No health surveillance is routinely carried out as the concentration of the pesticide is low (1L/100 L water - 1% ai). Inghams have carried out a workplace assessment and determined the risk of adverse effects to be low.

Worker exposure

Potential worker exposure may occur during transport of the chemical, when opening containers, during spray application and cleaning up spills and equipment.

Exposure during re-entry is not significant as the product is dilute and the sheds are entered for disinfection 2-3 days after spraying.

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