



Australian Government

**Australian Pesticides and
Veterinary Medicines Authority**



Diazinon

Final Review Technical Report
September 2024

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Contents

Preface	1
About this document	1
Further information	2
Contact details	2
Introduction	3
Purpose of review	3
Mode of action, product claims and use patterns	3
Chemistry	4
Active constituent	4
Formulated products	6
Recommendations	9
Toxicology	10
Evaluation of toxicology	10
Biochemical aspects	10
Major toxicological mode(s) of action and key events	10
Acute toxicity	10
Effect of ageing of diazinon on acute toxicity	11
Repeat dose toxicity	12
Genetic toxicology	13
Carcinogenicity	13
Reproduction and development studies	13
Special studies	14
Health-based guidance values	15
Poisons scheduling	16
Recommendations	16
Residues and trade	17
Previous residues assessments	17
Current residues assessments	18
Metabolism	19
Plant metabolism	20
Animal metabolism	22
Analytical methods and storage stability	23

Residue definition	24
Plant commodities – enforcement	24
Plant commodities – risk assessment	24
Animal commodities – enforcement and risk assessment	25
Residues from agricultural uses	26
Banana	26
Cauliflower and broccoli	27
Mushroom	27
Onion and garlic	28
Pineapple	29
Final recommendations for agricultural uses	30
Residues from veterinary medicine uses	31
Trade consideration for veterinary uses	33
Final recommendations for veterinary uses	35
Regulatory acceptable level for spray drift assessment	35
Dietary exposure	35
Chronic dietary exposure assessment	35
Acute dietary exposure assessment	36
Conclusions	36
Amendments to the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023	36
Residues assessment outcomes for diazinon agricultural use patterns	37
Residues assessment outcomes for diazinon veterinary use patterns	37
Uses supported from a residues and trade perspective	38
Occupational health and safety assessment	39
Points of departure and margins of exposure for risk characterisation	39
Use patterns relevant to risk assessment	39
Companion animal external parasiticide exposure, non-professional use surrogate exposure scenario evaluations	39
Professional occupational agricultural and veterinary use surrogate exposure scenario evaluations	41
Exposure situations	44
Professional occupational agricultural and veterinary use surrogate re-entry evaluations	49
Professional occupational exposure associated with the animal health use of diazinon	50
Spray drift assessment	52
First aid instructions	52
Safety directions	52

EC products	53
Ear tag products	55
Recommendations	55

Environmental assessment	57
Previous environment assessments	57
Current environment assessment	57
Fate and behaviour in the environment	58
Effects on non-target species	61
Risks to non-target species	64
Terrestrial vertebrates	64
Aquatic species	66
Bees	68
Other arthropod species	69
Soil organisms	70
Terrestrial plants	71
Recommendations	71

Spray drift assessment	74
Regulatory acceptable levels for sensitive areas	74

Appendix A – Summary of assessment outcomes	76
Appendix B – Listing of environmental endpoints	83
Appendix C – Terrestrial vertebrate assessments	99
Appendix D – Runoff assessments	104
Assessment scenarios	104

Appendix E – PBT and POP assessments	120
Persistence criterion	120
Bioaccumulation criterion	120
Toxicity criterion	120
Potential for long-range environmental transport	121
Conclusion	121

Appendix F – public consultation	122
Acronyms and abbreviations	124
Glossary	127

References

131

List of tables

Table 1: Nomenclature and structural formula of the active constituent diazinon	4
Table 2: Key physicochemical properties of the active constituent diazinon	4
Table 3: Current active approvals for diazinon	5
Table 4: Current active approvals for diazinon	6
Table 5: Registered agricultural products containing diazinon	6
Table 6: Registered veterinary products containing diazinon	7
Table 7: Summary of NOELs (mg/kg bw/day) for cholinesterase inhibition in plasma, RBC and brain	13
Table 8: Possible points of departure for human health risk assessment	15
Table 9: Acceptable daily intake for diazinon	16
Table 10: Acute reference dose for diazinon	16
Table 11: Poison scheduling for diazinon	16
Table 12: Structures of the major metabolites identified in the plant and animal metabolism studies	19
Table 13: Single metabolites of diazinon observed in matrices at >10% TRR in the primary crop plant metabolism studies	21
Table 14: Single metabolites of diazinon observed in matrices at >10% TRR in the animal metabolism studies	22
Table 15: Residues of diazinon in cauliflower	27
Table 16: Residues of diazinon in bulb onions	28
Table 17: Residues of diazinon in pineapples	30
Table 18: Matrices, analytes and storage conditions in the direct animal treatment studies considered in the 2002 residues assessment	32
Table 19: Diazinon MRLs in Australia's major trading markets for meat, milk and offal products	33
Table 20: Amendments to Table 1 of the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023	36
Table 21: Points of departure and margins of exposure used for risk characterisation	39
Table 22: Parameters used in the non-professional use surrogate exposure scenario evaluation	40
Table 23: Diazinon home garden and pet product exposure assessment	41
Table 24: Exposure situations and modelling parameters	43
Table 25: Exposure assessment outcomes and risk characterisations	44
Table 26: Re-entry outcomes	49
Table 27: Required Personal Protective Equipment	51
Table 28: First aid instructions	52
Table 29: Environmental risk assessment scenarios	58
Table 30: Key regulatory endpoints for exposure assessment	60
Table 31: Regulatory acceptable levels for non-target species	62

Table 32: Summary of risk assessment outcomes for terrestrial vertebrates	65
Table 33: Food chain assessment in terrestrial vertebrates (maximum acceptable threshold)	65
Table 34: Summary of runoff risk assessment outcomes	67
Table 35: Screening level assessment of risks to bees	69
Table 36: Assessment of risks to other non-target arthropods	70
Table 37: Screening level assessment of risks to soil organisms	71
Table 38: Supported uses from the viewpoint of environmental safety	72
Table 39: Uses not supported from the viewpoint of environmental safety	73
Table 40: Diazinon uses and amended label statements that are supported by all risk assessments	76
Table 41: Diazinon uses that are not supported due to safety, residues or trade concerns	79
Table 42: Physical and chemical properties	83
Table 43: Dissipation in animal food items	83
Table 44: Fate and behaviour in soil	84
Table 45: Fate and behaviour in water and sediment	88
Table 46: Fate and behaviour in air	88
Table 47: Monitoring data	89
Table 48: Laboratory studies on terrestrial vertebrates	89
Table 49: Field studies on terrestrial vertebrates	90
Table 50: Laboratory studies on aquatic species	91
Table 51: Bioconcentration in aquatic species	95
Table 52: Laboratory studies on bees	96
Table 53: Higher tier studies on bees	96
Table 54: Laboratory studies on other non-target arthropods	96
Table 55: Higher tier studies on other non-target arthropods	97
Table 56: Laboratory studies on soil organisms	97
Table 57: Field studies on soil organisms	97
Table 58: Effects on non-target terrestrial plants (pre-emergent exposure)	97
Table 59: Effects on non-target terrestrial plants (post-emergent exposure)	98
Table 60: Seasonal exposure estimates for diazinon in animal food items	99
Table 61: Long-term risks of diazinon to wild mammals (RAL 0.65 mg/kg bw/d)	100
Table 62: Acute risks of diazinon to birds (RAL 0.80 mg/kg bw/d)	102
Table 63: Soil exposure rates assessed for the runoff assessments of diazinon	104
Table 64: Tier 2 scenarios showing acceptable runoff risks of diazinon to aquatic species (RAL 0.15 µg/L)	106
Table 65: Tier 3 scenarios showing acceptable runoff risks of diazinon to aquatic species without restrictions	107
Table 66: Regions showing unacceptable runoff risks of diazinon to aquatic species at any time	108
Table 67: Regions showing acceptable runoff risks of diazinon with timing restrictions	109
Table 68: Submissions in response to the proposed regulatory decision on the reconsideration of diazinon	122

Preface

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

The APVMA has legislated powers to reconsider the approval of an active constituent, registration of a chemical product or approval of a label at any time after it has been registered. The reconsideration process is outlined in sections 29 to 34 of Part 2, Division 4 of the Agvet Codes. The Code provides for the suspension and cancellation of approvals and registrations if it appears to the APVMA that the criteria for approval or registration are not, or are no longer, satisfied (s 41 and s 44 of Part 2, Division 5).

A reconsideration may be initiated when new research or evidence has raised concerns about the use or safety of a particular chemical, a product containing that chemical, or its label. The scope of each reconsideration can cover a range of areas including human health (toxicology, public health, work health and safety), the environment (environmental fate and ecotoxicology), residues and trade, chemistry, efficacy or target crop or animal safety. However, the scope of each reconsideration is determined on a case-by-case basis reflecting the specific issues raised by the new research or evidence.

The reconsideration process includes a call for data from a variety of sources, a scientific evaluation of that data and, following public consultation, a regulatory decision about the ongoing use of the chemical or product. The data required by the APVMA must be generated according to scientific principles. The APVMA conducts scientific and evidence-based risk analysis with respect to the matters of concern by analysing all the relevant information and data available.

About this document

This Technical Report is intended to provide an overview of the assessments that have been conducted by the APVMA and of the specialist advice received from its advisory agencies. It has been deliberately presented in a manner that is likely to be informative to the widest possible audience, thereby encouraging public comment.

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

- the toxicology of both the active constituent and product
- the residues and trade assessment
- occupational exposure aspects
- environmental fate, toxicity, potential exposure and hazard
- efficacy and target crop or animal safety.

Further information

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

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Introduction

Diazinon is a broad-spectrum organophosphorus insecticide and acaricide that was first introduced to Australia in 1953 (British Crop Production Council, 2016). Diazinon is used in domestic, agricultural and veterinary situations for the control of certain insect pests and mites. Diazinon was nominated for review in response to an invitation to the public by the APVMA (then the NRA) in 1994. The APVMA began its reconsideration of diazinon active constituent approvals, product registrations and associated label approvals in 1996 because of concerns relating to chemistry, toxicology, occupational health and safety, efficacy, residues, trade, and the environment. The APVMA took interim action on select products in 2003, following the publication of component assessment reports in 2002. These actions were to:

- suspend or cancel product registrations and associated label approvals for hydrocarbon based formulations without added stabiliser in the finished product
- cancel product registrations for use as dog and kennel flea treatments and associated label approvals.

Purpose of review

The scope of the reconsideration for diazinon active constituent approvals, product registrations and label approvals includes chemistry, toxicology, occupational health and safety, efficacy, residues, trade, and the environment. In addition to these assessments, all diazinon labels were reviewed for consistency with current APVMA policies and guidelines, including the [APVMA Spray Drift Policy July 2019](#).

Mode of action, product claims and use patterns

Diazinon is a group 1b (organophosphorus) non-systemic insecticide and acaricide that acts through acetylcholinesterase inhibition by contact, ingestion and respiration. Diazinon is currently registered in Australia for the control of certain mites and insect pests in domestic, agricultural and veterinary situations. These situations include:

- control of chewing and sucking insects in fruit, vegetable, nut and field crops, nursery and ornamental plants, pastures and turf
- control of mushroom pests in mushrooms
- control of Argentine ants in pastures, lawns and around trees
- control of flies, fleas, cockroaches, bedbugs, ants, beetles and other insects in commercial, industrial, domestic and farm buildings, ships, refuse areas and garbage containers
- control of mosquito larvae in ponds and stagnant waters
- use as an ectoparasiticide in livestock including cattle, sheep, pigs and goats.

Diazinon is also used under permit for the control of certain insect pests on cherries, coriander, parsley, leeks, macadamia nuts, mustard (oilseed cultivars), spring onions, and shallots, and as a sheep dip used via the Richards Submersible Cage Dipping System. The permit uses were not included under this reconsideration but will be reviewed following the final outcome of this reconsideration.

Chemistry

Active constituent

Table 1: Nomenclature and structural formula of the active constituent diazinon

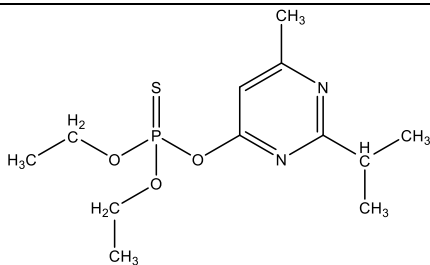
Common name (ISO):	Diazinon
IUPAC name:	O,O-diethyl O-2-isopropyl-6-methylpyrimidin-4-yl phosphorothioate
CAS registry number:	333-41-5
Molecular formula:	C ₁₂ H ₂₁ N ₂ O ₃ PS
Molecular weight:	304.3 g/mol
Structural formula:	

Table 2: Key physicochemical properties of the active constituent diazinon

Common name (ISO)	Diazinon
Appearance	Clear, colourless liquid (purified active ingredient) Yellow liquid (technical active ingredient)
Boiling point	83–84 °C (0.0002 mm Hg)
Specific gravity	1.11 (20–25 °C)
Solubility in water	60 mg/L (20–25 °C)
Organic solvent solubility (20–25 °C):	Soluble in acetone, alcohols, benzene, cyclohexane, dichloromethane, ethers, hexane, petroleum oils, toluene
Octanol/water partition coefficient (Log K _{ow}):	3.3
Vapour pressure	0.012 Pa (25 °C)
Henry's law constant (calculated):	0.00609 Pa.m ³ mol ⁻¹
Hydrolysis (DT50, 25 °C):	pH 5: 12 days pH 7: 138 days pH 9: 77 days

Common name (ISO)	Diazinon
Aqueous photolysis (DT50):	50 days

Diazinon is a liquid at room temperature, colourless when pure, and yellow when formulated as a technical active ingredient. It is only slightly water soluble, but soluble in polar organic, and aromatic and aliphatic hydrocarbon solvents.

At an acidic pH, diazinon shows relatively rapid hydrolysis, while being more stable at neutral and alkaline conditions. Photolysis does not significantly accelerate degradation of diazinon in aqueous solution.

There are 3 active constituent approvals for diazinon, listed in Table 3.

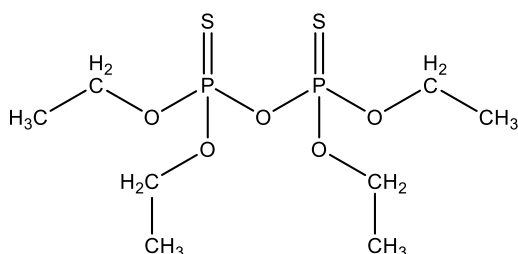
Table 3: Current active approvals for diazinon

Approval number	Holder
44033	Adama Australia Pty Ltd
46132	Nippon Kayaku o Ltd
92520	Sanonda (Australia) Pty Ltd

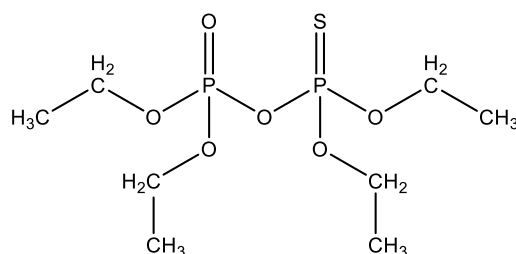
The [Agricultural and Veterinary Chemicals Code \(Agricultural Active Constituents\) Standards 2022](#) specifies a minimum purity for diazinon of 950 g/kg (excluding any added stabiliser). Maximum levels are specified for 2 toxicologically significant impurities of 2.5 g/kg for O,O,O',O'-tetraethyl dithiopyrophosphate and 0.2 g/kg for O,O,O',O'-tetraethyl thiopyrophosphate, plus maximum levels of 0.6 g/kg for water, and 0.3 g/kg for acidity (calculated as equivalents of H₂SO₄).

Both O,O,O',O'-tetraethyl dithiopyrophosphate (S,S-TEPP) and O,O,O',O'-tetraethyl thiopyrophosphate (O,S-TEPP) have considerably higher acute toxicity than diazinon itself.

Figure 1: Structures of toxicologically significant impurities in diazinon



O,O,O',O'-tetraethyl dithiopyrophosphate (S,S-TEPP),
CAS number 3689-24-5



O,O,O',O'-tetraethyl thiopyrophosphate (O,S-TEPP),
CAS number 645-78-3

A [chemistry component assessment report](#) published in 2002 and a [toxicological hazard assessment report](#) published in 2011 discussed the degradation of diazinon technical active constituent. The toxicologically significant degradation products S,S-TEPP and O,S-TEPP can form in the presence of trace amounts of water in the

technical active, or during the manufacturing process as impurities. Formation of dangerous levels of S,S-TEPP and O,S-TEPP can be limited by the inclusion of a water scavenger in the technical active constituent. Typically, this is epoxidised soyabean oil, or 3,4-epoxycyclohexylmethyl 3,4-epoxycyclohexanecarboxylate.

The APVMA has considered all information including information submitted as part of assessment applications and additional information requested under s 33 of the Agvet Code. This information was used to confirm whether approved active constituents complied with the APVMA standard and FAO specifications in regards to the levels of S,S-TEPP, O,S-TEPP and water. This information includes Declaration of Compositions, Certificates of Analysis, analytical methodology and manufacturing processes.

Table 4: Current active approvals for diazinon

Approval number	Holder	Sufficient data was provided to confirm the active constituent complied with the levels of S,S-TEPP, O,S-TEPP and water	Approval continued to be supported
44033	Adama Australia Pty Ltd	No	No
46132	Nippon Kayaku Co Ltd	Yes	Yes
92520	Sanonda (Australia) Pty Ltd	Yes	Yes

Formulated products

There are currently 20 registered products containing diazinon as an active constituent – 15 veterinary chemical products, and 5 agricultural chemical products. The products are tabulated below in Table 5 and Table 6, grouped by product format (formulation type, diazinon content, and other actives (if any)).

Table 5: Registered agricultural products containing diazinon

Registration number	Holder	Product name
Emulsifiable concentrate (EC) formulation containing 800 g/L diazinon		
50007	Amgrow Pty Ltd	Barmac Diazinon Insecticide
59707	Adama Australia Pty Ltd	Farmoz Diazol 800 Insecticide
68534	Accensi Pty Ltd	Accensi Diazinon 800 Insecticide
87681	Imtrade Australia Pty Ltd	Imtrade Diazinon 800 EC Insecticide
88946	Axichem Pty Ltd	AC Dizzy 800 Insecticide

Table 6: Registered veterinary products containing diazinon

Registration number	Holder	Product name
Topical solution/suspension (emulsifiable concentrate formulation applied after dilution in water to form an emulsion) containing 3 g/L diazinon		
92828	Abbey Laboratories Pty Ltd	BFD BLOWFLY DRESSING
Topical solution/suspension (emulsifiable concentrate formulation applied after dilution in water to form an emulsion) containing 93.3 g/L diazinon		
51290	Zagro Animal Health Pte Ltd	Eureka Gold Op Spray-on Off-Shears Sheep Lice Treatment
68253	Zagro Animal Health Pte Ltd	Nucidol Gold Op Spray-on Off-Shears Sheep Lice Treatment
86308	Intervet Australia Pty Ltd	Coopers Erase Gold Spray-on Off-Shears Sheep Lice Treatment
86314	Intervet Australia Pty Ltd	Coopers Gold Spray-on Off-Shears Sheep Lice Treatment
Topical solution/suspension (emulsifiable concentrate formulation applied after dilution in water to form an emulsion) containing 200 g/L diazinon		
39572	WSD Agribusiness Pty Ltd	WSD Diazinon for Sheep, Cattle, Goats and Pigs
49876	Zagro Animal Health Pte Ltd	Nucidol 200 EC Insecticide and Acaricide
62353	Intervet Australia Pty Ltd	Coopers Diazinon Sheep Blowfly Dressing and Cattle, Goat and Pig Spray
Ear tag formulation containing 200 g/kg diazinon		
46406	Nutrien Ag Solutions Limited	Y-Tex Optimiser Insecticidal Cattle Ear Tags
Ear tag formulation containing 400 g/kg diazinon		
53910	Elanco Australasia Pty Ltd	Patriot Insecticide Ear Tag for Cattle
Ear tag formulation containing 300 g/kg diazinon and 100 g/kg chlorpyrifos		
51524	Nutrien Ag Solutions Limited	Y-Tex Warrior Insecticidal Cattle Ear Tags
Ear tag formulation containing 200 g/kg diazinon and 200 g/kg coumaphos		
60662	Elanco Australasia Pty Ltd	Co-Ral Plus Insecticide Cattle Ear Tag
Topical dust/powder (dustable powder applied without dilution) containing 0.8 g/kg piperonyl butoxide, 15 g/kg diazinon and 1 g/kg pyrethrins		
39573	WSD Agribusiness Pty Ltd	WSD Fly Strike Powder to Control Flystrike and for Wound Dressing for Animals

Registration number	Holder	Product name
39574	WSD Agribusiness Pty Ltd	WSD Mulesing Powder Wound Dressing Following Mules Operation General Wound Dressing for Sheep, Cattle and Goats
46231	Intervet Australia Pty Ltd	Coopers Fly Strike Powder Insecticide

A chemistry component assessment report published in 2003 and a toxicological hazard assessment report published in 2011 discussed the degradation of diazinon in the formulated products in detail (particularly non-aqueous formulations such as emulsifiable concentrates). The toxicologically significant degradation products S,S-TEPP and O,S-TEPP can form in the presence of trace amounts of water in the non-aqueous formulation (hence the need for a maximum impurity limit for water). Formation of dangerous levels of S,S-TEPP and O,S-TEPP can be limited by the inclusion of a water scavenger in the technical active constituent and formulated products. Typically, this is epoxidised soyabean oil, or 3,4-epoxycyclohexylmethyl 3,4-epoxycyclohexanecarboxylate. Additionally, liquid hydrocarbon-based/EC formulations should be packaged or stored in conditions or in packaging that are not conducive to the formation of S,S-TEPP and O,S-TEPP.

The 2003 chemistry component assessment report also noted the potential for products formulated as emulsifiable concentrates to form S,S-TEPP and O,S-TEPP if mixed with hydrophobic substances such as kerosene or oil, which may contain trace amounts of water and recommended that uses that rely on mixing with kerosene or oil should be removed from the label and replaced with the restraint “Do not use oil or kerosene to dilute this product. Dilute this product in water only”.

In the [Preliminary Review Findings published in 2006](#) the APVMA proposed that it could not be satisfied of the safety of diazinon containing chemical products with liquid hydrocarbon-based/EC formulations, unless they have:

- an expiry date of not more than 12 months (unless product specific stability data is available to support a longer shelf life)
- adequate packaging, such glass or metal containers pre-coated with inert material inside (epoxy/Epon lined).

The APVMA does not have standards established under section 6E of the Agvet Code for products containing diazinon. However, the FAO specifications for diazinon list an acceptable quantity of the impurities S,S-TEPP and O,S-TEPP and water for EC formulations. The APVMA considers that all approved agricultural and veterinary liquid hydrocarbon-based/EC formulations should comply with these limits.

The APVMA has considered all information including information submitted as part of assessment applications and additional information requested from the product holders under a s 33 notice. This information was used to confirm whether the products complied with the APVMA standard and FAO specifications in regards to the levels of S,S-TEPP, O,S-TEPP and water and to set an appropriate shelf life and storage conditions. The information considered included product specifications, stability data and analytical methods.

No changes were required to the ear tag and topical dust/powder formulations as these products are not expected to have unacceptable levels of the impurities.

Recommendations

Based on the information available, the assessment supports the continuation of the approval 46132 and 92520 as sufficient data was provided to confirm that the active constituent complied with the levels of S,S-TEPP, O,S-TEPP and water. The information provided for the approval of 44033 was insufficient to assess the level of potential impurities and the continuation of that approval is not supported.

Based on the information available, the APVMA was able to determine shelf life for 50007, 59707, 68534, 88946, 49876, 51290, 68253, 62353, 86308, 86314, 39572, 92828 and therefore supports these product's continued registration. However, the APVMA was unable to set a shelf life for 87681 and therefore does not support its continued registration.

No changes are required to the ear tag and topical dust/powder formulations as these products are not expected to develop unacceptable levels of the impurities.

Toxicology

A large toxicology database is available for diazinon and was considered to be of sufficient breadth and quality for human-health risk-assessment purposes. [A consolidated human health risk assessment was published on the APVMA website in 2011](#), and is summarised below, with the addition of material from subsequently published literature.

Diazinon is a contact organophosphorus insecticide with a broad range of insecticidal activity. As discussed below and noted in the 2016 JMPR toxicology monograph for diazinon (WHO 2016), the main biological effect of diazinon derives from the anticholinesterase activity of its metabolite diazoxon. As the studies discussed below assessed the effects of diazinon administered *in vivo*, the toxicological effect of metabolites, including diazoxon, is accounted for when deriving the health-based guidance values.

Evaluation of toxicology

Biochemical aspects

Following oral administration to rats, diazinon was almost completely absorbed from the GI tract with only about 3% of the administered dose being measurable in faeces. Furthermore, a substantial proportion of the dose found in the faeces was derived from biliary excretion. From GI-absorbed diazinon, systemic bioavailability was 35.5%, indicating pronounced hepatic first-pass extraction. Extensive metabolism of diazinon was observed in a number of species, with diazoxon produced as a major metabolite. Diazoxon is subsequently metabolised to diethyl phosphate. The short half-life of diazinon of 2.86 hours in plasma was consistent with a rapid elimination of diazinon from the circulation. Excretion studies indicated that most of the absorbed diazinon (96–97%) was present in urine as metabolites within 24 hours. The major degradative pathway includes the oxidase/hydrolase-mediated cleavage of the ester bond leading to the pyrimidinol derivative 2-isopropyl-6-methyl-4(1H)-pyrimidone, which was further oxidised to more polar metabolites (Wu *et al.*, 1996, Tomokuni *et al.*, 1985, Janes *et al.*, 1973, Wester *et al.*, 1993, Iverson *et al.*, 1975; Simoneaux, 1988a, b, c; Robbins *et al.*, 1957).

Major toxicological mode(s) of action and key events

As with other organophosphorus cholinesterase insecticides, the most sensitive known effects following acute and repeated exposures to diazinon are the inhibition of blood and neuronal cholinesterases. At higher, systemic exposure levels, the key adverse effects reflect the associated cholinergic crisis. Based on current knowledge, inhibition of blood cholinesterases are generally more accessible biomarkers of toxicity compared with the inhibition of neuronal cholinesterase (the key adverse event).

Acute toxicity

Signs of acute toxicity were those typically seen in organophosphate intoxication, including diarrhoea, hypersalivation and pupil constriction as well as muscle fasciculation and fatigue. Ataxia and convulsions were also seen (Aardema *et al.*, 2008). The acute toxicity of technical diazinon in mammals is moderate. The oral LD50 of stabilised diazinon in rats ranged from 300 to 1,350 mg/kg bw in a variety of vehicles (Boyd & Carsky, 1969; Bathe, 1972a, 1980; Gains, 1969; Nissimov & Nyska, 1984a; Piccirillo, 1978; Schoch, 1985a, b; Yoshida, 1978).

Non-stabilised diazinon (i.e. pre-1969 studies) also had moderate acute oral toxicity, with LD50s between 76–466 mg/kg bw (Bruce *et al.*, 1955; Boyd & Carsky, 1969; Gains, 1960).

The acute dermal toxicity of stabilised diazinon was moderate in rats (LD50 876 - >2150 mg/kg bw) and rabbits (LD50 960–3,500 mg/kg bw) (Bathe, 1972b; Yoshida *et al.*, 1978). The acute inhalation toxicity of stabilised diazinon was low in rats, with whole-body inhalation toxicity ranging between LC50 3,100 and 4,370 mg/m³ (Hardy & Jackson, 1984; Holbert, 1994; Jackson *et al.*, 1987; Sachsse, 1972e), with nose-only exposure LC50 >5,437 mg/m³ (Cummins, 1985; Holbert, 1994). In mice, the LC50 from whole-body inhalational exposure was 1,600 mg/m³ (Sachsse 1972a).

Technical diazinon was a slight eye and skin irritant (Sachsse, 1972b, c, d ; Nissimov, 1984a, b; Hayashi & Yoshida, 1979a, b; Kuhn, 1989c, d), and there was evidence of skin sensitisation (Cummins, 1987; Kuhn, 1989e).

The acute oral toxicity of formulated products varied, with LD50s ranging from 293 to >5,050 mg/kg bw. Dermal toxicities were generally low (>1,000 mg/kg bw) (Edson & Noakes, 1960; Hartmann & Schneider, 1987b; Lheritier, 1989a, b; Mercier, 1995a, b; Syntex, 1985). Microencapsulated formulations also have very low acute oral (LD50 >5,000 mg/kg bw) and low dermal toxicity (LD50 >2,000 mg/kg bw) (Mallory, 1993a, b; Kuhn, 1993a, b). Generally, the products were slight eye and skin irritants and did not sensitise skin. (Armondi, 1993; Kuhn, 1993c, d, e; Mallory, 1993c, d; Mercier, 1989a, b; Mercier, 1995c, d, e; Schneider & Hartmann, 1987a, b; Schneider & Gfeller, 1987).

The effects of atropine-oxime therapy on cholinesterase activity after acute diazinon poisoning was investigated. Reactivation of diaphragm cholinesterase levels was seen in rats following treatment with atropine and 2-PAM, while 2-PAM treatment in rabbits resulted in a reactivation of inhibited blood cholinesterase (ChE) activity with decreases in signs of toxicity. However, clinical signs and blood ChE inhibition reappeared within 2 hours of 2-PAM administration (Harris *et al.*, 1969).

Rats treated with diazinon showed very little regional variation in the degree of ChE inhibition in different brain regions (cerebellum, cerebral cortex, striatum and hippocampus). Significant ChE inhibition occurred throughout the brain and spinal cord at doses >2.5 mg/kg bw, along with significant inhibition of plasma ChE. At this dose, erythrocyte ChE was not significantly inhibited, however inhibition was observed at the next highest dose (Potrepka, 1994).

Acute effects of diazinon in dogs included pancreatic effects, with an increase in intraductal pressure, secretory rate, and induction of histopathological sequelae in the pancreas resulting from inhibition of tissue-fixed butyryl ChE activities (Dressel *et al.*, 1979; 1980). This is also a probable effect in humans, with good correlation between observed hyperamylasemia in human cases and the severity of the cases. This also appears associated with the formation of toxic impurities in stored diazinon products (Lee *et al.*, 1998).

Effect of ageing of diazinon on acute toxicity

During the late 1950s and early 1960s, it became apparent that 'aged' technical diazinon could cause laboratory animal deaths at lower concentrations than had been observed using freshly prepared technical grade active diazinon or products. Further investigation into the cause of this temporally increased toxicity indicated that the presence of a small volume of water and oxygen in the technical promoted the formation of diethylphosphorothionate, which in turn was further hydrolysed to diethyl phosphate. Under catalytic influence,

these intermediates are able to combine to form highly toxic tetraethyl pyrophosphate (O,O-TEPP), O,S-TEPP or S,S-TEPP. (Bruce *et al.*, 1955; Gaines, 1960, 1969; Boyd & Carsky, 1969).

Median lethal dose studies have confirmed the markedly increased toxicity of these 3 compounds in female rats, i.e. 0.66 mg/kg bw for O,O-TEPP, 0.46 mg/kg bw for O,S-TEPP and 3.48 mg/kg bw for S,S-TEPP. Formation of O,O-TEPP, O,S-TEPP and S,S-TEPP has been claimed to be reduced by the addition of a stabiliser (epoxidised soybean oil) immediately after synthesis of the technical grade active constituent (Spindler, 1969; Sterling, 1972).

The acute oral LD50s in rats (strain and source not specified) of high-performance liquid chromatography (HPLC)-purified diazinon, 90% technical diazinon or 90% technical diazinon stored for one year was 470, 170 and 30 mg/kg bw respectively. The composition of 'new' and 'aged' 90% diazinon used in this study highlights increases in S,S-TEPP (4x), O,O-TEPP (7x) and isodiazinon (19x) concentration with ageing. The acute oral LD50 for pure isodiazinon was 65 mg/kg bw and together with S,S-TEPP and TEPP may have been responsible for the increased toxicity of 'aged' diazinon (Nichol *et al.*, 1982). S,S-TEPP in three commercial and three 'military' diazinon formulations, i.e. as a dust, emulsifiable concentrate (EC) and in an oil solution, was detected by gas chromatography/ mass spectroscopy (GC/MS). Although the detected percentage of S,S-TEPP ranged between 0.2–0.71%, the lowest levels were detected in the dust formulations. On the basis that the oldest EC formulation tested had one of the lower levels of S,S-TEPP, it was reasoned that formulation age was not a useful predictor for estimating S,S-TEPP content in formulations (Meir *et al.*, 1979).

Several different diazinon formulations (EC; liquid concentrate, LC; and dust) at various strengths available in Canada were tested by GC to determine their S,S-TEPP content. The maximum content found in these products was 0.53% and there was no apparent relationship between the date of manufacture and the S,S-TEPP content (Turtle & Levac, 1987). In the presence of a small quantity of water (in the order of 0.2 to 2.0%), diazinon decomposes to give the highly toxic degradation products. It is important to exclude water by addition of additives that absorb water and hence prevent hydrolysis of diazinon. The stability of hydrocarbon-based EC formulations depends on several factors including composition of the formulation, water content of the formulation (traces of moisture may be present in solvents and other excipients used), storage conditions (temperature, moisture uptake, container type, ultraviolet light etc.), and amount of stabiliser added. Products containing diazinon that are based on hydrocarbon solvents formulated without adequate stabiliser are considered a risk to public health and animal safety. In 2003, action was taken to cancel the registration of all emulsifiable concentrate products containing diazinon that did not contain adequate stabiliser.

Repeat dose toxicity

A range of repeat-dose studies in laboratory animals were assessed. The key effects identified across species were the inhibition of blood and brain cholinesterase. Female rats were more sensitive to the effects of diazinon on ChE inhibition.

As ChE inhibition is the primary indicator of diazinon toxicity, a summary of the No Observable Effect Levels (NOEL) findings for ChE inhibition in a range of repeat-dose studies is shown in Table 7. NOELs are presented for plasma, erythrocyte (RBC) and brain cholinesterase activity.

Table 7: Summary of NOELs (mg/kg bw/day) for cholinesterase inhibition in plasma, RBC and brain

Species	Duration	Route	Plasma	RBC	Brain	E-P ratio
Rat	3 months(1)	Diet	0.01	0.1	1.5	10
	3 months (2)		0.1	>0.4	>0.4	–
	3 months (3)		0.03	0.04	0.06	1.3
	3 months(4)		0.017	0.017	1.9	1
	2 years(5)		NE (>0.025)	0.1	1.5	–
	2 years (6)		0.004	0.06	0.06	15
Dog	3 months (7)		0.0034	0.02	0.02	5.9
	1 year (8)		0.0037	0.02	0.02	5.4
Monkey	2 years (9)	Gavage	0.05	5	ND	100

(1) Davies & Holub, 1980b, (2) Weir, 1957, (3) Singh *et al.*, 1988, (4) Pettersen & Morrissey, 1994, (5) Ashby & Danks, 1987, (6) Kirchner *et al.*, 1991 & Mann, 1993, (7) Barnes *et al.*, 1988, (8) Rudzki *et al.*, 1991 & Mann, 1993, (9) Cockrell *et al.*, 1966.

Genetic toxicology

Based on a number of *in vitro* and *in vivo* mutagenicity studies using various endpoints, the weight of evidence indicates that diazinon is not a mutagen (Beilstein *et al.*, 1986, Bootman *et al.*, 1986, Bootman & May, 1986, Ceresa *et al.*, 1988, Chen *et al.*, 1981, Chen *et al.*, 1982, Fritz, 1975, Geleick & Arni, 1990, Henderson *et al.*, 1988, Hool *et al.*, 1981, Hool & Müller, 1981a, Hool & Müller, 1981b, Hool & Müller, 1981c, Hurni & Ohder, 1970, Jones & Wilson, 1988, Marshall *et al.*, 1976, Matsuoka *et al.*, 1979, Murli, 1990a, Murli, 1990b, Shirasu *et al.*, 1976, Sobti *et al.*, 1982, Strasser & Arni, 1988).

Carcinogenicity

There was no evidence of carcinogenicity from studies conducted in rats and mice (Wheeler *et al.*, 1979, Kung *et al.*, 1980, Goldsmith & Craig, 1983, Ashby & Danks, 1987).

Reproduction and development studies

In rat reproduction studies, or developmental studies in rats, rabbits or pigs, no teratogenic effects were observed. Although a published study (Abd El-Asiz *et al.*, 1994) reported that male rats treated with a diazinon at 1.5 or 3 mg/kg bw/day for 65 days had dose-related decreases in sex organ weight, sperm cell count, percentage of live sperm, sperm motility, and serum testosterone, together with an increase in the total sperm head deformity incidence, this finding was not observed in a 2-generation study using technical diazinon at doses of up to 10 mg/kg bw/day (Weatherholz, 1982).

Special studies

Porphyrin biosynthesis

In 1992, the National Health and Medical Research Council (NHMRC) Standing Committee on Toxicity consider a possible relationship between exposure to diazinon during shearing from wool fat, and an abnormally high incidence of *porphyria cutanea tarda* in humans in western New South Wales. They concluded that a mechanism for porphyrogenic action for diazinon metabolites is not clear, and the high levels observed were probably associated with persons having congenital low levels of liver uroporphyrinogen decarboxylase activity.

Human toxicity

Acute toxicity was investigated in male volunteers given a single dose of diazinon contained in a gelatine capsule (Boyeson 2000). The NOEL for erythrocyte cholinesterase inhibition was 0.2 mg/kg bw. Repeat-dose toxicity has been assessed in a number of volunteer studies. Capsular administration of diazinon for 37 days produced inhibition of plasma ChE at 0.025 mg/kg bw/day, and a No Observed Adverse Effect Level (NOAEL) was established at 0.020 mg/kg bw/d (Lazanes *et al.*, 1966).

Apart from the characteristic clinical signs associated with acute cholinergic crisis following accidental or deliberate ingestion, one report suggested that diazinon may induce an additional paralytic condition called 'Intermediate Syndrome'; a sequence of neurological signs that develop some 24–96 hours following poisoning. This condition appeared to develop prior to the onset of delayed neuropathy (so-called 'organophosphate-induced delayed neurotoxicity' or OPIDN).

Clinical signs of the Intermediate Syndrome can be distinguished from the characteristic muscarinic, nicotinic and central nervous system effects observed very soon after exposure as a delayed onset of muscular weakness affecting neck, proximal limb and respiratory muscles (Samul & Sahu, 1990). However, there have been no reported cases of OPIDN in humans following accidental or deliberate diazinon poisoning, a result consistent with the negative findings observed in animal studies.

Health-based guidance values

Table 8: Possible points of departure for human health risk assessment

Study type	NOAEL mg/kg bw/day	Lowest Observed Effect Level (LOEL) and toxic effect
F344 rat: 2-year dietary	Not established (<0.025)	Plasma ChE inhibition observed at 0.025 mg/kg bw/day in females. LOEL for RBC ChE inhibition was 1.5 mg/kg bw/day and for brain, 22.5 mg/kg bw/day (Ashby & Danks, 1987)
Sprague-Dawley rat: 2-year dietary	0.004	Plasma ChE inhibition observed at 0.06 mg/kg bw/day in males and 0.07 mg/kg bw/day in females. LOEL for RBC and brain ChE inhibition was 5 mg/kg bw/day (Kirchner et al 1991, Mann, 1993)
Beagle dog: 1-year dietary	0.0037	Plasma ChE inhibition and elevated serum amylase observed in females at 0.02 mg/kg bw/day. LOEL for RBC and brain ChE inhibition was 4.5 mg/kg bw/day (Rudski <i>et al.</i> , 1992, Mann, 1993)
Sprague-Dawley rat: 2-gen reproduction	5 (100 ppm)	Reduced maternal food consumption, body weight gain and body weight at next higher dose of 500 ppm (25 mg/kg bw/day) (Ginkis 1989)
	5 (100 ppm)	Reduced pup weight, viability at the next highest dose of 500 ppm (25 mg/kg bw/day) (Ginkis, 1989)
Sprague-Dawley rat: gavage teratology	20	Maternal body weight, reduced food consumption, skeletal variations at 100 mg/kg bw/day (Infurna, 1985)
NZW rabbit: gavage teratology	25	Maternal survival, body weight loss, cholinomimetic signs, delayed foetal ossification at 100 mg/kg bw/day (Harris, 1981)
NZW rabbit: gavage teratology	10	Maternal body weight loss, reduced food consumption and cholinomimetic signs at 40 mg/kg bw/day (Edwards <i>et al.</i> , 1987)
	40	No embryo/foetotoxicity effects observed at the highest dose tested (Edwards <i>et al.</i> , 1987)
Human – 37–41 days Capsule PO (3/group)	0.02	Plasma ChE inhibition observed at 0.02 mg/kg bw/day in males. LOEL for plasma ChE inhibition was 0.025 mg/kg bw/day. No ChE inhibition in RBCs observed at 0.025 mg/kg bw/day (Lazanas <i>et al.</i> , 1966)

Based on evaluation of the available toxicological databases, the current acceptable daily intake (ADI; shown in Table 9) and acute reference doses (ARfD; shown in Table 10) for diazinon will be retained by the APVMA.

Table 9: Acceptable daily intake for diazinon

Chemical	ADI mg/kg bw/day	NOEL	Date	Study
Diazinon	0.001	0.02	29 April 1999	37–43-day human study; a NOAEL of 0.02 mg/kg bw/d was based on plasma ChE inhibition at the next higher dose.

Table 10: Acute reference dose for diazinon

Chemical	ARfD mg/kg bw	NOEL	Date	Study
Diazinon	0.01	0.2	20 December 2002	Acute dose human volunteer study: a NOAEL of 0.2 mg/kg bw was based on RBC ChE inhibition at the next higher dose.

Poisons scheduling

A summary of the current poison scheduling for diazinon is shown in Table 11. No changes to poisons scheduling are proposed.

Table 11: Poison scheduling for diazinon

Chemical schedule	Description
Schedule 5	DIAZINON in dust preparations containing 2% or less of diazinon
Schedule 6	DIAZINON except when included in Schedule 5

Recommendations

The toxicological assessment considered the hazards identified in acute, short-term, chronic, reproduction, and developmental toxicity studies, in addition to genotoxicity, carcinogenicity, and neurotoxicity studies of diazinon.

The diazinon toxicology assessment concludes that the:

- ADI for diazinon should remain at 0.001 mg of diazinon per kilogram body weight per day established on a no observed adverse effect level of 0.02 mg/kg bw/day in a 37–43 day human volunteer study and based on inhibition of plasma cholinesterase activity at the next higher dose. The ADI incorporates a 20-fold uncertainty factor to account for any intra-species variations in sensitivity
- ARfD for diazinon should remain at 0.01 mg of diazinon per kg body weight, based on a no observed adverse effect level of 0.2 mg per kilogram body weight in an acute dose human volunteer study. The ARfD incorporates a 20-fold uncertainty factor to account for any intra-species variation in sensitivity
- scheduling for diazinon in the Standard for the Uniform Scheduling of Medicines and Poisons remain unchanged.

Residues and trade

Previous residues assessments

The APVMA published the [Diazinon Residue Assessment Report](#) in September 2002 (APVMA, 2002) then in June 2006, the Diazinon Preliminary Review Findings (Volume 1 and Volume 2) were published (APVMA 2006a, b). This Review Technical Report summarises the findings of previous reports and assess additional information available to the APVMA.

Diazinon has been evaluated on several occasions by the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) commencing in 1963 and including Periodic Reviews in 1993 and 2022.

In the *Diazinon Residue Assessment Report* (APVMA, 2002) the APVMA did not have access to, or receive, any plant metabolism studies or hen metabolism studies, and relied on conclusions from the 1993 JMPR periodic review of diazinon for the residue definition at that time.

The 2002 APVMA report concluded that:

“Animal and plant metabolism studies show diazinon and the pyrimidinols G-27550 and GS-31144 to be key residues, with diazinon constituting the majority of the residue found in animal fat. Adequate methodology exists to measure all three residues. However, it has been shown that metabolites which do not contain the pyrimidinyl phosphorus ester bond do not exhibit the same cholinesterase inhibitory activity as the parent (with cholinesterase inhibition being the principal source of diazinon’s toxicity). It is recommended that the current residue definition of ‘diazinon’ be retained. This is consistent with the Codex residue definition for diazinon.”

For the 2022 JMPR Periodic Review (FAO and WHO, 2022), the JMPR received information from the manufacturer on physical and chemical properties, animal and plant metabolism, rotational crop studies, environmental fate in soil, analytical methods, storage stability, use patterns, supervised residue trials, processing studies and livestock feeding studies. In general, the studies were the same as those considered by the 1993 JMPR for plant metabolism (with the addition of a new field rotational study) and those considered by JMPR 1993 to 1996 for animal metabolism. However, the contemporary JMPR evaluation reached different conclusions to those reached previously using similar data. Although the 2022 JMPR concluded that a residue definition of ‘diazinon’ is a suitable marker for monitoring compliance with MRLs for plant commodities, the JMPR was unable to reach a conclusion on a suitable residue definition for risk assessment for plant commodities as a result of concerns relating to the lack of suitable quantitative information on the individual levels of metabolites in plants. Similarly, owing to the low level of identification in some tissues, the lack of suitable quantitative information on the individual levels of metabolites and identified storage stability concerns, the JMPR was not able to reach a conclusion on residue definitions for monitoring compliance with MRLs or for risk assessment for animal commodities.

A pesticide residue is the combination of the pesticide (parent compound) and its metabolites. A residue definition for the purposes of monitoring compliance with MRLs is a suitable marker to allow regulatory authorities to determine whether the amount of residue on, or in, the commodity exceeds the relevant MRL. In contrast, residue definition for dietary risk assessment is used to evaluate the potential risk from dietary exposure to residues resulting from the treatment with a pesticide according to the proposed or approved Good Agricultural Practice

(GAP) and takes regard of the toxicological profile, and expected levels, of the pesticide and its metabolites in food commodities.

As the JMPR could not reach a conclusion on the residue definition for risk assessment, in 2022 JMPR recommended withdrawal of all previous recommendations for Codex maximum residue limits (MRLs) for diazinon in crops. As the dietary burdens of livestock could not be estimated, the JMPR was unable to estimate MRLs for animal commodities. In 2022 JMPR also recommended that all previous MRL recommendations for diazinon in animal commodities be withdrawn (FAO & WHO, 2022). The 2023 Codex Committee on Pesticide Residues (CCPR) supported these recommendations and withdrew all previously established Codex MRLs for diazinon (FAO & WHO, 2022).

The decision made by CCPR in 2023 to withdraw all MRLs for diazinon also applied to Codex MRLs previously established by the JMPR in 1996 and 1999 to cover direct animal treatments.

The conclusions on residue definition in the *Diazinon Residue Assessment* report published by the APVMA in 2002 were based on conclusions previously reached by the JMPR in 1993. Noting that these have changed based on contemporary consideration of a similar dataset, it was considered appropriate for the APVMA to reconsider an appropriate residue definition for diazinon.

Current residues assessments

This current assessment includes a contemporary assessment of the residue definition(s) for diazinon, and of the available residue studies. An updated trade risk assessment for animal commodities is also included, noting that some international MRLs for diazinon have recently changed.

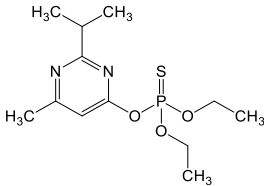
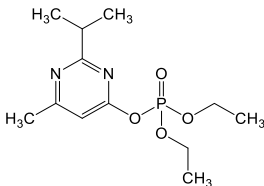
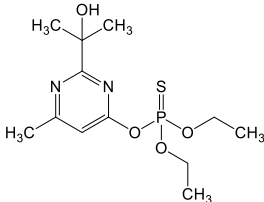
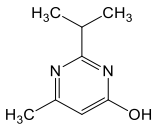
The 2002 *Diazinon Residue Assessment* report identified use patterns in numerous crops for which relevant residue data for parent diazinon were not available, and, therefore, consideration of an appropriate MRL and dietary exposure risk were not possible. No additional residues data has been submitted to support the use of diazinon on: apples, beans, beetroot, blueberries, Brussels sprouts, cabbage, canola, cantaloupes (rockmelon), capsicum, carrots, celery, cereals, chokos, chou moellier, citrus, cotton, cucumbers, cucurbits, cumquats, eggplant, gherkins, globe artichoke, grape vines, hops, kale, kiwifruit, kohlrabi, lettuce, lucerne, macadamia nuts, marrows, oilseed crops, parsnip, pastures, pears, peas, pumpkin, potatoes, rhubarb, rice, silverbeet, sorghum, soybeans, squash, stone fruit, sugarcane, sweet corn, trifoliolate orange, tomatoes, turnips, or watermelons. The 2002 *Diazinon Residue Assessment* report recommended that these use patterns be deleted, unless supporting data was submitted for assessment. As no additional data has been supplied to support assessment of these crops, the recommendation to delete the use patterns remains and these crops will therefore not be assessed further in this report.

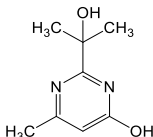
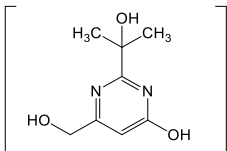
At the time of the 2006 Preliminary Review Findings Australian data had been provided to support the continued registration of diazinon in some crops (bananas, bulb onions, pineapples, and mushrooms). These data are briefly discussed below, together with a contemporary risk assessment. In addition, data for use of diazinon on cauliflower were also submitted for consideration under this review and are discussed below.

Metabolism

The contemporary assessment of available diazinon metabolism studies is summarised below. The structures of compounds referred to are shown in Table 12.

Table 12: Structures of the major metabolites identified in the plant and animal metabolism studies

Common name/ Code	Chemical structure	Found in
Diazinon	 <chem>CC(C)C1=NC2=C(N1)C(=C(C)C)OC(=S)P(=O)(OCC)OCC</chem>	<ul style="list-style-type: none"> • Apple • Beans • Sweet corn • Lettuce • Potatoes • Goat • Hen • Rotated spring wheat
G-24576 (diazoxon)	 <chem>CC(C)C1=NC2=C(N1)C(=C(C)C)OC(=O)P(=O)(OCC)OCC</chem>	<ul style="list-style-type: none"> • Goat • Hen
CGA-14128 (hydroxydiazinon)	 <chem>CC(C)C1=NC2=C(N1)C(=C(C)C)OC(=S)P(=O)(OCC)OCC</chem>	<ul style="list-style-type: none"> • Goat • Hen
G-27550 B1	 <chem>CC(C)C1=NC2=C(N1)C(=C(C)C)O</chem>	<ul style="list-style-type: none"> • Apple • Beans • Sweet corn • Lettuce • Potatoes

Common name/ Code	Chemical structure	Found in
GS-31144 C		<ul style="list-style-type: none"> • Apple • Beans • Sweet corn • Lettuce • Potatoes • Goat • Hen • Rotated spring wheat
Glucose conjugate of trihydroxy pyrimidinyl moiety H	 *Glucose	<ul style="list-style-type: none"> • Apple • Beans • Sweet corn • Lettuce • Potatoes • Rotated spring wheat

Plant metabolism

Parent diazinon was observed in matrices from all 5 crops tested (apples, green beans, sweet corn, lettuce and potato), albeit at low levels (<10% TRR) in some cases: in apple leaves (43.7% TRR, 22.3 mg/kg), apple peel (73.3% TRR, 2.5 mg/kg), apple pulp (16.1% TRR, 0.02 mg/kg) and whole apple (69.0% TRR, 0.89 mg/kg) (Wong *et al.*, 1989a); in beans with pods (2.1% TRR, 0.01 mg/kg) but not in bean vines (Wong *et al.*, 1990a); in sweet corn forage (0.5-1.8% TRR, 0.01-0.07 mg/kg) but not in sweet corn stalks, cobs or grain (Rezaaiyan *et al.*, 1989); in immature lettuce leaves (18.6% TRR, 0.35 mg/kg in the organosoluble fraction) and mature lettuce leaves (11.8% TRR, 0.08 mg/kg, Wong *et al.*, 1990b); and in mature potato foliage (14.2% TRR, 0.27 mg/kg), noting that identification/characterisation was only determined in the potato foliage samples (Wong *et al.*, 1989b).

In confined rotational crop studies, the identification of metabolites was only undertaken for spring wheat samples in the first study, but not for the other rotational crops included in that study (lettuce, sugar beet and soya bean). Diazinon was identified in mature wheat stalks (7.2% TRR, 0.045 mg/kg), but not in the other wheat matrices (Rezaaiyan *et al.*, 1990). In the second study, no identification of the radioactive residues was undertaken for any of the rotational crops (winter wheat, lettuce, soya beans and sugar beet, Vincent *et al.* 1999).

In a field rotational crop study, no quantifiable residues of diazinon (or of the other measured metabolites G-24576 and CGA-14128) were observed in any matrix of any of the rotational crops lettuce, turnips or wheat, at any of the plant-back intervals (30, 60 and 180 days, Sobralske *et al.*, 1990).

Table 13: Single metabolites of diazinon observed in matrices at >10% TRR in the primary crop plant metabolism studies

Crop/matrix	Metabolite of diazinon					
	G-27550 (B1)		GS-31144 (C)		A glucose conjugate of trihydroxy pyrimidinyl moiety (H)	
	% TRR	mg eq/kg	% TRR	mg eq/kg	% TRR	mg eq/kg
Apple						
Apple leaves	–	–	–	–	–	–
Apple peel	11.9	0.4	–	–	–	–
Apple pulp	60.7	0.08	–	–	–	–
Whole apple	14.7	0.19	–	–	–	–
Green beans						
Vines harvested at 32 DAFT	–	–	–	–	–	–
Beans with pods harvested at 14 DALA	26.7	0.12	–	–	–	–
Vines harvested at 14 DALA	–	–	–	–	–	–
Sweet corn						
Sweet corn forage sampled 72 DAFT	–	–	–	–	–	–
Sweet corn stalks sampled 72 DAFT	–	–	–	–	–	–
Sweet corn forage sampled 14 DALA - organosoluble fraction / (organosoluble + aqueous fraction)	10.8/ (14.5)	0.42/ (0.56)	–	–	–	–
Sweet corn cobs sampled 14 DALA	–	–	–	–	–	–
Sweet corn grain sampled 14 DALA	–	–	–	–	–	–
Lettuce						
Mature lettuce leaves -organosoluble fraction / (organosoluble + aqueous fraction)	10.2/ (17.5)	0.07/ (0.12)	4.3/ (11.7)	0.03/ (0.08)	–	–
Immature lettuce leaves (organosoluble fraction)	18.9	0.36	–	–	–	–
Potato						
Mature potato foliage	–	–	–	–	14.1	0.27

DAFT: Days after first treatment, DALA: Days after last treatment

No metabolite apart from G-27550 was observed at >10% TRR in more than one of the primary crop metabolism studies. No single metabolite was identified at >10% TRR in any of the wheat matrices in the confined rotational study.

There were a number of deficiencies with the crop metabolism studies (primary and confined rotational), which diminish the reliance that can be placed on them. In particular, the levels of post-extraction solids (PES) in some bean, sweet corn, lettuce and potato matrices were high and subsequent analysis did not fully establish the identity of the released radioactivity. The observed instability of residues of diazoxon (G-24576) in frozen storage and the time of frozen storage prior to analysis mean that the levels of this toxicologically significant metabolite are unknown in plant commodities. In addition, identification of metabolites in the confined rotational studies was only undertaken for the wheat samples, so it is not possible to compare metabolism pathways for rotational crops with the primary crops.

Animal metabolism

The metabolism and distribution of diazinon was investigated in laying hens and lactating goats. Both were dosed orally, by capsule, with [^{14}C]-pyrimidine-diazinon.

Parent diazinon was the major identified component in goat fat (perirenal and omental) at 64-67.8% TRR (0.228-0.246 mg/kg), and was also observed in liver (0.2% TRR, 0.003 mg/kg), kidney (<0.1% TRR, <0.003 mg/kg), muscle (leg and tenderloin) (1.6-6.2% TRR, 0.007-0.025 mg/kg) and milk (0.15% TRR, 0.001 mg/kg) at much lower levels (Brown *et al.*, 1988; Simoneaux *et al.*, 1988a, b). Diazinon was also observed in all poultry matrices at low levels: in egg yolk at 0.02% TRR (<0.001 mg/kg), in egg white at 0.03% TRR (<0.001 mg/kg), in liver at 0.03% TRR (<0.001 mg/kg), in kidney at 0.08% TRR (<0.001 mg eq./kg), in muscle at 0.04% TRR (<0.001 mg eq./kg), in skin with fat at 0.89% TRR (<0.001 mg/kg) and in peritoneal fat at 2% TRR (<0.001 mg/kg, Brown *et al.*, 1988, 1989; March *et al.*, 1992); Perez *et al.*, 1992; Selman *et al.*, 1993; Simoneaux *et al.* 1988d, e).

Table 14: Single metabolites of diazinon observed in matrices at >10% TRR in the animal metabolism studies

Animal/matrix	Metabolite of diazinon					
	G-27550		GS-31144		CGA-14128	
	% TRR	mg eq/kg	% TRR	mg eq/kg	% TRR	mg eq/kg
Goat						
Goat liver/ (following acid hydrolysis)	19.2/ (24.7)	0.301/ (0.387)	19/ (24.1)	0.298/ (0.377)	–	–
Goat kidney/ (following acid hydrolysis)	19.8/ (22.8)	0.598/ (0.688)	30.6/ (41.1)	0.924/ (1.241)	–	–
Goat fat (omental)	–	–	–	–	12.8	0.047
Goat fat (perirenal)	–	–	–	–	12.3	0.044
Muscle (tenderloin)	26	0.106	39.4	0.16	–	–
Muscle (leg)	35.3	0.158	40.4	0.181	–	–

Animal/matrix	Metabolite of diazinon					
	G-27550		GS-31144		CGA-14128	
	% TRR	mg eq/kg	% TRR	mg eq/kg	% TRR	mg eq/kg
Milk	39.3	0.270	37.3	0.256	–	–
Hen						
Egg yolk (Day 7)	11.1	0.007	18.6	0.012	–	–
Egg white (Day 7)	–	–	33.3	0.022	–	–
Hen liver	–	–	–	–	–	–
Hen kidney	–	–	–	–	–	–
Hen lean meat	–	–	–	–	–	–
Hen skin plus fat	–	–	–	–	–	–
Hen peritoneal fat	–	–	–	–	–	–

There were a number of deficiencies in the laying hen and lactating goat metabolism studies, which diminish the reliance that can be placed on them. In particular, the individual levels of metabolites in the hen and goat metabolism studies were not always determined in the extracted residues, the levels of PES were high in some matrices and the level of identification was low in some hen matrices (38% TRR in hen skin with fat and 29% TRR in hen peritoneal fat) and goat matrices (39% TRR in goat liver and 52% TRR in goat kidney). In addition, although the reported levels of the metabolite diazoxon (G-24576) were low in all goat and hen tissues as well as in milk and eggs, a freezer storage stability study indicated that diazoxon is stable in fat (for at least 24 months), of limited stability in milk (up to four months) and highly unstable in liver and muscle. As the samples from the goat metabolism study were stored for up to 5 months prior to analysis and the samples from the hen metabolism study were stored for up to 12 months prior to analysis, the reported levels of this metabolite cannot be relied on.

Analytical methods and storage stability

The 2022 JMPR periodic review evaluation summarised an analytical method suitable for the determination of parent diazinon in pineapple peel and pulp with a limit of quantitation (LOQ) of 0.01 mg/kg. Another method was found suitable for the determination of diazinon, G-24576 and CGA-14128 in various plant commodities (crops of high water content, crops of high acid content, crops of high oil content, crops of high starch content and crude and refined corn oil) and in animal commodities (muscle, fat, liver, milk and eggs), with a LOQ of 0.01 mg/kg. The methods reviewed use traditional extraction and clean-up techniques with gas chromatographic determination. Although some individual recoveries were not available and mean recoveries were sometimes outside the acceptable range, these methods were considered to be suitable for the analysis of parent diazinon, diazoxon (G-24576) and hydroxydiazinon (CGA-14128).

A freezer storage stability study indicated that parent diazinon is stable in frozen storage for at least 26 months in tomato, lettuce, field corn grain, potato and refined corn oil, up to 26 months in apple and at least 16 months in soybean dried beans, tomato paste, sugar beet molasses. In strawberry, the mean uncorrected recovery after

approximately 3 months was only 53%, decreasing to 27% after 26 months. The metabolite hydroxydiazinon is stable in frozen storage for at least 26 months in lettuce, field corn grain, potato and refined corn oil, at least 16 months in soybean dried beans, 6 months in tomato and 4 months in tomato paste and sugar beet molasses but was not stable in apples or strawberries (Beidler *et al.*, 1991). In another study diazinon, hydroxydiazinon and the metabolite G-27550 were shown to be stable in strawberries for at least 56 days in frozen storage (Beidler *et al.*, 1990).

The metabolite diazoxon, however, was found to degrade rapidly in all tested matrices except refined corn oil. The mean uncorrected recovery after approximately 3 months was <10% in tomato, apple, strawberry, potato and tomato paste, 10% in soybean dried beans, 13% in sugar beet molasses, 22% in lettuce and 57% in field corn grain (Beidler *et al.*, 1991). In the strawberry study, samples fortified with G-24576 only showed a recovery of 20% 4 hours after fortification and <1% after 13 days (Beidler *et al.*, 1990).

Residues of diazinon and hydroxydiazinon in muscle, liver, fat, and milk of sheep, stored at or below –18°C were stable over a period of at least 24 months, measured at fortification levels of approximately 0.20 mg/kg for fat and 0.10 mg/kg for milk, liver and muscle, respectively (Gasser, 2000).

Residues of diazoxon in fat of sheep, stored at or below –18°C were stable over a period of at least 24 months. Residues of diazoxon in milk degraded from 94% (initial value) to 65% after a storage period of 4 months and were below 20% after a storage period of 26 months. Residues of diazoxon in liver and muscle of sheep were not stable during storage at or below –18°C. In muscle only 18% of the initially added amount of diazoxon was observed after a storage period of 4 months while in liver, no residues above 20% of the added amount of G-24576 were observed, even at the initial interval (0 months, Gasser, 2000).

Residue definition

Plant commodities – enforcement

As parent diazinon was observed at up to 73% TRR in matrices in the five target plant metabolism studies (apple, beans with pods, sweet corn, lettuce and potato), it is considered to be a suitable residue definition for enforcement in plant commodities, noting that suitable analytical methods are available to analyse for diazinon in plants.

Plant commodities – risk assessment

The toxicologically significant metabolite diazoxon (G-24576) was found to degrade rapidly in all tested matrices except refined corn oil in a freezer storage stability study.

Noting:

1. the levels of post-extraction solids (PES) in some bean, sweet corn, lettuce and potato matrices were high, and subsequent analysis did not fully establish the identity of the released radioactivity. Although the level of identification was acceptable in apples [86% TRR (0.112 mg eq/kg) for pulp, 87% TRR (1.12 mg eq/kg) for whole apples and 89% TRR (3.01 mg eq/kg) for peel], it was low in beans with pods, sweet corn, lettuce and potatoes. For the crop fractions relevant to human consumption, the level of identification was 53% (0.24 mg eq/kg) for beans with pods, 1.1% TRR (0.005 mg eq/kg) for sweet corn grain, 40% TRR (0.75 mg eq/kg) for

immature lettuce leaves, 63.5% TRR (0.42 mg eq/kg) for mature lettuce leaves and 11.5% TRR (0.03 mg eq/kg) for potato tubers

2. the individual levels of metabolites were not always determined in the extracted residues
3. the observed instability of residues of diazoxon (G-24576) in frozen storage and the time of frozen storage prior to analysis (up to 15–21 months and 69 months for the green bean and lettuce supplementary studies) mean that the levels of this toxicologically significant metabolite are unknown in plant commodities
4. identification of metabolites in the confined rotational studies was only undertaken for the wheat samples, so it is not possible to compare metabolism pathways for rotational crops with the primary crops.

It is not considered possible to establish a risk assessment definition for plant commodities based on the available dataset.

Animal commodities – enforcement and risk assessment

Metabolism studies are available for laying hens, lactating goats, lactating cattle, sheep and laboratory animals (rats and dog).

Noting:

1. the individual levels of metabolites in the hen and goat metabolism studies were not always determined in the extracted residues
2. the levels of post-extraction solids (PES) were high in some matrices. The level of identification was low in some hen matrices (38% TRR in hen skin with fat and 29% TRR in hen peritoneal fat) and goat matrices (39% TRR in goat liver and 52% TRR in goat kidney)
3. the metabolite diazoxon (G-24576) was observed in all goat and hen tissues, and in milk and eggs. Although the reported levels of this metabolite were low in all goat and hen tissues as well as in milk and eggs, it is noted that a freezer storage stability study indicated that diazoxon is of limited stability in milk (up to 4 months) and highly unstable in liver and muscle. As the samples from the goat metabolism study were stored for up to 5 months prior to analysis and the samples from the hen metabolism study were stored for up to 12 months prior to analysis, the reported levels of this metabolite cannot be relied on. The 2022 JMPR Meeting commented that the storage stability data “do not support the storage interval in the feeding studies for G-24576 (diazoxon)” and also noted that the Meeting “considered that this metabolite is more toxic than diazinon” FAO & WHO (2022).

It is not considered possible to establish either an enforcement or a risk assessment definition for animal commodities based on the available dataset.

For uses of veterinary medicines, such as direct animal treatments, the APVMA currently utilises the JECFA approach where radiolabelled studies in each target animal are used to determine the marker residue and a marker residue to total residue ratio, which is calculated for use in the dietary exposure calculations. This approach for veterinary medicines is different to the approach currently used by the JMPR and APVMA for establishing residue definitions for pesticides. The currently registered direct animal treatments for diazinon were approved prior to the APVMA adopting this JECFA approach and the available dataset does not support the use of the JECFA approach because a marker residue to total residue ratio cannot be determined and many of the

studies do not meet contemporary standards. For these reasons and because the identified concerns regarding the storage stability of the diazoxon metabolite apply to uses of diazinon directly to animals, the recommendation that a residue definition (marker residue) cannot be established for diazinon applies to both uses as a pesticide to crops and as a veterinary medicine directly to food producing animal species.

Residues from agricultural uses

Residues data is available for banana, cauliflower, broccoli, mushroom, onion, garlic and pineapple but it is noted that the available residue trials for these crops only addressed parent diazinon. As a residue definition for risk assessment in plant commodities cannot be established, uses in food producing crops cannot be supported from a residues perspective but the available data is summarised below for completeness.

Banana

The registered use patterns for diazinon in bananas are firstly spray applications at the base of each plant (butt spray) in spring and again in late summer at 100 g ai/100L, to control banana weevil or beetle borer. A second use-pattern involves spray treatment as required of the emerged fruit at 40 g ai/100L at 14-day intervals. A maximum number of sprays was not specified for the second use pattern. The withholding period is 14 days for both use patterns.

The Australian banana growers were previously consulted, to identify which of the diazinon use patterns (as detailed on the product labels) are employed by their industry. The use pattern supported by the Banana Industry involves the application of diazinon as a butt spray to control banana weevil borer:

- Maximum of 2 applications of 100 g diazinon/100 L per season
- Applied at 14 day intervals
- Equivalent to 0.6 g diazinon/pseudostem base
- A nil harvest withholding period

Australian residue data for bananas has been assessed by the APVMA and reported in the Diazinon Preliminary Review Findings Report ([Volume 1](#) and [Volume 2](#)) published in 2006 (APVMA 2006 a and b) and is summarised below. The assessment of the four Queensland trials found that when bananas were treated with 2 butt spray applications of 0.6 g diazinon/plant at 14 day intervals (i.e. 1× the maximum proposed rate), residues in bananas immediately after the second treatment were all <0.02 mg/kg.

These results are comparable to the Costa Rican and Honduran banana data that were reviewed by JMPR in 1993. The maximum treatment in the Honduran trial involved 3 applications of 90 g diazinon/100 L, using an EC spray, while for the Costa Rican trial spot treatment was conducted three times at 600 g a.i./100L. For both trials banana pulp and peel were sampled at 0, 3, 7 and 14 days after the final treatment, and diazinon residues were <0.02 mg/kg at all sampling times.

As a residues definition for the risk assessment in plant commodities cannot be established, the use of diazinon on bananas is not supported from a residues perspective.

Cauliflower and broccoli

Diazinon is registered for use on cauliflower and broccoli for the control of a number of pests. Cauliflower is a representative crop for Subgroup 010A, [Flowerhead Brassicas](#), and the label uses of cauliflower and broccoli are the same. The application rates for most pests are 560 g a.i./ha (applications at 10–14 day intervals and with a 14-day withholding period). Application at rates up to 1.12 kg a.i./ha, depending on the size of the plant, is allowed in certain states for the control of cabbage white butterfly and cabbage moth.

The residues data available in the 1993 JMPR evaluation report was previously considered to be unsupportive of the Australian use pattern.

Australian residue data for cauliflower was initially submitted to the APVMA in 2006 for a permit application and was also provided for this review to support the registered uses (Dal Santo *et al.*, 2006).

Four Australian trials were conducted on cauliflower in 2002–03. In each trial, 3–4 foliar applications of diazinon were made at 6–14-day intervals at rates of 560 g ai/ha. At 3 of the sites, samples were collected at 0 and 14 days after the final treatment. At the fourth site samples were collected at 10 days after the final treatment.

Residues found in untreated control samples were <0.01 mg/kg for each trial site. Residues found in treated samples from the 4 test sites are summarised in Table 15.

Table 15: Residues of diazinon in cauliflower

Crop, variety, location, year	Application rate (g ai/ha)	No. of applications (interval, days)	Application volume (L/ha)	Days after last application	Diazinon Residues (mg/kg)
Cauliflower, unknown, Forth, Tas, 2002	560	4 (10, 14, 6)	600	0 14	0.24 <0.01
Cauliflower, All year hybrid, Werribee, Vic, 2002	560	4 (10)	223	0 14	0.03 <0.01
Cauliflower, Fremont, Baldivis, WA, 2002	560	4 (10)	300	0 14	0.07 <0.01
Cauliflower, Liberty, Guilderton, WA 2003	560	3 (10)	150-350	10	<0.01

Residues of diazinon in cauliflower immediately after the final treatment at 560 g ai/ha, were 0.03, 0.07 and 0.24 mg/kg. At 10–14 days after the final application, residues were <0.01 mg/kg (n = 4).

As a residues definition for the risk assessment in plant commodities cannot be established, the use of diazinon on cauliflower and broccoli is not supported from a residues perspective.

Mushroom

Two Australian use patterns are currently registered for the treatment of mushrooms with diazinon. These are treatment of compost at spawning at 112 g ai/10L water/tonne moist compost, and 24 g ai/10L water/tonne moist

compost applied as a spray over the top of the casing soil immediately after casing. The current harvest withholding period is 14 days.

Residues data for diazinon in mushrooms from the Netherlands were presented to the 1993 JMPR. The maximum rate in the studies was 50 g ai/tonne of compost, and residues were <0.02 mg/kg at 35 days after treatment. This rate is less than half that specified by Australian GAP for treatment of compost at spawning.

The Australian Mushroom Growers Association who indicated that they wish to retain the use submitted 2 Australian residue trials addressing the treatment of mushroom casing has been assessed by the APVMA and reported in the Diazinon Preliminary Review Findings Report ([Volume 1](#) and [Volume 2](#)) published in 2006 (APVMA 2006 a and b) and is summarised below. Diazinon residues in mushrooms grown in casing that had been treated with a single application of 3.2 g diazinon/m² (equivalent to 24 g diazinon/tonne of casing mix) were <0.01–<0.05 mg/kg at first flush (16–19 days after treatment) and <0.01 mg/kg at 21–24 days after treatment.

As a residues definition for the risk assessment in plant commodities cannot be established, the use of diazinon on mushrooms is not supported from a residues perspective.

Onion and garlic

The registered Australian use pattern for foliar treatment with diazinon in onions and garlic allows for application at 560 g ai/ha, with spraying at 10 day intervals as required for control of onion thrips (onions and garlic) and onion seedling maggot/fly (onions). A pre-plant use-pattern (up to 4 kg ai/ha to soil before sowing) also applies to onions. The withholding period for both of these uses is 14 days. The registered use in onions and garlic allows for the control of onion thrips in Queensland, New South Wales, Victoria, South Australia and Western Australia.

Australian data relevant to the pre-plant use-pattern (up to 4 kg ai/ha to soil before sowing) for onions was not submitted. Australian bulb onion growers who indicated that they wish to retain the foliar treatment use, submitted 3 Australian residue trials for onions. This data has been assessed by the APVMA and reported in the Diazinon Preliminary Review Findings Report ([Volume 1](#) and [Volume 2](#)) published in 2006 (APVMA 2006 a and b) and is summarised below. Diazinon residues in bulb onions that were treated with three foliar applications of 560 g diazinon/ha at 10 day intervals (i.e. 1× the maximum rate) are tabulated below.

Table 16: Residues of diazinon in bulb onions

Trial number	Trial location	Treatment regimen	Sampling time (DALY)	Diazinon residues (mg/kg)
1	Narranderra, NSW	Untreated control	3	0.057
		3 applications of 560 g ai/ha, applied at 10 day intervals (1×)	3	0.073
			14	0.036
2	Wanneroo, WA	Untreated control	0	<0.01
		3 applications of 560 g ai/ha, applied at 10 day intervals (1×)	0	<0.01
			14	<0.01

Trial number	Trial location	Treatment regimen	Sampling time (DALT)	Diazinon residues (mg/kg)
3	Forth, Tas	Untreated control	0	0.032
		3 applications of 560 g ai/ha, applied at 10 day intervals (1x)	0	0.032
			14	0.024

When bulb onions were treated with 3 foliar applications of 560 g diazinon/ha at 10 day intervals (i.e. at the maximum 1x registered use rate), residues in onions at 14 DALT were <0.01 mg/kg, 0.024 and 0.036 mg/kg.

As a residues definition for the risk assessment in plant commodities cannot be established, the use of diazinon on onions and garlic is not supported from a residues perspective.

Pineapple

There are 2 approved Australian use patterns for foliar treatment of pineapple with diazinon. The first involves spraying at a concentration of 52g ai/100L, at up to 3,000L/ha (1,560 g ai/ha), at 2 to 3 week intervals as required for the control of pineapple scale. The second involves unlimited boom spray treatments at up to 3L product/ha (2,400 g ai/ha) for control of mealy bug. There is no defined spray interval for the mealy bug use. The withholding period for both of these uses is 14 days.

Data presented to JMPR for pineapple were generated in Costa Rica and Honduras according to Costa Rican GAP. Additional data from the USA presented by the JMPR were not considered due to the exaggerated application rates used in these trials. The treatment rate in the Costa Rican and Honduran trials involved either a single dip treatment of the plant at 0.6 kg ai/100L, or three treatments of individual plants at 0.1L/plant using a spray concentration of 0.1 kg ai./100L, or 3 treatments at 0.1 kg ai/ha. At 7 days after the final application, residues in whole fruit ranged from <0.02–0.07 mg/kg. However, in view of the significantly higher application rate and unlimited number of sprays possible under Australian GAP, this data is not relevant to the Australian use pattern.

Australian pineapple growers who indicated that they wish to retain the use of diazinon on pineapples for the control of pineapple scale and mealy bug, submitted three Australian residue trials. This data has been assessed by the APVMA and reported in the Diazinon Preliminary Review Findings Report ([Volume 1](#) and [Volume 2](#)) published in 2006 (APVMA 2006 a and b) and is summarised below. Diazinon residues in pineapples that were treated with foliar applications at a rate of 2.4 kg diazinon/ha are tabulated below.

Table 17: Residues of diazinon in pineapples

Trial number	Trial location	Treatment regimen	Sampling time (DALT)	Diazinon residues (mg/kg)
1	Palmwoods, SE Qld	Untreated control	7/14†	<0.005
		26 applications of 2.4kg ai/ha, applied at 14-day intervals (1x)	3	0.07
			7	0.03
			14	<u>0.04</u>
			21	<0.01
2	Yeppoon, Central Qld	Untreated control	7/14†	<0.005
		2 applications of 2.4 kg ai/ha, applied at 7-day interval (1x)	7	0.01
			14	<u><0.005</u>
3	Glasshouse Mountains, Qld	Untreated control	7/14†	<0.005
		2 applications of 2.4 kg ai/ha, applied at 7-day interval (1x)	7	0.03
			14	<u><0.01</u>

†Untreated control samples were collected at 7 and 14 DALT. However, details of which of the control samples were analysed were not provided.

The trial conducted at Palmwoods addressed the maximum registered (1x) use pattern. Pineapple plants were treated with 2.4 kg diazinon/ha at 14-day intervals, for a period of one year (i.e. 26 applications). A diazinon residue of 0.04 mg/kg was reported in pineapple at 14 days after the last treatment.

In the trials conducted at Yeppoon and the Glasshouse Mountains, pineapples were treated twice with 2.4 kg diazinon/ha at a 7-day interval. Given that diazinon is known to break down rapidly in the environment (i.e. there is no evidence that diazinon residues accumulate because of multiple applications), retreatment of pineapples after a 7-day interval was considered appropriate to simulate the worst-case residues scenario. Diazinon residues of <0.005 mg/kg and <0.01 mg/kg were reported in pineapple at 14 days after the last treatment.

As a residues definition for the risk assessment in plant commodities cannot be established, the use of diazinon on pineapples is not supported from a residues perspective.

Final recommendations for agricultural uses

No agricultural use patterns can be supported for food producing situations from a residue safety perspective because it was not considered possible to establish a risk assessment residue definition for plant commodities based on the available data.

It is noted that the crops for which relevant residues data (for parent diazinon only) was available (banana, cauliflower, broccoli, mushroom, onion, garlic and pineapple) are not considered to be major export commodities and therefore use in these crops is unlikely to constitute an undue risk to trade; however, use cannot be supported from a residues perspective, as a residue definition for risk assessment cannot be established.

Residues from veterinary medicine uses

For the original residues assessment (September 2002), Australian residue data were available for sheep (trials conducted in 1963, 1971, 1974, 1986, 1987 and 1990), cattle (1974 and 1986) and goats (1986 and 1987). Overseas residues data were available for cattle, sheep, goats and pigs.

It was concluded in the 2002 residues assessment that there was sufficient residues data available to support all veterinary use patterns on sheep, cattle, pigs and goats from a residues perspective. The following alterations to approved label instructions were however recommended at that time:

- Products with a cattle meat withholding period of 3 days have this WHP extended to 14 days, with exception of the cattle ear tag products where a nil meat withholding period was supported.
- The milk restriction 'DO NOT USE IN LACTATING OR PREGNANT COWS/EWES/NANNIES WHERE MILK OR MILK PRODUCTS MAY BE USED FOR HUMAN CONSUMPTION' was recommended.

This milk restriction was recommended for diazinon based spray-on and dip products for cattle, sheep and goats in the 2002 residues assessment. In the 2006 PRF however, this recommendation was extended to also include diazinon cattle ear tag products to mitigate a potential increased risk to international trade of dairy commodities, as the US milk MRL had been deleted in the intervening period.

It is noted that in response to the 2006 PRF consultation, a number of responses were received from stakeholders concerning the recommended milk restrictions.

As a residue definition (marker residue) cannot be set based on a contemporary assessment of the available data, that the previous MRL recommendations are no longer considered to be appropriate.

The available diazinon residue studies relevant to direct animal treatments have been considered by the APVMA and reported in the 2002 Residues Assessment Report (APVMA, 2002). These studies generally do not meet contemporary standards in terms of details of how they were conducted. In particular, there are little or no details concerning the length of frozen storage before analysis. It is also noted that only the pig study analysed for compounds apart from parent diazinon. The lack of analysis of metabolites, particularly diazoxon, or details of the storage duration or conditions is important given that a residue definition (marker residue) cannot be established. Table 18 summarises the matrices, analytes and storage conditions in these studies and highlights the deficiencies relating to metabolite analysis and storage stability.

Table 18: Matrices, analytes and storage conditions in the direct animal treatment studies considered in the 2002 residues assessment

Study number in 2002 report	Tissues/matrix	Analytes	Storage conditions/duration
5.15.2 Sheep			
5.15.2 Ref.1	Various organs including fat and muscle tissue	Diazinon	No information about storage.
5.15.2 Ref.2	Fat, muscle	Diazinon	Frozen. Storage time not given.
5.15.2 Ref.3	Wool	Diazinon	No information about storage.
5.15.2 Ref.4	Sheep omental and subcutaneous fat (and wool)	Diazinon	Samples stored at –15°C until analysed. Storage time not given.
5.15.2 Ref.5	Muscle, liver, kidney, kidney fat	Diazinon	Samples stored at –15°C until analysed. Storage time not given.
5.15.2 Ref.6	Muscle, liver, kidney, fat, omental fat	Diazinon	Samples stored at –18°C until analysed. Storage time 7 months.
5.15.2 Ref.7	Liver, muscle, omental fat	Diazinon	Samples stored at –15°C until analysed. Storage time ≤3 weeks.
5.15.2 Ref.8	Cattle kidney fat, subcutaneous fat, muscle and milk Sheep kidney fat and muscle	Diazinon	No information about storage.
5.15.2 Ref.9	Blood, subcutaneous and omental fat	Diazinon	No information about storage.
5.15.2 Ref.10	Milk	Diazinon	No information about storage.
5.15.3 Cattle			
5.15.3 Ref.1	Cattle kidney fat, omental fat, muscle, liver and kidney	Diazinon	Samples stored at –15°C until analysed. Storage time not given.
5.15.3 Ref.2	Milk	Diazinon	No information about storage.
5.15.3 Ref.3	Milk, skim milk, cream and butter	Diazinon	No information about storage.
5.15.3 Ref.4	Milk	Diazinon	No information about storage.

Study number in 2002 report	Tissues/matrix	Analytes	Storage conditions/duration
5.15.4 Goats			
5.15.4 Ref.1	Goat kidney fat, omental fat, muscle, liver and kidney	Diazinon	Samples stored at –15°C until analysed. Storage time <4 months.
5.15.5 Pigs			
5.15.5 Ref.1	Pig kidney, fat and muscle	Diazinon, hydroxydiazinon, G-27550 and diazoxon. It is noted that no residues of diazoxon were observed.	No information about storage.

Trade consideration for veterinary uses

Commodities of animal origin, such as meat, offal and dairy products are considered to be major export commodities. Residues in these commodities resulting from the veterinary uses of diazinon may have the potential to unduly prejudice international trade. The significant export markets for Australian beef, sheep, pig meat and offals are listed in the APVMA Regulatory Guidelines – Data Guidelines: Agricultural - Overseas trade (Part 5B).

The MRLs in Table 19 have been established in major trading markets for meat, milk and offal products. The 2022 JMPR withdrew all previous recommendations for maximum residue levels for diazinon in animal commodities (FAO & WHO, 2022). The 2023 CCPR supported these recommendations and withdrew all Codex MRLs for diazinon (FAO & WHO 2023).

Table 19: Diazinon MRLs in Australia's major trading markets for meat, milk and offal products

Commodity	Diazinon MRLs (mg/kg)							
	Australia	China	Codex	USA	EU	Japan	Korea	Taiwan
Meat [in the fat]	0.7 <i>(to be deleted following phase-out period)</i>		–					
Cattle fat				0.5		0.03		
Pig fat						0.03		
Fat					0.7	0.03		0.03
Muscle		2 (pig, cattle, sheep, goat)			0.02	0.01	0.7 (F) (pig meat, cattle meat, sheep meat)	0.02 (pig meat, cattle meat, sheep meat)

Commodity	Diazinon MRLs (mg/kg)							
	Australia	China	Codex	USA	EU	Japan	Korea	Taiwan
Milks	0.5 (in the fat) (to be deleted following phase-out period)	0.02	–	–	0.02	0.01	0.02 (F)	0.02
Edible offal	0.7 (to be deleted following phase-out period)		–	–	–	0.7	–	0.03
Kidney ^a	–		–	–	0.03	0.01	–	
Liver ^b	–		–	–	0.03	0.01	–	

^a Kidney of cattle, goats, pigs & sheep; ^b Liver of cattle, goats, pigs & sheep
F Fat basis

Available residues monitoring data from the [National Residues Survey](#) for diazinon in cattle, sheep, pig and goat demonstrates that the frequency of detection of diazinon residues in cattle, sheep, pig and goat fat (the target tissue for monitoring purposes) is low but finite residues can be observed (particularly in beef fat).

Although, for reasons given above, it was not possible to recommend enforcement or risk assessment definitions for animal commodities, it is worth considering whether the recent changed Codex, Japanese and Taiwanese MRLs for animal commodities still allow for Export Slaughter Intervals (ESIs) to be established, if a definition of parent diazinon still applied to animal commodities. The Veterinary Labelling Code states that ESIs are required on veterinary products for use on cattle, sheep and pigs. The ESI is determined on the basis of residues in edible tissues declining to below the standards applied by the major export markets for Australian meat and offal. As the Codex MRLs have been withdrawn, it is considered that diazinon residues should be below the LOQ of 0.01 mg/kg in all animal tissues to mitigate a risk to trade in animal commodities.

Review of the available relevant data for spray treatments for cattle demonstrated a highest diazinon residue of 0.05 mg/kg in cattle fat (mean value 0.03 mg/kg) following a 21-day withdrawal time (the longest in the study). Available residues data for Y-Tex Warrior Insecticidal Cattle Ear Tags (P51524), similarly show finite residues of diazinon in cattle fat at the last sampling timings (29 and 56 days after treatment in the two studies). Considering the available residues data, it is therefore not possible to establish a suitable ESI, for all spray, backrubber, wound dressing and ear tag uses for cattle, as it is unknown when residues would decline to be less than the LOQ. The risk to international trade of cattle meat and offal is therefore considered to be undue given recent changes in international MRLs for diazinon.

For sheep, the highest observed residues following 14 and 21 day withdrawal periods after dip treatment at 250 mg a.i./L were observed in sheep renal fat [0.67 mg/kg (mean 0.65 mg/kg) at 14 days and 0.29 mg/kg (mean 0.27 mg/kg) at 21 days]. Although there is not a current registered dip treatment for sheep, the residues data is sparse. A residue study in which sheep were jetted with diazinon at a concentration of 0.08% showed high residues of 0.05 and 0.09 mg/kg in muscle (depending on formulation) and 0.16 mg/kg in fat. Considering the available residues data, it is therefore not possible to establish a suitable ESI, for all uses for sheep, as it is unknown when residues would be less than the LOQ. The risk to international trade of sheep meat and offal is therefore considered to be undue given recent changes to international MRLs for diazinon.

Singapore and Japan are significant export markets for pig meat and offal. The Codex MRL (which is referred to by Singapore) has been withdrawn and the Japanese MRLs at 0.03 mg/kg (fat) and 0.01 mg/kg (muscle, kidney and liver) are lower than in Australia (0.7 mg/kg). However, as no residues of diazinon were observed after spraying at 0.025 or 0.05% diazinon, the risk to international trade of pig meat and offal with a 14-day ESI, equal to the meat withholding period, is not considered to be undue.

Final recommendations for veterinary uses

No veterinary medicine use patterns can be supported for food producing species (cattle, sheep, pigs or goats) because it was not considered possible to establish either enforcement or risk assessment residue definitions for animal commodities based on the submitted animal metabolism studies and the potential levels of the toxicologically significant metabolite diazoxon (G-24576) cannot be determined. Also, given that some international diazinon MRLs for animal commodities have recently been lowered or withdrawn, it is now considered that an ESI cannot be established to manage the potential risk to trade for cattle and sheep meat and offal and therefore the trade risk associated with veterinary medicine products used in cattle and sheep is considered to be undue.

Consequently, the APVMA cannot be satisfied that these uses of diazinon would not be an undue hazard to the safety of people using anything containing its residues, according to the safety criteria as defined by Section 5A nor an undue risk to international trade as described by Section 5C of the Schedule to the Code Act, and the uses must be removed from currently approved product labels after a phase-out period.

Regulatory acceptable level for spray drift assessment

Animal commodity MRLs for diazinon are not currently established in all overseas markets. It is therefore considered that diazinon residues should be below LOQ of 0.01 mg/kg in animal tissues to mitigate a risk to the international trade of animal tissues.

In a lactating dairy cow feeding study, dosing with diazinon at 40 ppm gave a highest TRR of 0.04 mg/kg in omental fat (Selman, 1994; Krautter, 1994; Perez; 1994). For residues of diazinon to be at the LOQ (0.01 mg/kg), the maximum feeding level or Regulatory Acceptable Level (RAL) is 10 ppm.

Dietary exposure

The dietary risk assessment considers the recommendations of the APVMA's toxicology assessment for diazinon which concluded that the Australian acceptable daily intake (ADI) of 0.001 mg/kg bw/day and acute reference dose (ARfD) of 0.01 mg/kg bw/day remain appropriate.

Chronic dietary exposure assessment

The chronic dietary exposure to diazinon is estimated by the National Estimated Daily Intake (NEDI) calculation, encompassing all approved label uses of the chemical and the mean daily dietary consumption data derived primarily from the 2011–12 National Nutritional and Physical Activity Survey. The NEDI calculation is made in accordance with WHO Guidelines and is a conservative estimate of dietary exposure to chemical residues in food. As the APVMA was unable to recommend risk assessment residue definitions for plant and animal commodities, a chronic dietary exposure calculation could not be conducted.

Acute dietary exposure assessment

The acute dietary exposure for diazinon is estimated by the National Estimated Short-Term Intake (NESTI) calculation. The NESTI calculations are made in accordance with the deterministic method used by the JMPR with 97.5th percentile food consumption data derived primarily from the 2011–12 National Nutritional and Physical Activity Survey. NESTI calculations are conservative estimates of short-term exposure (24-hour period) to chemical residues in food. As the APVMA was unable to recommend risk assessment residue definitions for plant and animal commodities, an acute dietary exposure calculation could not be conducted.

Conclusions

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

Table 20 summarises recommended MRL changes to Table 1 of the APVMA MRL Standard as a result of this Review Technical Report. Amendments to the MRL Standard will occur after the completion of the diazinon review and associated phase out periods.

The following table includes the MRL recommendations for the use patterns considered in this Review Technical Report. The MRL changes in the table reflect the necessary MRLs resulting from the assessments of all risk areas at the completion of the review.

Table 20: Amendments to Table 1 of the Agricultural and Veterinary Chemicals (MRL Standard for Residues of Chemical Products) Instrument 2023

Code	Food	Current MRL (mg/kg)	Transitional MRLs at the start of the phase-out period (mg/kg)	MRL at the end of the phase-out period (mg/kg)
Diazinon				
GC 0080	Cereal grains	0.1	T0.1	MRL deleted
FC 0001	Citrus fruits	0.7	T0.7	MRL deleted
MO 0105	Edible offal (mammalian)	0.7	T0.7	MRL deleted
PE 0112	Eggs	*0.05	T*0.05	MRL deleted
	Fruits {except Citrus fruits; Grapes; Olives; Peach}	0.5	T0.5	MRL deleted
FB 0269	Grapes	T2	T2	MRL deleted
FI 0341	Kiwifruit	0.5	T0.5	MRL deleted
MM 0095	Meat (mammalian) [in the fat]	0.7	0.7	MRL deleted
ML 0106	Milks [in the fat]	0.5	T0.5	MRL deleted

Code	Food	Current MRL (mg/kg)	Transitional MRLs at the start of the phase-out period (mg/kg)	MRL at the end of the phase-out period (mg/kg)
OC 0305	Olive oil, crude	2	MRL deleted (no use)	–
FS 0247	Peach	0.7	T0.7	MRL deleted
PM 0110	Poultry meat	*0.05	T*0.05	MRL deleted
PO 0111	Poultry, edible offal of	*0.05	T*0.05	MRL deleted
GS 0659	Sugar cane	0.5	T0.5	MRL deleted
VO 0447	Sweet corn (corn-on-the-cob)	0.7	T0.7	MRL deleted
TN 0085	Tree nuts	0.1	T0.1	MRL deleted
OC 0172	Vegetable oils, crude {except Olive oil, crude}	0.1	T0.1	MRL deleted
	Vegetables	0.7	T0.7	MRL deleted

Residues assessment outcomes for diazinon agricultural use patterns

No agricultural food use patterns can be supported as it was not considered possible to establish a risk assessment definition for plants. The potential levels of the toxicologically significant metabolite diazoxon (G-24576) in crops cannot be determined based on the submitted plant metabolism studies. Consequently, the APVMA cannot be satisfied that these uses of diazinon would not be an undue hazard to the safety of people using anything containing its residues, according to the safety criteria as defined by Section 5A of the Schedule to the Code Act, and the uses must be removed from currently approved product labels after a phase-out period.

Residues assessment outcomes for diazinon veterinary use patterns

No veterinary medicine use patterns (except on horses which are not for human consumption) can be supported because it was not considered possible to establish either enforcement or risk assessment residue definitions for animal commodities based on the submitted animal metabolism studies and the potential levels of the toxicologically significant metabolite diazoxon (G-24576) cannot be determined. Also, given that some international diazinon MRLs for animal commodities have recently been lowered or withdrawn, it is now considered that an ESI cannot be established to manage the potential risk to trade for cattle and sheep meat and offal and therefore the trade risk associated with veterinary medicine products used in cattle and sheep is considered to be undue.

Consequently, the APVMA cannot be satisfied that these uses of diazinon would not be an undue hazard to the safety of people using anything containing its residues, according to the safety criteria as defined by Section 5A nor an undue risk to international trade as described by Section 5C of the Schedule to the Code Act, and the uses must be removed from currently approved product labels after a phase-out period.

Uses supported from a residues and trade perspective

Use on lawns

Current labels have the following restraint for the registered use on lawns:

“DO NOT feed grass clippings from treated area to poultry and animals”.

This current restraint should be replaced with the restraint:

“DO NOT graze treated turf or lawn; or feed turf or lawn clippings from any treated area to poultry or livestock”,

to be in line with contemporary best practice in the APVMA labelling code.

Use in farm buildings/animal sheds

There are registered uses (fogging and spraying) in farm buildings including kennels, stables and piggeries.

Current labels have the following protection of livestock statements:

Protection of livestock

The product is suitable for spraying fowl houses provided birds are removed when spraying is carried out.

Avoid spraying drinking water and feed troughs.

The following restraint is considered appropriate for the registered uses in farm buildings/animal sheds to prevent exposure of food producing animals to diazinon:

DO NOT treat farm buildings and animal sheds by fog or spray in the presence of animals. Wait until chemical clears after treatment, then thoroughly ventilate treated area, before allowing re-entry of animals.

The protection of livestock statement concerning spraying fowl houses can be removed from registered labels. The current label statement ‘Avoid spraying water and feed troughs’ should be replaced by the restraint:

DO NOT spray water or feed troughs.

Use on horses

The registered veterinary medicine use on horses is acceptable to residues and trade providing a restraint is added disallowing use on horses that may be consumed.

The following restraint is considered appropriate for the registered use on horses:

DO NOT use on horses that may be used for human consumption.

The following WHP should be removed:

Meat (Horses): DO NOT USE less than 3 days before slaughter for human consumption.

Occupational health and safety assessment

The risks associated with the use of products containing diazinon have been assessed, in accordance with the [APVMA Human Health Risk Assessment Manual](#), and a summary of the evaluation is presented.

Points of departure and margins of exposure for risk characterisation

The points of departure (POD) and margins of exposure (MOE) used for risk characterisation are shown in Table 21.

Table 21: Points of departure and margins of exposure used for risk characterisation

Form of exposure	Point of departure	Required margin of exposure	Study and comments
Single exposure	0.2 mg/kg bw	20	Acute oral human study: NOEL of ≥ 0.2 mg/kg bw based on inhibition of peripheral blood erythrocyte cholinesterase in an acute dose human volunteer study. MOE of 20 with 10x for intraspecies differences and 2x for any other uncertainties
Short term repeated oral exposure	0.02 mg/kg bw/day	20	Repeat daily dose human volunteer study, NOAEL for inhibition of plasma (butyryl) cholinesterase. MOE of 20 with 10x for intraspecies differences and 2x for any other uncertainties

Use patterns relevant to risk assessment

Currently registered products are set out in Table 5 and Table 6, while the relevant use patterns that were supported by other APVMA risk assessment areas prior to the commencement of the current assessment are shown in Table 25 and Table 27. Uses that have been recommended for deletion by another risk assessment area prior to this assessment have not been considered.

Companion animal external parasiticide exposure, non-professional use surrogate exposure scenario evaluations

The methods and parameters used in the exposure evaluation are shown in Table 22. These methods were applied to the non-professional use of diazinon products in and around the home.

Table 22: Parameters used in the non-professional use surrogate exposure scenario evaluation

Parameters		
Body weight		
Adult	80 kg	
1–2 year old	11 kg	
2–3 year old	15 kg	
Absorption factors		
Dermal – concentrate/dilution	0.04 (4%)	
Oral/inhalational	1 (100%, default value)	
Unit exposures (external exposure = amount of active handled/day x unit exposure)		
	Dermal mg/lb ac (non-professional, residential)	Inhalation mg/lb ac (no respirator)
Manually pressurised hand wand sprayer (outdoor)	63	0.018
Manually pressurised hand wand sprayer (indoor / near indoor)	69	1.1
Hose end sprayer	58	0.022
Backpack sprayer	130	0.14
Hand trigger sprayer	85.1	0.061
Sprinkler can (ornamental and potted plant immersion)	13.4	0.022
Sponge application (companion horses)	1,600	0.21
Turf transfer coefficients for children		
1–2 years old	49,000 cm²/h	
2–3 years old	60,000 cm²/h	

Based on the above parameters and using the default values and calculators in the US Residential Exposure Standard Operating Procedures, exposures associated with mixing, application and post-application exposure resulting from the non-professional use of diazinon products for a range of products were assessed. The results are summarised in the following table.

Table 23: Diazinon home garden and pet product exposure assessment

Exposure assessment summary					
Product	Application	Product use rate	Dilution rate	Acceptability for handler exposure	Acceptability for post application
Nucidol 200 EC Insecticide and Acaricide	Horses – sponge application	25 mL diluted in 10L of water	0.5 g ac/L applied by sponge	Not acceptable – MOE 11.3	Not applicable (fails handler assessment)
	Animal sheds (stables)	250 mL in 10 L of water	5 g ac/L	Acceptable- for use with a hose end sprayer	Not acceptable
				Not acceptable for use with backpack sprayer, hand wand sprayer)	Not applicable (fails handler assessment)
Barmac Diazinon Insecticide	Homes, flats, refuse areas, garbage containers – general	6 mL/L water or kerosene	4.8 g ac/L	Acceptable	Not acceptable in areas where children may be allowed to play.
Ac Dizzy 800 Insecticide					
Accensi Diazinon 800 Insecticide	Lawns and around trees	6 mL/L water 1 L/10m ²	4.8 g ac/L	Acceptable for all application methods	Not Acceptable
Farmoz Diazol 800 Insecticide					
	Ornamentals and potted plants	2 mL/10 L water	1.6 g ac/10L	Acceptable	Not acceptable

Based on unacceptable exposure to children entering treated areas, the use of diazinon products in and around residential premises is not supported. Professional use of diazinon in areas considered unlikely to result in child exposure is accepted (i.e. refuse areas, crack and crevice spray, treatment of ponds and stagnant waters, treatment of non-recreational and non-domestic turf). The following restraints are recommended to be added to prevent unacceptable exposure of children to diazinon.

- Statement of claims – “THIS PRODUCT IS TOO HAZARDOUS FOR USE BY HOUSEHOLDERS.”
- Restraints – “DO NOT use in or around publicly accessible residential, public or commercial areas. DO NOT use in areas accessible to children.”

Professional occupational agricultural and veterinary use surrogate exposure scenario evaluations

The residues evaluation published by the APVMA in 2006 concluded that there was not sufficient information to support the use of diazinon on: apples, beans, beetroot, blueberries, Brussels sprouts, cabbage, canola, cantaloupes, capsicum, carrots, celery, cereals, chokos, chou moellier, citrus, cotton, cucumbers, cucurbits, cumquats, eggplant, gherkins, globe artichoke, grape vines, hops, kale, kiwifruit, kohlrabi, lettuce, lucerne,

macadamia nuts (label uses), marrows, oilseed crops, parsnip, pastures, pears, peas, pumpkin, potatoes, rhubarb, rice, silverbeet, sorghum, soybeans, squash, stone fruit, sugarcane, sweet corn, trifoliate orange, tomatoes, turnips, or watermelons.

On this basis, the occupational exposure associated with these uses has not been reevaluated in this report and will only be considered further should additional information be provided to support these uses. In certain cases, it may be possible to extrapolate from uses on other, supported, crops to determine the acceptability of these uses.

The exposure scenarios are based on the [US EPA Occupational Pesticide Handler Exposure Calculator](#) (OPHEC) and [Occupational Pesticide Re-entry Exposure Calculator](#) (OPREC). The exposure modelling parameters, assumptions, exposure situations and use rates evaluated are shown in Table 24. The outcomes of the exposure risk assessments for the various exposure situations are shown in Table 25. Bystander exposure was assessed based on the [APVMA spray drift risk assessment tool](#).

Table 24: Exposure situations and modelling parameters

Parameter	Values
Bodyweight	80 kg
Normal workday	8 h with an application period of 6 h
Average size of house	Area 170 m ² Volume 430 m ³
Average size of greenhouse	Area 150 m ² Volume 375 m ³
Average industrial building	Area 2500 m ² , Volume 12,500 m ³
Average office building	Area 7,500 m ² , Volume 18,000 m ³
Penetration through overalls	10%
Penetration through chemical-resistant full body clothing	5%
Penetration through chemical-resistant gloves	10%
Protection afforded by half face-piece respirator with gas/dust cartridges	90%
Protection afforded by full face-piece respirator with gas/dust cartridges	98%
Protection afforded by supplied air respirator (air-hose respirator or SCBA)	100%
Container neck width	Narrow
Dermal absorption factor	
Concentrate	4%
Dilution	4%
Inhalation absorption factor	100%
Oral absorption factor	100%
Re-entry exposure assessment parameters	
Initial dislodgeable foliar residues (DFR):	20% of the ac applied
Dissipation rate/day	10%
Adult exposure duration	8 h/day

^a Rate specified for registered product with specific use on apples

^b Total work rate covered by the general rate for airblast application

Exposure situations

Table 25: Exposure assessment outcomes and risk characterisations

Use context	Application method	Application rate	Area treatable per day or useable volume	Minimum PPE required for the modelled scenario	Comments
Pastures/turf	Boom spray – mixing and loading	Up to 1.12 kg ac/ha	19 ha	Single layer of clothing	The scenario is based upon the maximum per hectare application rate.
	Boom spray – application		32.4 ha	Gloves	Does not include lawns, rights of way or public access turf.
	Boom spray – M/L/A		12 ha		Since this includes locust and grasshopper control consultation with the relevant state and territory control programs regarding these exposure scenarios is recommended.
					Larger areas can be treated if lower rates and higher levels of PPE are used, in particular if engineering controls are applied to mixing, loading, and closed cabs ± a respirator are used during application.
Around trees	Boom spray – mixing and loading	Up to 0.48 kg ac/ha	45 ha	Single layer of clothing	The scenario assumes use in commercial non-food trees such as the establishment of fibre tree plantations or sandal wood trees etc. During tree plantation establishment boom spraying application is possible. It is also potentially possible using high boom sprayer equipment to treat low to medium height small trees.
	Boom spray – application		77 ha	Gloves	
	Boom spray – M/L/A		28 ha		
	Mechanically pressurised handgun (ground directed)		1 ha (applied area to base of tree). Equal to approximately 2,500 trees		In professional, larger scale, tree management situations the scenario assumes that manually pressurised application equipment is impractical. Under such circumstances it is assumed that mechanically pressurized devices (ranging from backpack to truck based types) are more likely to be used.
	Manually pressurized handgun (ground directed)	1 g ac/L applied to the base of each plant)	190 L	Single layer of clothing	The number of plants treated based on this scenario is about 317 trees.
	M/L/A			Gloves	

Use context	Application method	Application rate	Area treatable per day or useable volume	Minimum PPE required for the modelled scenario	Comments
Banana Butt sprayed at base of plant – ground directed	Mechanically pressurized handgun (ground directed) M/L/A	equivalent to 3 kg/ha	400 L		The number of plants treated based on this scenario is about 667 trees.
Mushroom Applied to surface of casing soil - ground directed	Manually pressurized handgun M/L/A	30 mL of and 800 g ac/L formulation in 10 L (24 g ac/10L)	100 L	Single layer of clothing Gloves	Much higher ai handling rates are possible; however, the listed scenario is based upon mixing, loading and applying 85 L of spray per day using manual equipment.
	Mechanically pressurized handgun M/L/A		170 L		Much higher ai handling rates are possible; however, the listed scenario is based upon mixing, loading and applying 170 L of spray per day using manual equipment.
Mushroom Poured into/mixed with compost during spawning	Pour in/on, M/L/A	140 mL of an 800 g ac/L formulation in 10 L (112 g AI/10L)	200L	Single layer of clothing	Although gloves are not required based on the assessed scenario they are recommended as a basic good agricultural hygiene practice. Higher ai handling rates are possible; however, the evaluated scenario is based on the production of 20 tonnes of compost per day
Nursery plants (commercial) Dip before planting	Dip before planting M/L/A	60 mL of 800 g ai/L product in 100L (0.48 g ac/L)	100L	Single layer of clothing	The assumption that 100 L of prepared solution is used per day is considered to be highly conservative. While gloves are not required, they are recommended as a basic form of good agricultural hygiene.
Ornamental potted plants (commercial) Drenching	Pour in/on, M/L/A	Up to 2 mL of 800 g ac/L product (0.16 g ac/L)	100L	Single layer of clothing	The assumption that 100 L of prepared solution is used per day is considered to be highly conservative. While gloves are not required, they are recommended as a basic form of good agricultural hygiene

Use context	Application method	Application rate	Area treatable per day or useable volume	Minimum PPE required for the modelled scenario	Comments
Pineapple (scale treatment)	Ground boom – M/L	Up to 65 mL of 800 g ac/L product per 100L applied at 1,560 g ac/ha	14 ha	Single layer of clothing	These work rates are lower than the standard use rates of 30 ha/day.
	Ground boom – Applicator		22 ha	Gloves	
	Ground boom M/L/A		8 ha		Higher amounts can be handled using closed mixing loading and a closed cab or respirator during application
	Dip before planting M/L/A	Up to 65 mL of 800 g ac/L product in 100L	97 L	Single layer of clothing	
Pineapple (mealy bug)	Ground boom – M/L	Up to 3 L of 800 g ac/L per hectare (2.4 kg ai/ha)	8 ha	Single layer of clothing	These work rates are lower than the standard use rates of 30 ha/day.
	Ground boom – Applicator		14 ha	Gloves	
	Ground boom M/L/A		5.7 ha		Higher amounts can be handled using closed mixing loading and a closed cab or respirator during application.
Cauliflower Broccoli	Ground boom – M/L	Up to 1.4 L of 800 g ac/L product per ha (1.12 kg ai/ha)	19 ha	Single layer of clothing	
	Ground boom – applicator		32.4 ha	Gloves	Higher amounts can be handled using closed mixing loading and a closed cab or respirator during application.
	Ground boom M/L/A		12 ha		
Onions (low rate)	Ground boom – M/L	Up to 0.7 L of 800 g ac/L product per	5 ha	Single layer of clothing	Higher amounts can be handled using closed mixing loading and a closed cab or respirator during application.
	Ground boom – applicator		9 ha		

Use context	Application method	Application rate	Area treatable per day or useable volume	Minimum PPE required for the modelled scenario	Comments
	Ground boom M/L/A	hectare (560 g ai/ha)	3 ha	Gloves	
Onions (high rate)	Ground boom – M/L	Up to 3 to 5 L of 800 g ac/L formulation per hectare	5 ha	Single layer of clothing	Higher amounts can be handled using closed mixing loading and a closed cab or respirator during application.
	Ground boom – applicator	(up to 4 kg/ha)	9 ha	Gloves	
	Ground boom M/L/A		3 ha		
Commercial and industrial buildings, ships, farm buildings, refuse areas, garbage containers	Sprayer, mister, swingfog – M/L/A	Sprayer – 4.8 g ac/L water or kerosene Mister 12 g ac/L water or kerosene	80 L	Single layer of clothing, gloves, respirator	

*Additional personal protective equipment may be required based on the first aid instructions and safety directions.

Overall key findings for exposure of professional workers during mixing, loading and application of diazinon are as follows:

- All agricultural use exposure scenarios have acceptable risk using minimal personal protective equipment (PPE) **except** for the use of truck mounted misting equipment for control of Argentine ants in trees (use of diazinon for Argentine ant control is currently restricted to WA). This type of application method appears to be inconsistent with the goal of killing the colony queens in the nests rather than worker ants located on the trunks, branches and colonies of the trees.
- The use of a single layer of clothing and gloves is required to mitigate the risk of diazinon exposure in most cases. In those cases where gloves are not strictly required to mitigate the risk, their use is supposed based on encouraging basic good agricultural hygiene practices.

Professional occupational agricultural and veterinary use surrogate re-entry evaluations

The US EPA OPREC standard transfer co-efficients have been used for a range of worker activities following application of diazinon at label rates. Acceptable re-entry periods have been recommended assuming single layer of clothing with any additional protective equipment. Earlier re-entry is possible wearing single layer of clothing and gloves to reduce exposure. Based on the application rates assessed for mixing, loading and application of diazinon products, the following re-entry periods are recommended.

Table 26: Re-entry outcomes

Crop	Activity	Re-entry period
Pasture	Scouting, harvesting, fertilising, irrigation	11 days
Around trees	Irrigation (hand set)	10 days
	Scouting, all other activities	8 days
Banana	Irrigation (hand set)	18 days
Butt sprayed at base of plant (Ground directed) – re-entry in 2 square metre around base of sprayed tree	Scouting, all other activities	15 days
Mushroom, nursery plants (dipping before planting), ornamental potted plants (drenching), pineapple (dipping before planting)	All	Nil
Pineapple (ground boom) (low rate)	Hand weeding	1 day
	Scouting	5 days
	Hand harvesting	13 days

Crop	Activity	Re-entry period
Pineapple (ground boom)(high rate)	Hand weeding	3 days
	Scouting	7 days
	Hand harvesting	20 days
Onions (low rate)	Green onions – scouting and hand weeding with minimum foliage density, thinning plants	3 days
	Bulb onions – Scouting, thinning plants, irrigation (non-handset)	9 days
	Irrigation (handset)	11 days
	Hand weeding	14 days
Onion (high rate)	All	Nil – application is prior to sowing followed by harrowing or irrigation
Broccoli, cauliflower	Transplanting, weeding (mechanical)	4 days
	Hand weeding, full foliage density	23 days
	Thinning plants, scouting (minimal foliage density)	6 days
	Hand weeding, minimal foliage density	12 days
	Irrigation, handset	13 days

Unless otherwise specified, all labels should include at least the following re-entry statement:

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

Professional occupational exposure associated with the animal health use of diazinon

Diazinon products are currently registered for use on a range of animal species. Exposure to applicators have been assessed using the basic parameters set out above. Acceptable margins of exposure have been established for label uses as follows in Table 27.

Table 27: Required Personal Protective Equipment

Product	Use	Required PPE
KFM Blowfly Dressing	Diluted 1 L in 5L water, applied by brushing, swabbing, hand spraying or jetting	Single layer clothing, gloves
SD Fly Strike Powder To Control Flystrike And For Wound Dressing For Animals	Powder applied directly to sheep, goats or cattle	Single layer clothing, gloves
WSD Mulesing Powder Wound Dressing Following Mules Operation General Wound Dressing For Sheep, Cattle And Goats		
Coopers Fly Strike Powder Insecticide		
Eureka Gold OP Spray-On Off-Shears Sheep Lice Treatment	Applied to sheep using hand application	Double layer clothing (overalls over normal clothing), gloves, PF10 respirator
Nucidol Gold OP Spray-On Off-Shears Sheep Lice Treatment		
Coopers Erase Gold Spray-On Off-Shears Sheep Lice Treatment		
Coopers Gold Spray-On Off-Shears Sheep Lice Treatment		
WSD Diazinon For Sheep, Cattle, Goats And Pigs	Treatment of sheep on an individual basis for fly strike, and treatment of other animals on an individual basis following animal husbandry procedures	Pour on/brushing: single layer clothing, gloves Goat, spray application: single layer clothing, no gloves Goat – automatic jetting races: single layer clothing, gloves Cattle, spray application: single layer clothing, gloves Cattle, automatic jetting races: single layer clothing, no gloves
Coopers Diazinon Sheep Blowfly Dressing And Cattle, Goat And Pig Spray		
Nucidol 200 EC Insecticide and Acaricide	Treatment of other animals on an individual basis	
Nucidol 200 EC Insecticide and Acaricide	Mechanically pressurised spray application to horses Mechanically pressurised spray application to stables and animal sheds	Gloves, PF10 respirator
Z-Tex Optimizer Insecticidal Cattle Ear Tags	Ear tags applied to cattle when pests first appear and replaced as necessary	Gloves
Terminator Insecticide Ear Tag for Cattle		

Product	Use	Required PPE
Y Tex Warrior Insecticide Cattle Ear Tag		
Patriot Insecticide Ear Tags for Cattle		
Co-Ral Plus Insecticide Cattle Ear Tag		

Acceptable margins of exposure were not obtained for the application of Nucidol 200 EC Insecticide and Acaricide (product 49876) by sponging to horses and this use is not supported on human health grounds.

Spray drift assessment

Consideration of potential exposure via spray drift for products containing diazinon has been considered in this assessment. The systemic point of departure for repeat dose exposure (0.02 mg/kg bw/day) has been used for this assessment, along with a dermal absorption factor of 0.04 and an acceptable margin of exposure of >20. Based on these parameters, the Regulatory Acceptable Level for 1–2-year-olds (the most sensitive group) is 9 g ac/ha.

First aid instructions

Based on the current risk assessments, no change to the first aid instruction entries is recommended for diazinon. The statements remain as follows in Table 28:

Table 28: First aid instructions

Concentration	Code	First aid instruction
Diazinon in dusts, plastic resin strips or when microencapsulated in preparations containing < 25% of diazinon	a	If poisoning occurs, contact a doctor or Poisons Information Centre. Phone Australia 13 11 26, New Zealand 0800 764 766.
Diazinon	m	If swallowed, splashed on skin or in eyes, or inhaled, contact a Poisons Information Centre (Phone Australia 13 11 26, New Zealand 0800 764 766) or a doctor at once. Remove any contaminated clothing and wash skin thoroughly. If swallowed, activated charcoal may be advised. Give atropine if instructed.

Safety directions

Following consideration of both the acute hazards and systemic risks of exposure to formulated products, safety directions have been amended or established. These safety directions must be included on the relevant product label.

EC products

EC 250 g/L or less and more than 50 g/L in hydrocarbon solvents

Products:

- 39572 WSD Diazinon for Sheep, Cattle, Goats and Pigs
- 62353 Coopers Diazinon Sheep Blowfly Dressing and Cattle, Goat and Pig Spray

Poisonous if swallowed. Repeated minor exposure may have a cumulative poisoning effect. Will irritate the eyes and skin. Avoid contact with eyes and skin. Do not inhale vapour or spray mist. When preparing spray and using the prepared spray, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow-length chemical resistant gloves. After use and before eating, drinking, or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash gloves and contaminated clothing

EC 215 g/L or less in liquid hydrocarbons (other than xylene) 750 g/L or less, with surfactants

Product:

- 49876 Nucidol 200 EC Insecticide and Acaricide

Poisonous if swallowed. Repeated minor exposure may have a cumulative poisoning effect. Will irritate the eyes and skin. Avoid contact with eyes and skin. Do not inhale vapour or spray mist. When opening the container and preparing spray, wear cotton overalls buttoned to the neck and wrist or equivalent clothing and a washable hat, and elbow-length chemical resistant gloves. When using the prepared spray, wear protective waterproof clothing, cotton overalls buttoned to the neck and wrist or equivalent clothing and a washable hat, elbow-length chemical resistant gloves and a half-face piece respirator. If clothing becomes contaminated with product, remove clothing immediately. If product on skin, immediately wash area with soap and water. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash gloves, respirator and if rubber wash with detergent and warm water, and contaminated clothing.

EC ULV 200–800 g/L

Products:

- 50007 Barmac Diazinon Insecticide
- 59707 Farmoz Diazol 800 Insecticide
- 68534 Accensi Diazinon 800 Insecticide
- 87681 Imtrade Diazinon 800 EC Insecticide
- 88946 AC Dizzy 800 Insecticide

Product is poisonous if absorbed by skin contact or swallowed. Repeated minor exposure may have a cumulative poisoning effect. Will irritate the eyes and skin. Avoid contact with eyes and skin. DO not inhale spray mist. When preparing the spray and using the prepared spray, wear cotton overalls buttoned to the neck and wrist and a washable hat, elbow length chemical resistant gloves and face shield or goggles. If product on skin, immediately

wash area with soap and water. After use and before eating drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash gloves, face shield or goggles and contaminated clothing.

PD products

PD 15 g/kg or less and pyrethrin 1 g/kg or less

Products:

- 39573 WSD Fly Strike Powder to Control Flystrike and for Wound Dressing for Animals
- 39574 WSD Mulesing Powder Wound Dressing Following Mules Operation General Wound Dressing for Sheep, Cattle and Goats
- 46231 Coopers Fly Strike Powder Insecticide

Harmful if swallowed. Repeated minor exposure may have a cumulative poisoning effect. Avoid contact with eyes and skin. Do not inhale dust. When using the product, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow-length chemical resistant gloves. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use wash gloves and contaminated clothing.

BL products

BL 95 g/L or less with dibutyl phthalate 720 g/L or less, with surfactants

Products:

- 51290 Eureka Gold OP Spray-On Off-Shears Sheep Lice Treatment
- 68253 Nucidol Gold OP Spray-On Off-Shears Sheep Lice Treatment
- 86308 Coopers Erase Gold Spray-On Off-Shears Sheep Lice Treatment
- 86314 Coopers Gold Spray-On Off-Shears Sheep Lice Treatment

Poisonous if swallowed. Repeated minor exposure may have a cumulative poisoning effect. Will irritate the eyes and skin. Avoid contact with eyes and skin. Do not inhale vapour or spray mist. When mixing and loading wear cotton overalls, over normal clothing, buttoned to the neck and wrist and a washable hat, elbow-length chemical resistant gloves, goggles or safety glasses. When using the prepared spray, wear cotton overalls, over normal clothing, buttoned to the neck and wrist and a washable hat, elbow-length chemical resistant gloves, goggles or safety glasses, water resistant footwear and a half-face piece respirator. If product on skin, immediately wash area with soap and water. If product in eyes, wash it out immediately with water. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash gloves, goggles or safety glasses, respirator and if rubber wash with detergent and warm water and contaminated clothing. Do not re-use footwear until thoroughly aired.

Ear tag products

Ear tags 400 g/kg or less

Products:

- 46406 Y-TeX Optimizer Insecticidal Cattle Ear Tags
- 53910 Patriot Insecticide Ear Tag for Cattle
- 55722 Terminator Insecticide Ear Tag for Cattle

Poisonous if swallowed. Repeated minor exposure may have a cumulative poisoning effect. Avoid contact with eyes and skin. When using the product wear disposable gloves. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.

Ear tags 300 g/kg or less with chlorpyrifos 100 g/kg or less

Product:

- 51524 Y-TeX Warrior Insecticidal Cattle Ear Tags

Poisonous if swallowed. Repeated minor exposure may have a cumulative poisoning effect. May irritate the skin. Avoid contact with eyes and skin. Do not open inner pouch until ready to use. Do not allow children to play with tag. When using the product wear disposable gloves. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.

Ear tags 200 g/kg or less with coumaphos 200 g/kg or less

Product:

- 60662 Co-Ral Plus Insecticide Cattle Ear Tag

Poisonous if swallowed. Repeated minor exposure may have a cumulative poisoning effect. Avoid contact with eyes and skin. When using the product wear disposable gloves. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water.

Recommendations

The use of diazinon does not present any unacceptable risk to users or the public when used in accordance with the following:

- The uses of diazinon in the following crops has not been assessed based on unacceptable residue evaluations: apples, beans, beetroot, blueberries, Brussels sprouts, cabbage, canola, cantaloupes, capsicum, carrots, celery, cereals, chokos, chou moellier, citrus, cotton, cucumbers, cucurbits, cumquats, eggplant, gherkins, globe artichoke, grape vines, hops, kale, kiwifruit, kohlrabi, lettuce, lucerne, macadamia nuts (label uses), marrows, oilseed crops, parsnip, pastures, pears, peas, pumpkin, potatoes, rhubarb, rice, silverbeet,

sorghum, soybeans, squash, stone fruit, sugarcane, sweet corn, trifoliate orange, tomatoes, turnips, or watermelons.

- The use of diazinon on horses by sponging is not supported.
- The use of diazinon in or around domestic premises or in public areas where children may have access is not supported. The restraints indicated above should be included on the label.
- First aid instructions for products containing diazinon remain unchanged from current recommendations.
- Safety directions are amended from current recommendations as specified as recommended above and should be included on the label.
- Re-entry periods are applicable and should appear on the product labels as appropriate as recommended above.

Environmental assessment

Previous environment assessments

Diazinon was nominated for review in response to an invitation to the public by the APVMA (then the NRA) in 1994. Environmental concerns were cited as part of the justification for the nomination and the [Diazinon Environmental Assessment](#) was published in 2002. Environmental risks of the following uses were determined to be acceptable and there are no changes to these risk conclusions under the current review. However, some updated labelling is recommended to comply with current standards.

- Ear tags, wound dressings and hand sprays for control of lice, flies or mange in sheep, horses, goats, cattle, and pigs.
- Space and surface sprays to control crawling insects, flies or maggots indoors (domestic, commercial, industrial, ships, farm buildings, animal sheds, skins/hides) or outdoors (refuse areas, garbage containers, ant trails and nests).
- Use in mushrooms to control various insect pests.

Some diazinon products are registered for the control of mosquito larvae in ponds and stagnant water. Risks to non-target aquatic species were determined to be unacceptable for this use pattern in the 2002 assessment, and there is no change to this risk conclusion. However, use by handheld sprayers in temporary pools can be supported, which are not expected to contain sensitive non-target aquatic species. The following restraint is therefore advised.

DO NOT use on permanent water bodies for control of mosquito larvae.

The environmental risks of diazinon products registered as spray-on off-shears lice treatments in sheep have been addressed by APVMA's [Sheep Ectoparasiticides Review Findings](#) published in 2014. There are no changes to these risk conclusions under the current review; however, some updated labelling is similarly recommended to comply with current standards.

Current environment assessment

The current assessment considers the environmental risks of the remaining registered uses of diazinon; however, many that are not supported based on human health or food safety grounds have not been reconsidered from the viewpoint of environmental safety in the interest of efficiency.

Diazinon is primarily applied as a broadcast foliar spray to crops and other plants for control of various insect pests, but it can also be applied as a pre-plant dip or soil drench.

The environmental risk assessment scenarios considered in the current assessment are summarised in Table 29. Environmental risks were determined according to the methodology outlined in the APVMA [Risk Assessment Manual – Environment](#).

Table 29: Environmental risk assessment scenarios

Category	Situation	Risk assessment scenario
Control of Argentine ants	Lawns (grid pattern)	1× 4,800 g ac/ha
	Pasture	1× 4,800 g ac/ha
Ornamentals	Soil drench in potted ornamentals	1× 3,200 g ac/ha (1.6 g ac/10 L, 2L/m ²)
	Pre-plant dip of nursery plants	1× 240 g ac/ha (48 g ac/100 L, 10,000 plants/ha)
Tropical fruit	Control of mealy bug in pineapples	3× 2,400 g ac/ha 14d interval
	Control of pineapple scale in pineapples	3× 1,560 g ac/ha 14d interval
	Pre-plant dip of pineapples	1× 520 g ac/ha (52 g ac/100 L, 40,000 plants/ha)
	Banana butt treatments	2× 1,800 g ac/ha (0.6 g ac/plant, 3000 plants/ha) 14d interval
Vegetable crops	Cauliflower, broccoli	4× 560 g ac/ha 10d interval
	Onions, garlic	3× 560 g ac/ha 10d interval

Fate and behaviour in the environment

The fate and behaviour of diazinon in the environment have been described in the previous APVMA 2002 and 2014 assessments. Key regulatory endpoints for the exposure assessment are summarised in the table at the end of this section. A full listing of endpoints is provided in Appendix B.

Diazinon is volatile and moderately soluble in water. Its octanol-water partition coefficient indicates potential for bioaccumulation. Diazinon has an acid dissociation constant of 2.6, indicating that its form will not change significantly at environmentally relevant pH and exists as a cation below this pH. Diazinon is uncharged between pH 4 and 7. UV-VIS absorption maxima of diazinon were not observed above 290 nm, suggesting low susceptibility to photochemical degradation under natural light; however, this is not precluded.

Lewis & Tzilivakis (2017) collated data on the dissipation of diazinon on or within various plant matrices using a systematic review approach using several scientific databases. Collated literature was subjected to a quality

assessment, for which 14 published articles covering various foliar and fruit matrices were determined to be acceptable. Mean DT₅₀ values for foliar dissipation ranged from 0.80 to 6.1 days (geomean 2.3 days). Mean DT₅₀ values for fruit dissipation ranged from 0.80 to 9.6 days (geomean 2.6 days). Diazinon is non-systemic and is not known to translocate in plants.

The photodegradation of diazinon on the surface of soil was studied using natural sunlight and an artificial light source. Diazinon degraded with an experimental half-life of <3 days of natural sunlight. There was only one photodegradation product, oxypyrimidine. No significant degradation was observed in the dark control samples, demonstrating the degradation observed in the exposed treated soil was due to photolysis rather than from any biotic mechanism. Photodegradation on the soil surface could be a significant dissipation route for diazinon in the environment, especially under strong natural sunlight conditions.

Diazinon was not persistent in aerobic or anaerobic soil under laboratory or field conditions. The rate of degradation was found to be microbially driven. Mineralisation reached 86% AR and bound residues represented up to 19% AR. The major metabolite was oxypyrimidine (82% AR). The data set from laboratory studies had a range of half-lives of 8.4-24 days with a geomean of 11 days.

The adsorption/desorption characteristics of diazinon were studied using the batch equilibrium method. Adsorption K_{oc}/K_{foc} values for diazinon ranged from 138 to 3779 mL/g (mean K_{oc} 824 mL/g) for 33 soils, indicating slight mobility. An analysis of the relationship between Freundlich K_f values and soil organic carbon from the values reported in Table 44 has been undertaken. Two values were identified as outliers. With the remaining results (n = 30), there was a good relationship (r² 0.80) when forcing a zero intercept (no sorption with no soil organic carbon). The linear relationship was described as K_f = 4.7 x %OC. The leaching characteristics of diazinon in column leaching columns and in aged residues indicate that while diazinon is unlikely to leach, due to rapid degradation, the principal metabolite oxypyrimidine could leach. Results from a field lysimeter study conducted in Germany over 3 years with ¹⁴C-diazinon (applied at a rate of 4 applications of 240 g ac/ha/year) did not raise concerns regarding the potential of diazinon to leach to groundwater.

Hydrolysis is not likely to be a significant route of dissipation for diazinon from the environment under neutral or basic conditions, but diazinon is susceptible to hydrolysis under acidic conditions. Diazinon degraded in irradiated solutions with a half-life of 49 days under natural sunlight, indicating photolysis is unlikely to be a major route of dissipation under environmental conditions. Diazinon is not readily biodegradable.

A water/sediment study conducted with diazinon demonstrated that diazinon rapidly dissipates from the water phase into the sediment phase, as indicated by a geomean DT₅₀ of 4.3 days. Dissipation from the sediment and total system is also rapid (geomean DT₅₀ values of 13 and 10 days, respectively). Diazinon degrades under aquatic conditions to the major degradate oxypyrimidine, bound residues, carbon dioxide and organic volatiles. Oxypyrimidine reached a maximum of 47% AR and 13% AR in the water and sediment, respectively, by day 30. The DT₅₀ for oxypyrimidine in the water phase was 87 days, in the sediment 49 days and 65 days for the total system.

Based on its vapour pressure, diazinon could be volatilised from the surface of soil and plants. However, its Henry's law constant suggests low volatility from moist soil and water surfaces. In soil, the rate of volatilisation of diazinon increased with increasing pesticide concentration, with losses of up to 10% observed after the initial 24 hours following application. The volatilisation from maize plants after a single foliar application of diazinon was found to be 24% in the initial 24 hours following application. Volatilisation could be a route of environmental

contamination. However, long-range transport of diazinon through the air is unlikely due to its rapid reaction with hydroxyl radicals.

Monitoring data indicate relatively low levels of diazinon reaching surface water in urban areas. Following high usage in orchard situations, high levels of diazinon have been measured in pond water, and detections in bird carcasses confirm exposure of avian wildlife.

Diazinon was more recently detected in one sediment sample (out of 151 samples) at 18 µg/kg in Onkaparinga River of Adelaide and Mt Lofty Ranges, South Australia. The catchment includes a range of land uses, including urban, intensive agriculture (market gardening, orchards, vines), forestry and broadacre cropping.

Table 30: Key regulatory endpoints for exposure assessment

Compartment	Value	Reference
Animal food items	Foliage: DT ₅₀ 2.3 d	Ettiene <i>et al.</i> 2006, Khay <i>et al.</i> 2006, Kuhr & Tashiro 1978, Lemmon & Pylypiw 1992, Ripley <i>et al.</i> 2003, Sears & Chapman 1979, Sears <i>et al.</i> 1987, Talebi 2006, Willis & McDowell 1987
	Fruit: DT ₅₀ 2.6 d	Cabras <i>et al.</i> 1997, Lindquist <i>et al.</i> 1973, Minelli <i>et al.</i> 1996, Prieto <i>et al.</i> 2002
	Other: DT ₅₀ 10 d	Default
Soil	DT ₅₀ 8.7 d	Bird 1990a,b, Guy 1989, 1990a,b, Jacobson & Gresham 1989a,b, Kimmel <i>et al.</i> 1989a,b, Offizorz 1990a,b, Offizorz 1992a,b, Rice <i>et al.</i> 1990a,b, Walker 1990
	Kd 4.7 mL/g at 1% OC Kd 9.3 mL/g at 2% OC	Arienzo <i>et al.</i> 1994, Bondarenko & Gan 2004, Iglesias-Jiménez <i>et al.</i> 1996, Nemeth-Konda <i>et al.</i> 2002, Sparrow 2000
Water	DT ₅₀ 4.3 d	Corden 2004
Sediment	DT ₅₀ 13 d	Corden 2004
	Kp 23 mL/g at 5% OC	Arienzo <i>et al.</i> 1994, Bondarenko & Gan 2004, Iglesias-Jiménez <i>et al.</i> 1996, Nemeth-Konda <i>et al.</i> 2002, Sparrow 2000
Air	DT ₅₀ 1.3 h	Comb 2002

Effects on non-target species

The effects of diazinon on non-target species have been described in the previous APVMA 2002 and 2014 assessments. Key regulatory endpoints for the effects assessment are summarised in the table at the end of this section. A full listing of endpoints is provided in Appendix B.

Diazinon has moderate toxicity to mammals (LD₅₀ 1,129 mg ac/kg bw, *Rattus norvegicus*) and high toxicity to birds (lowest LD₅₀ 1.4 mg ac/kg bw, *Anas platyrhynchos*). Therefore, the following protection statement is required on diazinon product labels (followed by an appropriate risk management statement).¹

Toxic to birds.

Following dietary administration in reproductive toxicity tests, decreased survival and body weight of F1 pups was observed in mammals at doses as low as 7.0 mg ac/kg bw/d (NOEL 0.65 mg ac/kg bw/d, *Rattus norvegicus*), while fewer hatchlings, 14-day survivors and reduced body weight of birds was observed in birds at concentrations as low as 16 mg ac/kg diet (NOEL 1.2 mg ac/kg bw/d, *Anas platyrhynchos*).

A field study with an EC formulation of diazinon noted behavioural and reproductive effects in small rodents at field-relevant rates (560 g ac/ha), although population-level effects were not observed at rates up to 4,500 g ac/ha. In another field test with enclosed animals, ground-feeding birds were more susceptible to a granular formulation than a flowable formulation at 1,100 g ac/ha, but voles were not susceptible to either formulation at 1,110 g ac/ha.

Diazinon has high toxicity to some species of aquatic vertebrates (lowest LC₅₀ 0.085 mg ac/L, *Anguilla anguilla*) and invertebrates (lowest geomean EC₅₀ 0.38 µg ac/L, *Ceriodaphnia dubia*), and moderate toxicity to algae (lowest EC₅₀ 6.4 mg ac/L, *Selenastrum capricornutum*). Based on the acute toxicity data, the following protection statement is required on diazinon product labels.

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

Following long-term exposure of fish in the early life stages, reduced growth was observed at concentrations as low as 0.17 mg ac/L (NOEC 0.092 mg ac/L, *Pimephales promelas*). In a 6-month mesocosm study (Giddings 1992), reduced populations of Cladocerans and other sensitive invertebrates were observed at concentrations as low as 0.0023 mg ac/L with insufficient recovery within 8 weeks to allow the results to be used in establishing a suitable endpoint.

Invertebrates are the most sensitive aquatic receptor to diazinon with survival being the key parameter. Based on a species sensitivity distribution analysis of the acute EC₅₀ values of 26 aquatic invertebrate species, the HC₅ was calculated to be 0.44 µg ac/L. Applying an assessment factor of 3 (based on EFSA 2013 guidance for establishment of a Tier 2b RAL), the RAL for the assessment is 0.15 µg ac/L.

Bioconcentration of diazinon residues was determined to be moderate in fish, with BCF values ranging from 18 to 500. Elimination was rapid, with a depuration half-life between one and 3 days. Bioconcentration in aquatic

¹ Not required for veterinary products, spray & surface sprays (unless in farm buildings or animal sheds), mushroom use, or mosquito larvae control

invertebrates was relatively low, with BCF values ranging from 3 to 82. Based on the available data, bioconcentration in the aquatic environment is not expected.

Diazinon has high toxicity to adult bees by contact exposure (LD₅₀ 0.13 µg ac/bee, *Apis mellifera*) and oral exposure (LD₅₀ 0.09 µg ac/bee, *Apis mellifera*) and high toxicity to bee larvae (LD₅₀ 0.00012 µg ac/bee, *Apis mellifera*). The EC formulation does not appear to enhance toxicity. In a foliar residue toxicity study, acceptable bee mortality was observed at 468 g ac/ha after exposure to fresh-dried residues and 1,170 g ac/ha after 7 days of aging. Based on the LD₅₀ values, the following hazard statement is advised for diazinon product labels, followed by an appropriate risk management statement (except for veterinary products, indoor spray and surface sprays, mushroom use, mosquito larvae control, soil drenches or pre-plant dips).

Highly toxic to bees.

For protection of pollinator areas, the RAL for spray drift assessment is 22 g ac/ha based on the contact LD₅₀ 0.13 µg ac/bee and a conversion factor of LOC 0.4 / ExpE 2.4 * 1000 as per APVMA's [Spray drift risk assessment manual](#) (SDRAM).

In Tier 1 laboratory tests, fresh-dried residues of a representative EC formulation of diazinon on glass plates resulted in the mortality of the indicator species of predatory arthropods (LR₅₀ 811 g ac/ha, *Typhlodromus pyri*) and parasitic arthropods (LR₅₀ 0.15 g ac/ha, *Aphidius rhopalosiphi*). In Tier 2 extended laboratory tests on natural substrates, lower toxicity was demonstrated for both predatory arthropods (LR₅₀ >1,170 g ac/ha, ER₅₀ >1,170 g ac/ha, *Typhlodromus pyri*) and parasitic arthropods (LR₅₀ >42 g ac/ha, ER₅₀ >42 g ac/ha, *Aphidius rhopalosiphi*). Testing of additional arthropod species resulted in similar effects on green lacewings (LR₅₀ >42 g ac/ha, ER₅₀ >184 g ac/ha, *Chrysoperla carnea*) and rove beetles (LR₅₀ >184 g ac/ha, ER₅₀ >184 g ac/ha, *Aleochara bilineata*). In aged residue tests, foliar residues at rates up to 1,170 g ac/ha were acceptable 28 days after treatment (<50% effect on *Aphidius rhopalosiphi* and *Chrysoperla carnea*), while soil residues at 468 g ac/ha were acceptable 36 days after treatment (<50% effect on *Aleochara bilineata*).

Diazinon has moderate toxicity to soil macro-organisms such as earthworms in artificial soil (LC_{50corr} 65 mg ac/kg dry soil, *Eisenia fetida*); however, no adverse effects on earthworms were observed under field conditions at rates as high as 20 kg ac/ha. Diazinon did not adversely affect soil processes such as nitrogen transformation at exaggerated soil concentrations (NOEC 80 mg ac/kg dry soil).

A representative EC formulation of diazinon was not phytotoxic to non-target terrestrial plants following pre-emergent exposure (ER₂₅ >11 kg ac/ha, ten species tested). However, significantly reduced growth of some species was observed at high rates, with the most sensitive species tested being cucumber (53% effect on dry weight at 11 kg ac/ha, *Cucumis sativus*).

The activated sludge test indicates that no adverse effect on microbial activity in sewage treatment works is expected at concentrations of 100 mg ac/L (Bader 1990a).

Table 31: Regulatory acceptable levels for non-target species

Group	Exposure	Endpoint	AF	RAL	Reference
Mammals	Acute	LD ₅₀ 1,129 mg ac/kg bw	10	113 mg ac/kg bw	Dreher 1997

Group	Exposure	Endpoint	AF	RAL	Reference
	Chronic	NOEL 0.65 mg ac/kg bw/d	1	0.65 mg ac/kg bw/d	Giknis 1989
Birds	Acute	LDD ₅₀ 8.0 mg ac/kg bw	10	0.80 mg ac/kg bw	Fletcher & Pederson 1988c
	Chronic	NOEL 1.2 mg ac/kg bw/d	1	1.2 mg ac/kg bw/d	Marselas 1989b
Aquatic species	Acute/ chronic	HC ₅ 0.44 µg ac/L	3	0.15 µg ac/L	Albuquerque 2002, Anderson & Lydy 2002, Anderson <i>et al.</i> 2006, Ankley & Collyard 1995, Ashauer <i>et al.</i> 2010a, 2010b, Bailey <i>et al.</i> 1996, 1997, 2001, Banks <i>et al.</i> 2003, 2005, Call 1993, Cripe 1994, Dohke & Hatanaka 1977b, Federle & Collins 1976, Hall & Anderson 2005, Hong <i>et al.</i> 2004, Jemec <i>et al.</i> 2007, Kaligis and Lasut 1997, Kretschmann <i>et al.</i> 2011, Kurata & Kurosawa 1990b, LeLievre 1991, Matsumoto <i>et al.</i> 2009, Overmyer <i>et al.</i> 2010, Shigehisa & Shiraishi 1998, Snell & Moffat 1992, Stuijtzand <i>et al.</i> 2000, Sucahyo <i>et al.</i> 2008, Surprenant 1998b, Surprenant 1998c, van der Geest <i>et al.</i> 1999, 2000a, 2000b, 2002, Vilkas 1976, Werner <i>et al.</i> 2002, Yokoyama <i>et al.</i> 2009
Adult bees	Acute contact	LD ₅₀ 0.13 µg ac/bee	2.5	0.052 µg ac/bee	Wainwright 2002a
	Acute oral	LD ₅₀ 0.09 µg ac/bee	2.5	0.036 µg ac/bee	Wainwright 2002a
Bee larvae	Acute oral	LD ₅₀ 0.00012 µg ac/bee	2.5	0.000048 µg ac/bee	Atkins & Kellum 1986
Predatory arthropods	Contact	Tier 1 LR ₅₀ 811 g ac/ha	0.5	1,622 g ac/ha	Sharples 2002a
Parasitic arthropods (foliar)	Contact	Tier 2 ER ₅₀ >42 g ac/ha	1	42 g ac/ha	Sharples 2002e
Parasitic arthropods (soil)	Contact	Tier 2 ER ₅₀ >184 g ac/ha	1	184 g ac/ha	Gray 2002

Group	Exposure	Endpoint	AF	RAL	Reference
Soil organisms	Acute	LC _{50corr} 65 mg ac/kg ds	10	6.5 mg ac/kg ds	Vial 1990
	Chronic	NOEC 27 mg ac/kg ds	1	27 mg ac/kg ds	Schäpfer 1977
Soil micro-organisms	Chronic	NOEC 80 mg ac/kg ds	1	80 mg ac/kg ds	Gruth 1983
Terrestrial plants	Post-emergent	ER ₅₀ ~11,000 g ac/ha	10	1,100 g ac/ha	Cañez 1988

Risks to non-target species

Terrestrial vertebrates

Direct dietary exposure of terrestrial vertebrates is considered negligible for soil drenches and pre-plant dips. For the remaining uses, the terrestrial vertebrate assessments are presented in Appendix C. No outcomes were identified as acceptable for birds or wild mammals (Table 32). Further, the maximum supported rate is well below the lowest label rate for any situation in any of the currently registered diazinon products.

The log Pow 3.3 for diazinon indicates a potential for bioaccumulation, and therefore a food chain assessment was conducted for soil drenches and pre-plant dips. As bioaccumulation processes are often slow, a chronic assessment is appropriate. The food chain assessment for fish-eating species assumes that the RAL for aquatic species is not exceeded on the basis that only use situations with acceptable risks to aquatic species will be approved. Provided water concentrations do not exceed the aquatic RAL, any accumulated residues in fish will not reach levels harmful to predators (Table 33). A maximum seasonal rate of 143 g ac/ha was determined to be acceptable to earthworm-eating mammals. After considering potential exposure rates over a 10-hectare area (see Table 42 in Appendix B), only pre-plant dip of nursery plants was determined to be acceptable to terrestrial vertebrates. The following protection statement is appropriate for pre-plant dip of nursery plants.

Toxic to birds. However, the use of this product as directed is not expected to have adverse effects on birds.

Disposal of spent dipping solution also presents a potential exposure pathway for terrestrial vertebrates. Spreading of 20,000 L/ha of spent nursery dip at 48 g ac/100 L to land is equivalent to 9,600 g ac/ha which greatly exceeds the maximum threshold for food chain risk to terrestrial vertebrates. Therefore, spent dips must not be disposed by spreading onto land; rather, the following instruction is advised for the label.

Dispose of dip in an authorised dip disposal facility. If an authorised dip disposal facility is not available, dispose of dip in compliance with the relevant local, state or territory government regulations.

Table 32: Summary of risk assessment outcomes for terrestrial vertebrates

Category	Situation	Application rate and frequency	Wild mammal assessment	Bird assessment	Max seasonal rate supported
Control of Argentine ants	Lawns (grid pattern)	1× 4,800 g ac/ha	Not supported	Not supported	52 g ac/ha
	Pasture	1× 4,800 g ac/ha	Not supported	Not supported	26 g ac/ha
Ornamentals	Soil drench in potted ornamentals	1× 3,200 g ac/ha (1.6 g ac/10 L, 2L/m ²)	Not supported (food chain)	Not supported (food chain)	357 g ac/ha (0.18 g ac/10 L)
	Pre-plant dip of nursery plants	1× 240 g ac/ha (48 g ac/100 L, 10,000 plants/ha)	Acceptable risk	Acceptable risk	n/a
Tropical fruit	Control of mealy bug in pineapples	3× 2,400 g ac/ha 14d interval	Not supported	Not supported	14 g ac/ha
	Control of pineapple scale in pineapples	3× 1,560 g ac/ha 14d interval	Not supported	Not supported	14 g ac/ha
	Pre-plant dip of pineapples	1× 520 g ac/ha (52 g ac/100 L, 40,000 plants/ha)	Not supported (food chain)	Not supported (food chain)	286 g ac/ha (14 g ac/100 L)
	Banana butt treatments	2× 1,800 g ac/ha (0.6 g ac/plant, 3,000 plants/ha) 14d interval	Not supported	Not supported	17 g ac/ha (0.006 g ac/plant)
Vegetable crops	Cauliflower, broccoli	4× 560 g ac/ha 10d interval	Not supported	Not supported	8.8 g ac/ha
	Onions, garlic	3× 560 g ac/ha 10d interval	Not supported	Not supported	30 g ac/ha

Maximum seasonal supported rate considers both dietary exposure scenario (see Appendix B) and food chain assessment scenario (exposure rates over 10 ha from Table 60 in Appendix C were compared to maximum acceptable of 143 g ac/ha).

Table 33: Food chain assessment in terrestrial vertebrates (maximum acceptable threshold)

Exposure	Indicator species	Group	Shortcut	PEC _{medium} (mg/kg or mg/L)	DDD (mg/kg/d)	RAL (mg/kg/d)	RQ
Chronic	Earthworm-eating species	Mammals	1.28	0.19	0.65	0.65	1.0
		Birds	1.05	0.19	0.53	1.2	0.44

Exposure	Indicator species	Group	Shortcut	PEC _{medium} (mg/kg or mg/L)	DDD (mg/kg/d)	RAL (mg/kg/d)	RQ
	Fish-eating species	Mammals	0.142	0.0024	0.17	0.65	0.26
		Birds	0.159	0.0024	0.19	1.2	0.16

Shortcut value from EFSA (2009)

PEC_{medium} is:

PEC_{soil} = predicted environmental concentration in soil (mg/kg) = 143 g ac/ha (maximum acceptable seasonal rate to achieve RQ 1.0) / 750

PEC_{water} = aquatic RAL (from Table 31)

PEC_{food} = PEC_{medium} * BCF, where:

BCF_{earthworm} is 2.7 based on $[0.84 + 0.012 * 10^{\log \text{Pow } 3.3}] / K_d$ 9.3 (for 2% OC; from Table 30)

BCF_{fish} is 500 (Fackler 1988)

DDD = daily dietary dose (mg/kg bw/d) = shortcut value * PEC_{food}

RAL = regulatory acceptable level (from Table 31)

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

Aquatic species

The RAL for assessment of the risks to aquatic species is 0.15 µg ac/L. Risks of spray drift are assessed separately, as needed.

The runoff assessments are presented in Appendix D. Runoff risks to aquatic species were determined to be acceptable with restraints required in the food crops. The summary of results is reported in Table 34.

Table 34: Summary of runoff risk assessment outcomes

Category	Situation	Application rate and frequency	Runoff assessment outcome
Control of Argentine ants	Lawns (grid pattern)	1× 4,800 g ac/ha	Acceptable risk ²
	Pasture	1× 4,800 g ac/ha	Not assessed ³
Ornamentals	Soil drench in potted ornamentals	1× 3,200 g ac/ha (1.6 g ac/10 L, 2L/m ²)	Acceptable risk
	Pre-plant dip of nursery plants	1× 240 g ac/ha (48 g ac/100 L, 10,000 plants/ha)	Acceptable risk
Tropical fruit	Control of mealy bug in pineapples	3× 2,400 g ac/ha 14d interval	Restrictions required: DO NOT apply in Fitzroy, Mary/Burnett or SE Queensland DO NOT apply in Wet Tropics from May to January
	Control of pineapple scale in pineapples	3× 1,560 g ac/ha 14d interval	Restrictions required: DO NOT apply in Fitzroy, Mary/Burnett or SE Queensland DO NOT apply in Wet Tropics from June to January
	Pre-plant dip of pineapples	1× 520 g ac/ha (52 g ac/100 L, 40,000 plants/ha)	Restrictions required: DO NOT plant treated material in Wet Tropics from October to December DO NOT plant treated material in Mary/Burnett from April to January DO NOT plant treated material in SE Queensland from August to May
	Banana butt treatments	2× 1,800 g ac/ha 14d interval	Restrictions required: DO NOT apply in Mackay/Whitsunday, Fitzroy, Mary/Burnett, or SE Queensland

² Control of Argentine ants in lawns is only registered for use in Western Australia. Acceptable runoff risks have also been determined in NSW, ACT and South Australia; higher tier assessments would be necessary for other regions.

³ Broadcast application to control Argentine ants was not supported by the terrestrial vertebrate or residues assessments and therefore was not considered further.

Category	Situation	Application rate and frequency	Runoff assessment outcome
			DO NOT apply in Wet Tropics from July to January DO NOT apply in Burdekin from July to December DO NOT apply in northern NSW from September to January
Vegetable crops	Cauliflower, broccoli	4× 560 g ac/ha 10d interval	Restrictions required: DO NOT apply in Mackay/Whitsunday, Mary/Burnett or SE Queensland
	Onions, garlic	3× 560 g ac/ha 10d interval	DO NOT apply in Victoria or South Australia from Autumn to summer DO NOT apply in Wet Tropics from August to December DO NOT apply in Burdekin from July to November DO NOT apply in Fitzroy from July to September

Bees

Diazinon is not systemic, and exposure of bees is expected to be negligible for space/surface sprays, mosquito larvae control, soil drenches, and pre-plant dips. Therefore, risks to bees are acceptable for these use patterns. The following protection labelling is appropriate for outdoor surface sprays.

Toxic to bees. However, the use of this product as directed is not expected to have adverse effects on bees.

Where exposure of bees foraging in treated areas is possible, risks to bees are assessed using a tiered approach. A screening level risk assessment assumes the worst-case scenario of a direct overspray of blooming plants that are frequented by bees in order to identify those substances and associated uses that do not pose a risk. Acceptable risks to foraging bees cannot be concluded at the lowest rate of 560 g ac/ha. Foliar residues at 1,170 g ac/ha are acceptable after 7 days of aging. Therefore, the following protection statement is advised for labels with maximum rates ≤1,170 g ac/ha (onion, garlic, cauliflower, broccoli).

Highly toxic to bees. DO NOT apply to crops from the onset of flowering until flowering is complete. DO NOT allow spray drift to flowering weeds or flowering crops in the vicinity of the treatment area. Before spraying, notify beekeepers to move hives to a safe location with an untreated source of nectar and pollen, if there is potential for managed hives to be affected by the spray or spray drift. Residues may remain at levels toxic to bees for 7 days following application.

The following protection statement is advised if label rates exceed 1,170 g ac/ha (such as for Argentine ant control in pasture and turf and pineapples).

Highly toxic to bees. DO NOT apply to crops from the onset of flowering until flowering is complete.
DO NOT allow spray drift to flowering weeds or flowering crops in the vicinity of the treatment area.
Before spraying, notify beekeepers to move hives to a safe location with an untreated source of nectar and pollen if there is potential for managed hives to be affected by the spray or spray drift.

The RAL for the spray drift assessment is 22 g ac/ha for the protection of pollinator areas. Risks of spray drift are assessed separately, as needed.

Table 35: Screening level assessment of risks to bees

Life stage	Exposure	Rate (g/ha)	Predicted total dose (µg/bee)	RAL (µg/bee)	RQ
Highest single rate					
Adults	Acute contact	4,800	12	0.052	99
	Acute oral	4,800	137	0.036	3 122
Larvae	Acute oral	4,800	58	0.000048	1 211 280
Lowest single rate					
Adults	Acute contact	560	1.3	0.052	12
	Acute oral	560	16	0.036	364
Larvae	Acute oral	560	6.8	0.000048	14 316

Highest single rate is 4,800 g ac/ha for control of Argentine ants in pasture and lawns

Lowest single rate is 560 g ac/ha in onions, garlic, cauliflower and broccoli

Predicted total dose calculated using USEPA BeeREX tool for adult worker bee foraging for nectar and larval drone within the hive

RAL = regulatory acceptable level (from Table 31)

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

Other arthropod species

Exposure of non-target arthropod populations is expected to be negligible for space/surface sprays and mosquito larvae control. Therefore, risks to other non-target arthropods are acceptable for these use patterns, and no protection statements are required.

Arthropods are often utilised in integrated pest management programs in ornamentals/nurseries and various horticultural crops. Natural enemies can also be exposed to outdoor sprays or residues from dipped plants that are planted outdoors. The risk assessment assumes that non-target arthropods are exposed to fresh-dried residues within the treatment area immediately after the last application (or planting out). Acceptable risks to beneficial arthropods cannot be concluded at the lowest rate of 240 g ac/ha (planting out of dipped nursery plants). The

available aged residue tests are not sufficient to advise on an acceptable aging period for soil-dwelling arthropods. Therefore, the following protection statement is advised for potted ornamentals, pre-plant dips, Argentine ant control in pastures and lawns, and horticultural crops.

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

Table 36: Assessment of risks to other non-target arthropods

Group	Exposure	Rate (g/ha)	RAL (g/ha)	RQ
Highest single spray rate				
Predatory arthropods	Contact	4,800	1,622	3.0
Parasitic arthropods (foliar)	Contact	4,800	42	114
Parasitic arthropods (soil)	Contact	4,800	184	26
Lowest single spray rate				
Predatory arthropods	Contact	560	1,622	0.35
Parasitic arthropods (foliar)	Contact	560	42	13
Parasitic arthropods (soil)	Contact	560	184	3.0
Lowest planting out rate				
Parasitic arthropods (soil)	Contact	240	184	1.3

Highest single spray rate is 4,800 g ac/ha for control of Argentine ants in pasture and lawns

Lowest single spray rate is 560 g ac/ha in onions, garlic, cauliflower and broccoli

Lowest planting out rate is 240 g ac/ha for pre-plant dip of nursery plants

RAL = regulatory acceptable level (from Table 31)

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

Soil organisms

Risks to soil organisms are assessed using a tiered approach. A screening level risk assessment assumes the worst-case scenario of a direct overspray of soil without interception in order to identify substances and associated uses that do not pose a risk to soil organisms. Acceptable risks of diazinon to soil organisms could be concluded for broadcast rates up to 4,800 g ac/ha. Therefore, no protection statements are required for soil organisms on diazinon product labels.

Table 37: Screening level assessment of risks to soil organisms

Group	Exposure	Rate (g/ha)	PEC (mg/kg dry soil)	RAL (mg/kg dry soil)	RQ
Macro-organisms	Acute	4,800	6.4	6.5	0.98
	Chronic	4,800	6.4	27	0.24
Micro-organisms	Chronic	4,800	6.4	80	0.08

Assessed rate based on worst-case scenario of 1× 4,800 g ac/ha for Argentine ant control in pasture and lawns

PEC = predicted environmental concentration in top 5-cm soil (mg ac/kg dry soil) = rate (g ac/ha)/750

RAL = regulatory acceptable level (from Table 31)

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

Terrestrial plants

The RAL for the spray drift assessment is 1,100 g ac/ha for the protection of vegetation areas. Risks of spray drift are assessed separately, as needed.

Recommendations

Uses supported from the viewpoint of environmental safety are listed in Table 38 with the required protection statements and restraints. Uses that are not supported from the viewpoint of environmental safety are listed in Table 39.

Table 38: Supported uses from the viewpoint of environmental safety

Situations	Protection statements and restraints
All situations	Very toxic to aquatic life. DO NOT contaminate wetlands or watercourses with this product or used containers.
Ear tags	(No additional protection statements or restraints are required).
Lice, fly or mange sprays and backrubbers	
Wound dressings	
Off-shears sheep lice treatment	
Mushrooms	
Indoor space and surface sprays (domestic, commercial, industrial, ships, skins/hides)	
Indoor space and surface sprays (farm buildings, animal sheds)	Toxic to birds. Remove birds from fowl houses before spraying. Avoid spraying drinking water and feed troughs.
Outdoor space and surface sprays (refuse areas, garbage containers, ant trails and nests)	DO NOT treat outdoor areas if rain is expected within 24 hours. DO NOT spray outdoor refuse areas or containers to the point of runoff. Highly toxic to bees. However, the use of this product as directed is not expected to have adverse effects on bees.
Control of mosquito larvae in temporary water pools	DO NOT use on permanent water bodies for control of mosquito larvae.
Pre-plant dip of nursery plants	DO NOT plant treated material if heavy rains or storms are forecast within 3 days. Toxic to birds. However, the use of this product as directed is not expected to have adverse effects on birds. Dispose of dip in an authorised dip disposal facility. If an authorised dip disposal facility is not available, dispose of dip in compliance with the relevant local, state or territory government regulations.

Table 39: Uses not supported from the viewpoint of environmental safety

Situation	Basis
Control of mosquito larvae in permanent water bodies	Unacceptable risk to non-target aquatic species
Pineapple (sprays, pre-plant dip)	Unacceptable risk to terrestrial vertebrates
Banana butt treatments	
Onions and garlic	
Cauliflower and broccoli	
Argentine ant control in lawns & pasture	

Spray drift assessment

Regulatory acceptable levels for sensitive areas

Although regulatory acceptable levels for sensitive areas identified in the [APVMA's spray drift policy](#) have been determined, all uses that are proposed to be supported at the conclusion of this reconsideration are exempt from spray drift assessment. Accordingly, no buffer zone calculations have been completed.



Appendix

Appendix A – Summary of assessment outcomes

Table 40: Diazinon uses and amended label statements that are supported by all risk assessments

800 g/L products
<p>Statement of claims:</p> <p>THIS PRODUCT IS TOO HAZARDOUS FOR USE BY HOUSEHOLDERS</p>
<p>Restrictions:</p> <p>DO NOT use in areas accessible to children</p> <p>DO NOT spray water or feed troughs</p> <p>DO NOT treat farm buildings and animal sheds by fog or spray in the presence of animals. Wait until chemical clears after treatment, then thoroughly ventilate treated area, before allowing re-entry of animals.</p> <p>DO NOT treat outdoor areas if rain is expected within 24 hours</p> <p>DO NOT plant treated material if heavy rains or storms are forecast within 3 days</p>
<p>Disposal Statements:</p> <p>Dispose of dip in an authorised dip disposal facility. If an authorised dip disposal facility is not available, dispose of dip in compliance with the relevant local, state or territory government regulations.</p>
<p>Environmental protection statement:</p> <p>Very toxic to aquatic life. DO NOT contaminate wetlands or watercourses with this product or used containers.</p> <p>Highly toxic to bees. However, the use of this product as directed is not expected to have adverse effects on bees.</p>
<p>Safety Directions:</p> <p>Product is poisonous if absorbed by skin contact or swallowed. Repeated minor exposure may have a cumulative poisoning effect. Will irritate the eyes and skin. Avoid contact with eyes and skin. DO not inhale spray mist. When preparing the spray and using the prepared spray, wear cotton overalls buttoned to the neck and wrist and a washable hat, elbow length chemical resistant gloves and face shield or goggles. If product on skin, immediately wash area with soap and water. After use and before eating drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash gloves, face shield or goggles and contaminated clothing.</p>

Crop/host	Pest	Active constituent (ac) Rate	Amended instructions for use
Indoor and outdoor space and surface sprays (Commercial and industrial buildings, ships, farm buildings including kennels, stables and piggeries, refuse areas garbage containers)	Cockroaches, silverfish	4.8-15 g ac/L water	Apply to crevices, cracks and hiding places, eg beneath cupboards, behind sinks and stoves.
	Carpet beetles		Apply to floors and under carpets
	Fleas		Areas generally infested with fleas should be sprayed
	Flies		Apply to surfaces on which insects congregate, eg ceilings, under eaves, walls
	Spiders		Remove existing webbing and saturate area with the mixture.
	Ants		Apply to ant trails. Attempt to locate nests and thoroughly saturate surface. Use at least 1 litre of mixture per 10 square meters.
Refuse areas, garbage containers	Maggots	48 g ac/100L water	Apply to thoroughly penetrate the refuse.
Temporary water pools (puddles)	Mosquitos	100 g ac/100 L water	Apply to breeding areas
Skins & hides	Skin & hide beetles	4.8 g ac/L water	Apply 60 mL of mixture per hide individually, and spray area with 5 litres of mixture per 100 square meters.
Pre-plant dip of nursery plants	Aphids, thrips, mealy bugs, scale insects, plant bugs, beetles	48 g ac/100 L water	Dipping mixture: Thoroughly drench plant material with the dipping mixture. Treatment can be used for plants being moved from NSW into Victoria

200 g/L products

Statement of claims:

THIS PRODUCT IS TOO HAZARDOUS FOR USE BY HOUSEHOLDERS

Restraint:

DO NOT use on horses that may be used for human consumption

DO NOT use in areas accessible to children

Environmental protection statement:

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

Safety Directions

Poisonous if swallowed. Repeated minor exposure may have a cumulative poisoning effect. Will irritate the eyes and skin. Avoid contact with eyes and skin. Do not inhale vapour or spray mist. When opening the container and preparing spray, wear cotton overalls buttoned to the neck and wrist or equivalent clothing and a washable hat, and elbow-length chemical resistant gloves. When using the prepared spray, wear protective waterproof clothing, cotton overalls buttoned to the neck and wrist or equivalent clothing and a washable hat, elbow-length chemical resistant gloves and a half-face piece respirator. If clothing becomes contaminated with product, remove clothing immediately. If product on skin, immediately wash area with soap and water. After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. After each day's use, wash gloves, respirator and if rubber wash with detergent and warm water, and contaminated clothing.

Crop/host	Pest	Active constituent (ac) Rate	Amended instructions for use
Horses	Flies (<i>Musca vetustissima</i>) and Lice (<i>Damalinia equi</i> ; <i>Haematopinus asini</i>)	0.5 g ac/L of water	Instructions for use: Apply spray by mechanically pressurised hand wand only. Spray liberally as required.
Animal Sheds	Flies (<i>Musca domestica</i> ; <i>Stomoxys calcitrans</i>)	5 g ac/L	Instructions for use: Apply spray by mechanically pressurised hand wand only. Spray the inner walls thoroughly and any other places where flies settle. Respray as necessary.

Table 41: Diazinon uses that are not supported due to safety, residues or trade concerns

Crop/host	Pest	Application method	Assessment outcome
Veterinary Uses			
Cattle	Buffalo fly, cattle lice	Ear tag, back rubber, rubbing post, high and low volume spray	Not supported: residues, trade
Sheep	Sheep body louse, Sheep blowfly strike, wound dressing after mulesing marking and dehorning	Hand spray, swab, brush, jetting, strike dressing	Not supported: residues, trade
Goats	Lice, Wound dressing	Hand dusting, hand spray	Not supported: residues, trade
Pigs	Lice, mange	Hand spray, High volume hand spray	Not supported: residues, trade
Agriculture uses			
Apple	San Jose Scale, Woolly Aphid, Greedy Scale	Vertical Sprayer	Not supported: residues, trade
Bananas	Banana beetle borer, Banana rust thrip	Butt spray (spray base of plant) Vertical Sprayer	Not supported: residues, trade
Beans	Seed maggot, Blossom thrips, Bean fly, Bean caterpillar, Blossom thrips	Boom Sprayer, Knapsack Sprayer	Not supported: residues, trade
Beetroot, Silverbeet, Globe Artichoke	Webworm	Boom Sprayer	Not supported: residues, trade
Blueberries	Scale insects	Spot Sprayer / High volume spray	Not supported: residues, trade
Brussels sprouts, Broccoli, Cabbage, Cauliflower, Kale, Kohlrabi	Cabbage white butterfly, Centre Grub, Cluster caterpillar, Aphids, Looper	Boom Sprayer, Spot spray / high volume spray, Knapsack	Not supported: residues, trade

Crop/host	Pest	Application method	Assessment outcome
Capsicum, eggplant	Cutworms	Boom Sprayer	Not supported: residues, trade
Cereal crops, Pastures	Armyworm, Cutworm	Boom Sprayer	Not supported: residues, trade
Chou Moellier, Canola, Turnips	Cabbage moth, Cabbage white butterfly	Boom spray, Mister	Not supported: residues, trade
Citrus	Spined citrus bug, Citrus leaf miner, Grasshoppers	Vertical Sprayer	Not supported: residues, trade
Commercial and industrial buildings, ships, farm buildings including kennels, stables and piggeries, refuse areas, garbage areas	Cockroaches, silverfish, carpet beetles, bed bugs	Swingfog	Not supported: Chemistry
Cotton	Cotton flea beetle, Red shouldered beetle	Boom spray, Mister	Not supported: residues, trade
Cucurbits	Thrips	Knapsack, Boom Sprayer, Spot spray / high volume spray	Not supported: residues, trade
Grapevines	Mealy bug, Australian plague locust	Vertical Sprayer	Not supported: residues, trade
Hops	Common and Southern armyworm	Vertical Sprayer	Not supported: residues, trade
Kiwifruit	Leatania scale, Greedy scale, Leafroller Caterpillar, Cluster caterpillar	Vertical Sprayer	Not supported: residues, trade

Crop/host	Pest	Application method	Assessment outcome
Lucerne	Lucerne jassid, Spotted alfalfa aphid	Mister, Boom sprayer	Not supported: residues, trade
Macadamia nuts	Macadamia felted coccid, Macadamia leaf miner	Vertical Sprayer	Not supported: residues, trade
Mushrooms	Mushroom pests	Spray, Compost integration	Not supported: residues, trade
Onions, garlic	Onion seedling maggot, Onion maggot, onion thrips, wireworm	Spot spray / high volume spray, boom Sprayer	Not supported: environment, residues and trade
Ornamental potted plants	Fungus gnats	Soil drench	Not supported: environment
Pastures	Pasture webworm	Boom spray, Mister	
Pastures, cereals (including maize, sorghum), Oilseed crops (inc Cotton), Soybeans, Sugarcane	Australian plague locust, Spur-throated locust, migratory locusts	Boom spray, Mister	Not supported: residues, trade
Pastures, Lawns, around trees	Argentine ants	Boom spray, Mister	Not supported: environment
Pears	San Jose Scale	Vertical Sprayer	Not supported: residues, trade
Pineapples	Pineapple scale, Mealy bugs	High volume spray, Boom sprayer, Dip	Not supported: environment, residues and trade
Potatoes	Potato moth	Boom Sprayer	Not supported: residues, trade
Rice	Brown Plant Hopper, Bloodworm	Boom spray, Mister	Not supported: residues, trade
Sorghum	Sorghum midge	Boom spray, Mister	Not supported: residues, trade

Crop/host	Pest	Application method	Assessment outcome
Sorghum, Pastures	Grasshoppers	Boom spray, Mister	Not supported: residues, trade
Stone fruit	San Jose scale, Green peach aphid, Black cherry aphid	Vertical Sprayer	Not supported: residues, trade
Sundry vegetables including: cantaloupes, carrots, celery, chokos, cucumbers, gherkins, lettuce, marrows, pumpkins, parsnips, peas, squash, watermelons, rhubarb, sweetcorn	Caterpillars, cutworms	Boom Sprayer	Not supported: residues, trade
Tomatoes	Thrips, Wireworms, Cutworms	Knapsack sprayer, Boom Sprayer, Spot spray / high volume spray	Not supported: residues, trade

Appendix B – Listing of environmental endpoints

Table 42: Physical and chemical properties

Substance	Study	Result	Reference
Diazinon	Vapour pressure	12 mPa at 25°C	Rordorf 1988
	Henry's law constant	0.061 Pa m ³ mol ⁻¹	Anon 1993
	Solubility in water	60 mg/L at 22°C	Jäkel 1987a
	Partition coefficient	log P _{ow} 3.3	Carpenter 1985
	Dissociation constant	pKa 2.6	Jäkel 1987b
	UV-VIS absorption (max)	246 nm, 4050 L mol ⁻¹ cm ⁻¹	Comb 2002
		290 nm, 21 L mol ⁻¹ cm ⁻¹	Klöpffer 1991

Table 43: Dissipation in animal food items

Substance	Matrix	Result	Reference
Diazinon	Leaves	Spring onion: DT ₅₀ 1.0 d	Ettiene <i>et al.</i> 2006
		Chinese cabbage: DT ₅₀ 1.4 d	Khay <i>et al.</i> 2006
		Chinese broccoli: DT ₅₀ 2.3 d	Ripley <i>et al.</i> 2003
		Kentucky bluegrass: DT ₅₀ 6.1 d	Kuhr & Tashiro 1978
		Kentucky bluegrass: DT ₅₀ 3.3 d	Sears <i>et al.</i> 1987
		Annual bluegrass: DT ₅₀ 2.6 d	Sears & Chapman 1979
		Turfgrass: DT ₅₀ 3.1 d	Lemmon & Pylypiw 1992
		Alfalfa: DT ₅₀ 1.8 d	Talebi 2006
		Cotton: DT ₅₀ 1.9 d	Willis & McDowell 1987
		Endive: DT ₅₀ 2.2 d	
		Kale: DT ₅₀ 5.3 d	
		Maize: DT ₅₀ 1.1 d	
		Wheat: DT ₅₀ 5.0 d	

Substance	Matrix	Result	Reference
Geomean DT ₅₀ 2.3 d			
	Fruit	Olive: DT ₅₀ 9.6 d	Cabras <i>et al.</i> 1997
		Peach:DT ₅₀ 5.2 d	Minelli <i>et al.</i> 1996
		Tomato: DT ₅₀ 1.1 d	Prieto <i>et al.</i> 2002
		Tomato: DT ₅₀ 0.80 d	Lindquist <i>et al.</i> 1973
		Geomean DT ₅₀ 2.6 d	

Table 44: Fate and behaviour in soil

Substance	Study	Result							Reference
Diazinon	Soil photolysis	DT ₅₀ 1.6 d (natural sunlight), DT ₅₀ 39 d (dark control) 26-34% bound residues after 1.5 d Max 22% oxypyrimidine							Blair 1985
		DT ₅₀ 2.5 d under natural sunlight at 39°N Max 64% oxypyrimidine							Spare 1988c
Diazinon	Aerobic laboratory soil	Silt loam	DT ₅₀ 8.4 d					Seyfried 1994	
		Sandy loam	DT ₅₀ 8.9 d					Haynes 2004	
		Loamy sand	DT ₅₀ 24 d						
		Clay loam	DT ₅₀ 9.7 d						
		Geomean DT ₅₀ 11 d							
		9.0-86% mineralisation after 84-119d 5.4-19% bound residues after 84-119d Max 82% oxypyrimidine							
	Anaerobic laboratory soil	Sandy loam DT ₅₀ 24 d 0.2% mineralisation, 25% bound residues after 59d Max 66% oxypyrimidine							Caldwell 2002
	Adsorption/ desorption	<u>Soil</u>	<u>%OC</u>	<u>Kd</u>	<u>Koc</u>	<u>Kf</u>	<u>Kfoc</u>	<u>1/n</u>	
		Sand	0.2	1.0	651	1.5	752	0.82	Sparrow 2000
		Loam	0.6	3.9	657	4.1	688	0.77	
		Sandy loam	0.8	3.1	391	3.3	411		
			0.85						

Substance	Study	Result	Reference
		Silty clay 1.0 7.7 772 7.4 737 0.85	
		San Diego Creek 1.05 3.5 334 Bonita Creek 0.72 1.0 138	Bondarenko & Gan 2004
		Sandy loam 0.01 0.91	Iglesias-Jiménez <i>et al.</i> 1996
		Clay 0.68	Nemeth-Konda <i>et al.</i> 2002
		Silty clay 0.48 18 3779 20 4204 1.05	Arienzo <i>et al.</i> 1994
		Clay 0.64 4.6 725 4.8 755 1.02	
		Clay 0.90 5.6 618 7.2 793 1.13	
		Clay 0.33 4.4 1348 5.4 1614 1.06	
		Sandy clay loam 1.26 4.9 389 6.2 498 1.13	
		Sandy clay loam 0.32 1.7 519 1.6 494 0.97	
		Sandy clay loam 0.27 0.84 311 0.70 256 0.92	
		Sandy clay loam 0.54 2.6 476 2.7 507 1.03	
		Sandy clay 0.33 1.8 530 1.5 441 0.92	
		Sandy clay loam 0.09 2.6 2856 1.6 1812 0.80	
		Sandy loam 0.76 3.4 449 4.1 548 1.1	
		Sandy loam 0.13 3.2 2431 2.6 2017 0.91	
		Sandy loam 0.42 1.5 367 1.8 428 1.07	
		Clay 1.17 3.6 306 4.2 359 1.08	
		Clay 1.51 4.5 297 5.1 338 1.06	
		Sandy clay loam 1.10 4.2 386 6.6 598 1.26	
		Sandy clay loam 0.88 4.2 476 5.1 583 1.11	
		Sandy clay loam 0.30 2.5 840 2.4 810 0.99	
		Sand 0.40 2.0 500 1.8 436 0.94	
		Sandy loam 0.45 1.4 302 0.93 208 0.85	
		Sandy loam 5.93 20 333 23 383 1.07	
		Sandy loam 5.17 18 357 26 497 1.18	
		Loamy sand 3.46 13 365 20 571 1.27	
		Loamy sand 2.71 6.8 254 9.4 348 1.17	
		Sandy loam 2.00 8.9 445 9.8 492 1.05	

Substance	Study	Result	Reference																																		
Diazinon		Mean Koc 824 L/kg, Kfoc 818 L/kg, 1/n 1.0																																			
		Predicted Kd 4.7 L/kg at 1% OC Predicted Kd 9.3 L/kg at 2% OC Predicted Kd 23 L/kg at 5% OC																																			
	Column leaching	4 soil types, 200 mm elution: <0.5% diazinon in leachate	Guth 1978																																		
		4 soil types, 0.62-59% AR retained in top 2.5 cm 6.0-81% AR in leachate: 0.12-2.8% diazinon 5.3-72% oxyprimidine	Spare 1987																																		
	Aged residues leaching	4 soil types aged for 30 days, 508 mm elution: 5.8-16% AR retained in top 6 cm 45-56% AR in leachate: 1.2-2.2% diazinon 42-51% oxypyrimidine	Shepler 1993																																		
		2 soil types aged for 30 days, 572 mm elution: 4.0-33% AR in leachate: 1.3-9.8% oxypyrimidine 1.5-15% 2-ethyl-4-methyl 6-hydroxypyrimidine	Burkhard 1979b, 1980																																		
	Lysimeter studies	3-year study in Germany on sand soil cultivated with sugar beet, winter wheat and in the last year with summer rape and winter barley; 4x 240 g ac/ha/yr with ~70% crop interception: <table><tr><td></td><td>Yr 1</td><td>Yr 2</td><td>Yr 3</td><td></td></tr><tr><td>Precipitation</td><td>446</td><td>511</td><td>597</td><td>mm</td></tr><tr><td>Irrigation</td><td>476</td><td>371</td><td>226</td><td>mm</td></tr><tr><td>Leachate</td><td>219</td><td>197</td><td>275</td><td>L</td></tr><tr><td> Diazinon</td><td>nd</td><td>0.07</td><td>nd</td><td>µg/L</td></tr><tr><td> Oxypyrimidine</td><td></td><td>1.02</td><td>0.36</td><td>0.01 µg/L</td></tr><tr><td> GS-31144</td><td>0.27</td><td>0.26</td><td>0.07</td><td>µg/L</td></tr></table>		Yr 1	Yr 2	Yr 3		Precipitation	446	511	597	mm	Irrigation	476	371	226	mm	Leachate	219	197	275	L	Diazinon	nd	0.07	nd	µg/L	Oxypyrimidine		1.02	0.36	0.01 µg/L	GS-31144	0.27	0.26	0.07	µg/L
	Yr 1	Yr 2	Yr 3																																		
Precipitation	446	511	597	mm																																	
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Oxypyrimidine		1.02	0.36	0.01 µg/L																																	
GS-31144	0.27	0.26	0.07	µg/L																																	
Field soil dissipation	Florida:	DT ₅₀ 8.2 d	Guy 1990a																																		
	New York:	DT ₅₀ 5.3 d	Bird 1990a																																		

Substance	Study	Result		Reference
		Illinois:	DT ₅₀ 6.0 d	Rice <i>et al.</i> 1990a
		California:	DT ₅₀ 7.0 d	Jacobson & Gresham 1989a
		California:	DT ₅₀ 20 d	Kimmel <i>et al.</i> 1989a
		California:	DT ₅₀ 6.0 d	Walker 1990
		Germany:	DT ₅₀ 27 d	Offizorz 1990a
		Germany:	DT ₅₀ 4.0 d	Offizorz 1990b
		Germany:	DT ₅₀ 9.0 d	Offizorz 1992a
		Germany:	DT ₅₀ 16 d	Offizorz 1992b
		Florida:	DT ₅₀ 5.5 d	Guy 1989
		New York:	DT ₅₀ 17 d	Bird 1990b
		California:	DT ₅₀ 10 d	Guy 1990b
		Illinois:	DT ₅₀ 5.0 d	Rice <i>et al.</i> 1990b
		California:	DT ₅₀ 9.0 d	Jacobson & Gresham 1989b
		California:	DT ₅₀ 7.0 d	Kimmel <i>et al.</i> 1989b
		Geomean DT ₅₀ 8.7 d		
	Sheep dip dissipation	NSW:	DT ₅₀ 8.7 d DT ₅₀ 8.8 d	Levot <i>et al.</i> 2004
Oxypyrimidine	Aerobic laboratory soil	Silt loam	DT ₅₀ 20 d	Seyfried 1994
		Sandy loam	DT ₅₀ 124 d	Haynes 2002
		Loamy sand	DT ₅₀ 131 d	
		Clay loam	DT ₅₀ 124 d	
		Geomean DT ₅₀ 80 d		

Table 45: Fate and behaviour in water and sediment

Substance	Study	Result	Reference
Diazinon	Hydrolysis	pH 5, 25°C: DT ₅₀ 12 d pH 7, 25°C: DT ₅₀ 138 d pH 9, 25°C: DT ₅₀ 77 d	Matt 1988
		pH 5, 20°C: DT ₅₀ 3.8 d pH 7, 20°C: DT ₅₀ 78 d pH 9, 20°C: DT ₅₀ 40 d	Burkhard 1979a
	Aqueous photolysis	DT ₅₀ >2000 d in April in central Europe	Klöppfer 1991
		DT ₅₀ 20 d (artificial light) at 39°N at pH 7	Spare 1988a
		DT ₅₀ 49 d (natural sunlight) at 39°N at pH 7	Spare 1988b
	Ready biodegradability	Not readily biodegradable	Bader 1990b
	Degradation in water/sediment	UK pond water DT ₅₀ 4.7 d UK lake water DT ₅₀ 3.9 d Geomean DT ₅₀ 4.3 d	Corden 2004
		UK pond sediment DT ₅₀ 12 d UK lake sediment DT ₅₀ 15 d Geomean DT ₅₀ 13 d	
		UK pond system DT ₅₀ 9.9 d UK lake system DT ₅₀ 16 d Geomean DT ₅₀ 10 d	
		Max 42% diazinon in sediment 4.7-5.1% mineralisation, 23-49% bound residues after 100d Max 70% oxypyrimidine (47% in water, 23% in sediment)	
Oxypyrimidine	Degradation in water/sediment	UK pond water DT ₅₀ 87 d UK pond sediment DT ₅₀ 49 d UK pond system DT ₅₀ 65 d	Corden 2004

Table 46: Fate and behaviour in air

Substance	Study	Result	Reference
Diazinon	Photochemical oxidative degradation	DT ₅₀ 1.3 h (12h-day, 1.5×10^6 OH/cm ³)	Comb 2002

Substance	Study	Result	Reference
	Volatilisation	10% after 24h from soil (sand) 3.0% after 24h from soil (silty loam)	Burkhard 1977
		24% after 24h from plant and soil	Sandmeier 1992

Table 47: Monitoring data

Substance	Medium	Result	Reference
Diazinon	Surface water	Max 1.5 µg/L in streams of two urban areas in Northern California during the precipitation season (Oct-May)	Bailey <i>et al.</i> 2000
		Max 53 µg/L in pond water of three sites in Pennsylvania, USA after 6x 3.36 kg/ha to apple orchards	Biever 1990a, 1990b, 1990c
		Max 0.13 µg/L in surface water drains from farms in the irrigation areas of NSW	Bowmer <i>et al.</i> 1998
		Max 1.4 µg/L in 8 out of 57 surface water samples near golf courses in the USA	Cohen <i>et al.</i> 1999
		Max 1.4 µg/L in urban streams in the US	Hoffman <i>et al.</i> 2000
		Max 0.51 µg/L in farm ditches in Lower Fraser River Valley of British Columbia (Jul-Dec)	Wan <i>et al.</i> 1994
	Sediment	18 µg/kg in 1 out of 151 samples in Onkaparinga River of Adelaide and Mt Lofty Ranges, South Australia	Jenkins 2013
	Biota	Mean 2.2 µg/g in GI of 12 Canada geese Mean 1.8 µg/g in GI of 4 killdeer nestlings Mean 1.6 µg/g in GI of 5 American robins Mean 0.31 µg/g in GI of 4 Western meadowlark Mean 0.21 µg/g in GI of 3 European starling nestlings after 6x 3.0-3.1 kg/ha to orchards in Pennsylvania and Washington	Cobb <i>et al.</i> 2000

Table 48: Laboratory studies on terrestrial vertebrates

Substance	Group	Exposure	Species	Toxicity value	Reference
Diazinon	Mammals	Acute	<i>Rattus norvegicus</i>	LD ₅₀ 1,129 mg ac/kg bw	Dreher 1997
		Chronic	<i>Rattus norvegicus</i>	NOEL 0.65 mg ac/kg bw/d	Giknis 1989

Substance	Group	Exposure	Species	Toxicity value	Reference
	Birds	Acute	<i>Colinus virginianus</i>	LD ₅₀ 5.4 mg ac/kg bw	Fink 1976
				LD ₅₀ 15 mg ac/kg bw	Hill <i>et al.</i> 1984
				Geomean LD ₅₀ 9.0 mg ac/kg bw	
			<i>Anas platyrhynchos</i>	LD ₅₀ 1.4 mg ac/kg bw	Fletcher & Pedersen 1988a
			<i>Molothrus ater</i>	LD ₅₀ 85 mg ac/kg bw	Fletcher & Pedersen 1988b
			<i>Agelaius phoeniceus</i> <i>Sturnus vulgaris</i>	LD ₅₀ 2.4 mg ac/kg bw LD ₅₀ 13 mg ac/kg bw	Wolfe & Kendall 1998
	Dietary		<i>Anas platyrhynchos</i>	LC ₅₀ 32 mg ac/kg diet (8.0 mg ac/kg bw/d)	Fletcher & Pedersen 1988c
			<i>Molothrus ater</i>	LC ₅₀ 38 mg ac/kg diet	Fletcher & Pedersen 1988d
	Chronic		<i>Colinus virginianus</i>	NOEC 32 mg ac/kg diet	Marselas 1989a
			<i>Anas platyrhynchos</i>	NOEC 8.3 mg ac/kg diet (1.2 mg ac/kg bw/d)	Marselas 1989b

Table 49: Field studies on terrestrial vertebrates

Test substance	Crop	Exposure	Effect	Reference
EC 480 g/L	Prairie grassland	560 g ac/ha 4,500 g ac/ha	Behavioural and reproductive effects in various rodent species (prairie vole, fulvous harvest mouse, hispid cotton rat) observed at low rate; no effects on population-relevant endpoints (abundance, recapture ratio) at high rate (including house mouse and eastern harvest mouse)	Sheffield & Lochmiller 2001
CS formulation	Grass pasture	1,110 g ac/ha	No effect on the number of reproducing grey-tailed voles kept in pens or their population growth rate; no effect on mortality of bobwhite quail kept in pens	Wang <i>et al.</i> 2001
GR formulation	Grass pasture	1,110 g ac/ha	No effect on the number of reproducing grey-tailed voles kept in pens or their population growth rate; survival of bobwhite quail kept in pens was adversely affected	Wang <i>et al.</i> 2001

Table 50: Laboratory studies on aquatic species

Substance	Group	Exposure	Species	Toxicity value	Reference
Diazinon	Fish and other vertebrates	Acute	<i>Oncorhynchus mykiss</i>	LC ₅₀ 1.4 mg ac/L	Kurata & Kurosawa 1991
				LC ₅₀ 2.6 mg ac/L	Sachsse 1972e
				LC ₅₀ 3.2 mg ac/L	Sachsse & Ullman 1975
				Geomean LC ₅₀ 2.2 mg ac/L	
			<i>Cyprinus carpio</i>	LC ₅₀ 6.3 mg ac/L	Kurata & Kurosawa 1990a
				LC ₅₀ 5.5 mg ac/L	Yoshida 1974
				Geomean LC ₅₀ 5.9 mg ac/L	
			<i>Pimephales promelas</i>	LC ₅₀ 6.0 mg ac/L	Werner <i>et al.</i> 2002
			<i>Carassius carassius</i>	LC ₅₀ 7.6 mg ac/L	Sachsse 1972e
				LC ₅₀ 23 mg ac/L	Sachsse & Ullman 1975
				Geomean LC ₅₀ 13 mg ac/L	
			<i>Ictalurus punctata</i>	LC ₅₀ 2.7 mg ac/L	Sachsse 1972e
			<i>Poecilia reticulata</i>	LC ₅₀ 4.0 mg ac/L	
			<i>Lepomis macrochirus</i>	LC ₅₀ 16 mg ac/L	
			<i>Anguilla anguilla</i>	LC ₅₀ 0.085 mg ac/L	Sancho <i>et al.</i> 1994
			<i>Rana boylii</i>	LC ₅₀ 1.7 mg ac/L	Kerby 2006
	Invertebrates	Chronic	<i>Pimephales promelas</i>	NOEC 0.092 mg ac/L	Surprenant 1998a
		Acute	<i>Ceriodaphnia dubia</i>	EC ₅₀ 0.41 µg ac/L	LeLievre 1991
				EC ₅₀ 0.44 µg ac/L	Bailey <i>et al.</i> 1996
				EC ₅₀ 0.40 µg ac/L	Bailey <i>et al.</i> 1997
				EC ₅₀ 0.36 µg ac/L	Bailey <i>et al.</i> 2001

Substance	Group	Exposure	Species	Toxicity value	Reference
Diazinon	Invertebrates	Acute		EC ₅₀ 0.45 µg ac/L	Banks <i>et al.</i> 2003
				EC ₅₀ 0.21 µg ac/L	Banks <i>et al.</i> 2005
				EC ₅₀ 0.40 µg ac/L	Werner <i>et al.</i> 2002
				Geomean EC ₅₀ 0.38 µg ac/L*	
			<i>Ceriodaphnia cornuta</i>	EC ₅₀ 0.43 µg ac/L	Hong <i>et al.</i> 2004
			<i>Cyrnus trimaculatus</i>	EC ₅₀ 1.1 µg ac/L	van der Geest <i>et al.</i> 2000a
			<i>Hydropsyche angustipennis</i>	LC ₅₀ 1.3 µg ac/L	Stuijzand <i>et al.</i> 2000
				LC ₅₀ 1.3 µg ac/L	van der Geest <i>et al.</i> 1999
				Geomean EC ₅₀ 1.3 µg ac/L	
			<i>Cheumatopsyche brevilineata</i>	EC ₅₀ 1.8 µg ac/L	Yokoyama <i>et al.</i> 2009
			<i>Procloeon</i> sp.	EC ₅₀ 1.9 µg ac/L	Anderson <i>et al.</i> 2006
			<i>Paratya compressa</i>	LC ₅₀ 2.3 µg ac/L	Shigehisa & Shiraishi 1998
			<i>Daphnia magna</i>	EC ₅₀ 0.96 µg ac/L	Vilkas 1976
				EC ₅₀ 1.7 µg ac/L	Kretschmann <i>et al.</i> 2011
				EC ₅₀ 3.2 µg ac/L	Matsumoto <i>et al.</i> 2009
				EC ₅₀ 6.1 µg ac/L	Jemec <i>et al.</i> 2007
				Geomean EC ₅₀ 2.4 µg ac/L*	
			<i>Simulium vittatum</i>	LC ₅₀ 4.9 µg ac/L	Overmyer <i>et al.</i> 2010
			<i>Hyalella azteca</i>	LC ₅₀ 4.3 µg ac/L	Anderson & Lydy 2002
				LC ₅₀ 6.2 µg ac/L	Ankley & Collyard 1995

Substance	Group	Exposure	Species	Toxicity value	Reference
Geomean LC ₅₀ 5.2 µg ac/L					
<hr/>					
			<i>Mysidopsis bahia</i>	LC ₅₀ 4.2 µg ac/L	Surprenant 1998b
				LC ₅₀ 8.5 µg ac/L	Cripe 1994
Geomean LC ₅₀ 6.0 µg ac/L					
<hr/>					
			<i>Ephoron virgo</i>	LC ₅₀ 12 µg ac/L	van der Geest <i>et al.</i> 2000a
				LC ₅₀ 6.9 µg ac/L	van der Geest <i>et al.</i> 2000b
			LC ₅₀ 1.6 µg ac/L		van der Geest <i>et al.</i> 2002
Geomean LC ₅₀ 3.8 µg ac/L*					
<hr/>					
			<i>Gammarus pulex</i>	LC ₅₀ 4.1 µg ac/L	Ashauer <i>et al.</i> 2010a
				LC ₅₀ 13 µg ac/L	Ashauer <i>et al.</i> 2010b
Geomean EC ₅₀ 7.3 µg ac/L					
<hr/>					
			<i>Chironomus tentans</i>	LC ₅₀ 10 µg ac/L	Ankley & Collyard 1995
<hr/>					
			<i>Gammarus pseudolimnaeus</i>	LC ₅₀ 17 µg ac/L	Hall & Anderson 2005
<hr/>					
			<i>Chironomus riparius</i>	LC ₅₀ 18 µg ac/L	Stuijzand <i>et al.</i> 2000
<hr/>					
			<i>Penaeus duorarum</i>	LC ₅₀ 21 µg ac/L	Cripe 1994
<hr/>					
			<i>Lestes congener</i>	LC ₅₀ 47 µg ac/L	Federle & Collins 1976
<hr/>					
			<i>Crassostrea virginica</i>	EC ₅₀ 880 µg ac/L	Surprenant 1998c
<hr/>					
			<i>Haliotis varia</i>	LC ₅₀ 2,300 µg ac/L	Kaligis and Lasut 1997
<hr/>					
			<i>Pomacea paludosa</i>	EC ₅₀ 3,198 µg ac/L	Call 1993
<hr/>					
			<i>Monia macrocopa</i>	EC ₅₀ 4,000 µg ac/L	Kurata & Kurosawa 1990b
<hr/>					

Substance	Group	Exposure	Species	Toxicity value	Reference
Diazinon	Algae	Chronic	<i>Lumbriculus variegatus</i>	LC ₅₀ 5,852 µg ac/L	Ankley & Collyard 1995
			<i>Brachionus calyciflorus</i>	EC ₅₀ 11,000 µg ac/L	Snell & Moffat 1992
			HC ₅ 0.44 µg ac/L (26 species)		
			<i>Daphnia magna</i>	NOEC 0.17 µg ac/L	Surprenant 1998d
		Chronic	<i>Scenedesmus subspicatus</i>	EC ₅₀ 17 mg ac/L	Hitz 1982
				EC ₅₀ 8.5 mg ac/L	Oldersma <i>et al.</i> 1984
			Geomean EC ₅₀ 12 mg ac/L		
EC 600 g/L	Fish	Acute	<i>Cyprinus carpio</i>	LC ₅₀ 5.4 mg ac/L	Dohke & Hatanaka 1977a
				LC ₅₀ 2.2 mg ac/L	Koesoemadinata 1983
			Geomean LC ₅₀ 3.4 mg ac/L		
			<i>Puntius gonionotus</i>	LC ₅₀ 4.0 mg ac/L	Koesoemadinata 1983
	Invertebrates	Acute	<i>Caridina laevis</i>	EC ₅₀ 1.2 µg ac/L	Sucahyo <i>et al.</i> 2008
			<i>Daphnia magna</i>	EC ₅₀ 1.4 µg ac/L	Albuquerque 2002
			<i>Daphnia carinata</i>	EC ₅₀ 12 µg ac/L	Dohke & Hatanaka 1977b
CS 300 g/L	Fish	Acute	<i>Oncorhynchus mykiss</i>	LC ₅₀ >24 mg ac/L	Bettencourt 1994
GS-31144	Fish	Acute	<i>Oncorhynchus mykiss</i>	LC ₅₀ >100 mg/L	Grade 1993a
	Invertebrates	Acute	<i>Daphnia magna</i>	EC ₅₀ >100 mg/L	Grade 1993b
GS-31144	Algae	Chronic	<i>Scenedesmus subspicatus</i>	EC ₅₀ >100 mg/L	Flatman 2002
Oxypyrimidine	Fish	Acute	<i>Oncorhynchus mykiss</i>	LC ₅₀ >100 mg/L	Grade 1993c

Substance	Group	Exposure	Species	Toxicity value	Reference
	Invertebrates	Acute	<i>Daphnia magna</i>	EC ₅₀ >100 mg/L	Grade 1993d
	Algae	Chronic	<i>Scenedesmus subspicatus</i>	EC ₅₀ >100 mg/L	Grade 1993e

* Although mean is presented when more than one trial was conducted in a particular study, the geometric mean for the species considers all individual values; SSD analysis also considers toxicity of both technical product and EC 600 g/L formulation

Table 51: Bioconcentration in aquatic species

Test substance	Group	Species	BCF	Reference
Diazinon	Fish	<i>Lepomis macrochirus</i>	500	Fackler 1988
		<i>Ictalurus punctatus</i>	58	McAllister 1979
		<i>Cyprinodon variegatus</i>	213	Goodman <i>et al.</i> 1979
		<i>Pseudorasbora parva</i>	152	Kanazawa 1978
		<i>Cyprinus carpio</i>	65	
		<i>Cyprinus auratus</i>	37	
		<i>Labistes reticulatus</i>	18	
		<i>Labistes reticulatus</i>	142	Tsuda <i>et al.</i> 1997
		<i>Oryzia latipes</i>	94	
		<i>Cassius auratus</i>	49	
		<i>Cyprinus carpio</i>	120	Seguchi & Asaka 1981
		<i>Oncorhynchus mykiss</i>	63	
		<i>Misgurnus anguillicaudatus</i>	26	
		<i>Pseudorasbora parva</i>	64	Kanazawa 1975
		<i>Oryzias latipes</i>	28	Tsuda <i>et al.</i> 1995
Diazinon	Invertebrates	<i>Gammarus pulex</i>	82	Ashauer <i>et al.</i> 2010a
		<i>Crassostrea virginica</i>	56	Williams 1989
		<i>Daphnia magna</i>	18	Kretschmann <i>et al.</i> 2011
		<i>Gammarus pulex</i>	13	Ashauer <i>et al.</i> 2010b
		<i>Indoplanorbis exustus</i>	17	Kanazawa 1978
		<i>Cipangopoludina malleata</i>	6	
		<i>Procambarus clarkia</i>	5	

Test substance	Group	Species	BCF	Reference
		<i>Penaeopsis joyneri</i>	3	Seguchi & Asaka 1981

Table 52: Laboratory studies on bees

Test substance	Species	Life stage	Exposure	Toxicity value	Reference
Diazinon	<i>Apis mellifera</i>	Adult	Acute contact Acute oral	LD ₅₀ 0.13 µg ac/bee LD ₅₀ 0.09 µg ac/bee	Wainwright 2002a
		Larval	Acute oral	LD ₅₀ 0.00012 µg ac/bee	Atkins & Kellum 1986
EC 600 g/L	<i>Apis mellifera</i>	Adult	Acute contact Acute oral	LD ₅₀ 0.63 µg ac/bee LD ₅₀ 0.13 µg ac/bee	Wainwright 2002b

Table 53: Higher tier studies on bees

Test substance	Study type	Exposure	% mortality	Reference
EC 600 g/L	Aged foliar residues		<u>0 DAT</u> <u>3 DAT</u> <u>7 DAT</u>	Gray 2005
		468 g ac/ha 1,170 g ac/ha	6.3 7.0 6.7 60 15 5.0	

Table 54: Laboratory studies on other non-target arthropods

Test substance	Group	Species	Test substrate	Toxicity value	Reference
EC 600 g/L	Predatory arthropods	<i>Typhlodromus pyri</i>	Glass plate	LR ₅₀ 811 g ac/ha	Sharples 2002a
			Bean leaves	LR ₅₀ >1,170 g ac/ha ER ₅₀ >1,170 g ac/ha	Sharples 2002b
		<i>Chrysoperla carnea</i>	Bean plants	LR ₅₀ >42 g ac/ha ER ₅₀ >184 g ac/ha	Sharples 2002c
	Parasitic arthropods	<i>Aphidius rhopalosiphi</i>	Glass plate	LR ₅₀ 0.15 g ac/ha	Sharples 2002d
			Bean plants	LR ₅₀ >42 g ac/ha ER ₅₀ >42 g ac/ha	Sharples 2002e
		<i>Aleochara bilineata</i>	Soil	LR ₅₀ >184 g ac/ha ER ₅₀ >184 g ac/ha	Gray 2002

Table 55: Higher tier studies on other non-target arthropods

Substance	Study type	Species	Exposure	% effect		Reference
EC 600 g/L	Aged residues	<i>Chrysoperla carnea</i>		0 DAT	28 DAT	Sharples 2002c
			42 g ac/ha	0	0	
			184 g ac/ha	0	0	
			468 g ac/ha	100	0	
			1,170 g ac/ha	100	35	
		<i>Aphidus rhopalosiphi</i>		0 DAT	28 DAT	Sharples 2002e
			42 g ac/ha	0	-28	
			184 g ac/ha	100	-17	
			468 g ac/ha	100	-25	
			1,170 g ac/ha	100	24	
		<i>Aleochara bilineata</i>		0 DAT	14 DAT	Gray 2002
					36 DAT	
			184 g ac/ha	-45	11	
			468 g ac/ha	99	95	-11

Table 56: Laboratory studies on soil organisms

Test substance	Group	Exposure	Species/process	Toxicity value	Reference
Diazinon	Macro-organisms	Acute	<i>Eisenia fetida</i>	LC _{50corr} 65 mg ac/kg dry soil	Vial 1990
	Micro-organisms	Chronic	Respiration & nitrification	NOEC 80 mg ac/kg dry soil	Guth 1983
GS-31144	Macro-organisms	Acute	<i>Eisenia fetida</i>	LC ₅₀ >1000 mg/kg dry soil	Dias 2002a
Oxypyrimidine	Macro-organisms	Acute	<i>Eisenia fetida</i>	LC ₅₀ >1000 mg/kg dry soil	Dias 2002b

Table 57: Field studies on soil organisms

Test substance	Crop	Exposure	Effect	Reference
GR 100 g/kg	Tobacco	4.5 kg ac/ha	No adverse effects on earthworms at 7 DAT	Kring 1969
	Meadow	20 kg ac/ha	No adverse effects on earthworms at 27 DAT	Schäpfer 1977

Table 58: Effects on non-target terrestrial plants (pre-emergent exposure)

Test substance	Species	ER ₂₅	ER ₅₀	Reference
Diazinon	<i>Allium cepa</i>	>11 kg ac/ha	>11 kg ac/ha	Cañez & Jones 1988
	<i>Avena sativa</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Brassica oleracea</i>	>11 kg ac/ha	>11 kg ac/ha	

Test substance	Species	ER ₂₅	ER ₅₀	Reference
	<i>Cucumis sativus</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Daucus carota</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Glycine max</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Lactuca sativus</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Lolium perenne</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Lycopersicon esculentum</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Zea mays</i>	>11 kg ac/ha	>11 kg ac/ha	

Table 59: Effects on non-target terrestrial plants (post-emergent exposure)

Test substance	Species	ER ₂₅	ER ₅₀	Reference
Diazinon	<i>Avena sativa</i>	>11 kg ac/ha	>11 kg ac/ha	Cañez 1988
	<i>Brassica oleracea</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Glycine max</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Lolium perenne</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Zea mays</i>	>11 kg ac/ha	>11 kg ac/ha	
	<i>Cucumis sativus</i>	53% effect at 11 kg ac/ha		
	<i>Lactuca sativus</i>	33% effect at 11 kg ac/ha		
	<i>Lycopersicon esculentum</i>	29% effect at 11 kg ac/ha		
	<i>Allium cepa</i>	27% effect at 11 kg ac/ha		
	<i>Daucus carota</i>	26% effect at 11 kg ac/ha		

Appendix C – Terrestrial vertebrate assessments

Risks to terrestrial vertebrates following dietary exposure to contaminated food items are assessed using a tiered approach. The acute assessment assumes 100% of food items are obtained from the treatment area on the last day of application, while the chronic assessment assumes 50% of food items are obtained from the treatment area for the first 21 days after the last application (PT 0.5). Long-term exposure of mammals was determined to be higher risk than acute exposure, while acute exposure of birds was determined to be higher than long-term exposure. Therefore, the assessment in this Appendix focuses only on the long-term risks to wild mammals and acute risks to birds.

The use patterns were divided up into groups which consist of crop species that have similar growing patterns (Table 60). It is assumed that the exposure of a 'generic focal species' within each group will be the same as they relate to feeding habits and other ecological needs. A 'generic focal species' is not a real species; however, it is considered to be representative of all those species potentially at risk. The APVMA utilises the EFSA (2009) generic focal species which are considered protective of species that occur in Australia. Interception of the spray by the crop is taken into account by calculating the residue level on the several food types, depending on the growth stage of the crop. This consideration is reflected in the EFSA (2009) shortcut values.

Long-term risks to wild mammals are summarised in Table 61; acute risks to birds are summarised in Table 62.

Table 60: Seasonal exposure estimates for diazinon in animal food items

Use pattern	EFSA 2009 crop group	Situation	Application rate & frequency	Fraction field treated	Seasonal exposure rate (g/ha)		
					Foliage (DT ₅₀ 3.2 d)	Fruit (DT ₅₀ 4.7 d)	Other items (DT ₅₀ 10 d)
Argentine ant control	Grassland	Lawns (grid pattern)	1× 4,800 g ac/ha	0.5	2400	n/a	2400
		Pasture	1× 4,800 g ac/ha	1	4800	n/a	4800
Tropical fruit	Fruiting vegetables	Control of mealy bug in pineapples	3× 2,400 g ac/ha 14d interval	1	2436	2459	3654
		Control of pineapple scale in pineapples	3× 1,560 g ac/ha 14d interval	1	1583	1598	2375
		Banana butt treatments	2× 1,800 g ac/ha 14d interval	1	1826	1843	2482
Vegetable crops	Leafy vegetables	Cauliflower, broccoli	4× 560 g ac/ha 10d interval	1	589	n/a	1050

Use pattern	EFSA 2009 crop group	Situation	Application rate & frequency	Fraction field treated	Seasonal exposure rate (g/ha)		
					Foliage (DT ₅₀ 3.2 d)	Fruit (DT ₅₀ 4.7 d)	Other items (DT ₅₀ 10 d)
	Bulbs & onion like crops	Onions, garlic	3× 560 g ac/ha 10d interval	1	589	n/a	980

Risk assessment scenarios as described in section 2; seasonal exposure rates based on indicated application rate, frequency, DT₅₀ and fraction of field treated (50% assumed for application in 1m² grids for control of Argentine ants in lawns & pasture)

Table 61: Long-term risks of diazinon to wild mammals (RAL 0.65 mg/kg bw/d)

Crop group	Generic focal species	Crop stage	Shortcut value	Exposure rate (g/ha)	DDD (mg/kg bw/d)	RQ
Control of Argentine ants in lawns & pasture						
Grassland	Small omnivore	Early or late season	6.6	2400	1.2	1.9
	Large herbivore	All season	17.3	2400	3.3	5.0
	Small herbivore	All season	72.3	2400	14	21
	Small insectivore	Late season	1.9	2400	0.36	0.55
Control of mealy bug or pineapple scale in pineapples						
Fruiting vegetables	Small insectivore	BBCH 10-19	4.2	2375	2.6	4.0
		BBCH ≥20	1.9	2375	1.2	1.8
	Small herbivore	BBCH 10-49	72.3	1583	9.0	14
		BBCH ≥50	21.7	1583	2.7	4.2
	Small omnivore	BBCH 10-49	7.8	2375	4.9	7.5
		BBCH ≥50	2.3	2375	1.4	2.2
	Frugivore	BBCH 71-89	25.2	1598	3.6	5.5
	Banana butt treatments					
Orchards	Small insectivore	BBCH <10	1.9	2482	1.2	1.9

Crop group	Generic focal species	Crop stage	Shortcut value	Exposure rate (g/ha)	DDD (mg/kg bw/d)	RQ
	Small herbivore	BBCH <10	72.3	1826	10	16
		BBCH 10-19	57.8	1826	8.3	13
		BBCH 20-39	43.4	1826	6.2	9.6
		BBCH ≥40	22.7	1826	3.1	4.8
	Large herbivore	BBCH <10	14.3	1826	2.1	3.2
		BBCH 10-19	11.5	1826	1.7	2.5
		BBCH 20-39	8.6	1826	1.2	1.9
		BBCH ≥40	4.3	1826	0.62	0.95
	Small omnivore	BBCH <10	7.8	2482	5.1	7.8
		BBCH 10-19	6.2	2482	4.1	6.2
		BBCH 20-39	4.7	2482	3.1	4.7
		BBCH ≥40	2.3	2482	1.5	2.3
	Frugivore	BBCH 71-79	22.7	1843	3.7	5.7
Cauliflower and broccoli						
Leafy vegetables	Small insectivore	BBCH 10-19	4.2	1050	1.2	1.8
		BBCH ≥20	1.9	1050	0.53	0.81
	Small herbivore	BBCH 40-49	72.3	589	3.4	5.2
		BBCH ≥50	21.7	589	1.0	1.6
	Large herbivore	All season	14.3	589	0.66	1.0
	Small omnivore	BBCH 10-49	7.8	1050	2.2	3.3
		BBCH ≥50	2.3	1050	0.64	0.98
	Onions and garlic					
Bulbs & onion like crops	Small insectivore	BBCH 10-19	4.2	980	1.1	1.7
		BBCH ≥20	1.9	980	0.49	0.75
	Small herbivore	BBCH ≥40	43.4	589	2.0	3.1
	Small omnivore	BBCH 10-39	7.8	980	2.0	3.1
		BBCH ≥40	4.7	980	1.2	1.9

Crop groups as indicated in Table 60; generic focal species and shortcut values for indicated crop groups from EFSA (2009)
Seasonal exposure rates selected from Table 60 for the indicated crop groups represent worst-case scenario (if acceptable)
or best-case scenario (if not acceptable)

DDD = daily dietary dose (mg/kg bw/d) = shortcut value * rate (kg ac/ha) * PT 0.5 * TWA 0.16 (herbivores) or 0.18 (frugivores) or 0.53 (other)

RAL = regulatory acceptable level = NOEL 0.65 mg/kg bw/d (Giknis 1989)

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

Table 62: Acute risks of diazinon to birds (RAL 0.80 mg/kg bw/d)

Crop group	Generic focal species	Crop stage	Shortcut value	Exposure rate (g/ha)	DDD (mg/kg bw/d)	RQ
Control of Argentine ants in lawns & pasture						
Grassland	Small granivore	New sown	20.4	2400	49	61
	Large herbivore	Growing shoots	30.5	2400	73	92
	Small insectivore	Growing shoots	26.8	2400	64	80
	Small granivore	Late season	24.7	2400	59	74
Control of mealy bug or pineapple scale in pineapples						
Fruiting vegetables	Small granivore	BBCH 10-49	24.7	2375	59	73
		BBCH ≥50	7.4	2375	18	22
	Small omnivore	BBCH 10-49	24.0	2375	57	71
		BBCH ≥50	7.2	2375	17	21
	Small insectivore	BBCH 10-19	26.8	2375	64	80
		BBCH ≥20	25.2	2375	60	75
	Frugivore (e.g. crow)	BBCH 71-89	57.4	1598	92	115
	Frugivore (e.g. starling)	BBCH 71-89	49.4	1598	79	99
Banana butt treatments						
Orchards	Small insectivore	Spring/summer	46.8	2482	116	145
	Small insectivore/worm feeder	BBCH <10	7.4	2482	18	23
		BBCH 10-19	5.9	2482	15	18
		BBCH 20-39	4.4	2482	11	14
		BBCH ≥40	2.2	2482	5.5	6.8
	Small granivore	BBCH <10	27.4	2482	68	85
		BBCH 10-19	21.9	2482	54	68
		BBCH 20-39	16.4	2482	41	51
		BBCH ≥40	8.2	2482	20	25

Crop group	Generic focal species	Crop stage	Shortcut value	Exposure rate (g/ha)	DDD (mg/kg bw/d)	RQ
Cauliflower and broccoli						
Leafy vegetables	Small granivore	BBCH 10-49	27.4	1050	29	36
		BBCH ≥50	8.2	1050	8.6	11
	Small omnivore	BBCH 10-49	24.0	1050	25	32
		BBCH ≥50	7.2	1050	7.6	9.5
	Medium herbivore/granivore	BBCH 10-19	90.6	1050	95	119
	Small insectivore	BBCH 10-19	26.8	1050	28	35
		BBCH ≥20	25.2	1050	26	33
	Onions and garlic					
Bulbs and onion like crops	Small granivore	BBCH 10-39	24.7	980	24	30
		BBCH ≥40	14.8	980	15	18
	Small omnivore	BBCH 10-39	24.0	980	24	29
		BBCH ≥40	14.4	980	14	18
	Small insectivore	BBCH 10-19	26.8	980	26	33
		BBCH ≥20	25.2	980	25	31

Crop groups as indicated in Table 60; generic focal species and shortcut values for indicated crop groups from EFSA (2009)
 Seasonal exposure rates selected from Table 60 for the indicated crop groups represent worst-case scenario (if acceptable)
 or best-case scenario (if not acceptable)

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

RAL = regulatory acceptable level = LDD_{50} 8.0 mg/kg bw/d (Fletcher & Pedersen 1988c) and assessment factor of 10

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

Appendix D – Runoff assessments

Assessment scenarios

Runoff has been modelled following the methodology described in Appendix B, Aquatic species of the APVMA [Risk Assessment Manual, Environment](#). In order to perform the appropriate high tier calculations, the runoff assessment has been undertaken using the PERAMA⁴ software. All runoff calculations assume that 50% of residues intercepted by the foliage are washed off due a rainfall event and contribute to the total soil residue subject to runoff. In addition, it is assumed that the full catchment is treated at once, with the exceptions noted below (ornamentals and lawns).

For residential lawns, it is assumed that 38% of the catchment is impervious (such as roof tops, driveways and roadways) and runoff is directed to a drainage system. The remaining 62% is assumed to be pervious (such as lawns, garden bed, and vegetated areas) and subject to runoff. Assuming half of the pervious area is lawns and 10% of houses treat their lawn, then 3% of the catchment is assumed to be treated.

For ornamentals, it is assumed that 40% of the catchment is treated. This is based on information from the from Hort Innovation (2022) where, based on a comprehensive grower survey, the average size of farms was 3.9 ha with a 50th percentile area of 1.0 ha per farm.

Table 63: Soil exposure rates assessed for the runoff assessments of diazinon

Use pattern	Situation	Application rate and frequency	Foliar interception fraction	Fraction field treated	Fraction of 10 ha treated	Seasonal rate over 10 ha (g/ha)
Argentine ant control	Lawns (grid application)	1× 4,800 g ac/ha	0.90	0.5	0.03	40
Ornamentals	Soil drench in potted ornamentals	1× 3,200 g ac/ha	0	1	0.40	1280
	Pre-plant dip of nursery plants	1× 240 g ac/ha	1	1	0.40	48
Tropical fruit	Control of mealy bug in pineapples	3× 1,200 g ac/ha 14d interval	0.50	1	1	1722
		3× 2,400 g ac/ha 14d interval	0.50	1	1	3345
	Control of pineapple scale in pineapples	3× 1,040 g ac/ha 14d interval	0.50	1	1	1493

⁴ © Australian Environment Agency Pty Ltd 2023

Use pattern	Situation	Application rate and frequency	Foliar interception fraction	Fraction field treated	Fraction of 10 ha treated	Seasonal rate over 10 ha (g/ha)
		3× 1,560 g ac/ha 14d interval	0.50	1	1	2239
	Pre-plant dip of pineapples	1× 1,040 g ac/ha	1	1	1	520
	Banana butt treatments	2× 1,800 g ac/ha 14d interval	0	1	1	2390
Vegetable crops	Cauliflower, broccoli	4× 560 g ac/ha 10d interval	0.25	1	1	978
	Onions, garlic	3× 560 g ac/ha 10d interval	0.10	1	1	926

Risk assessment scenarios as described in section 2; foliar interception values are based on EFSA (2020) defaults for similar situations; exposure rates based on indicated application rate, frequency, soil DT_{50} 8.7 days, foliar interception (with 50% wash-off) and fraction of catchments treated.

Tier 1 assessments

The Tier 1 (screening level) is a worst-case scenario where slope is fixed at 8%, which is considered protective of 95% of agricultural activities in Australia. The rainfall value is set at 8 mm, which results in the maximum receiving water concentration using the standard water body of 1 ha and 15 cm initial depth when the clay dominated Queensland soil profile is used; the catchment is 10 ha with 50% of this area contributing to runoff. Further, for this worst-case scenario, a fallow/bare soil runoff profile is assessed. Acceptable risks could not be concluded for any of the scenarios assessed.

Tier 2 assessments

A regional assessment (Tier 2) was undertaken as either a state based or tropical/subtropical based assessment depending on the cropping situation and production areas. At this level of assessment, the 90th percentile slope value is applied. The rainfall value used is determined as that required to result in the maximum water concentration using the standard water body (1 ha surface area, 15 cm deep). At this level of assessment, the rainfall value is determined to be that resulting in the maximum water body concentration and reflects the soil profile applied in the modelling, not the actual rainfall pattern of the region being assessed. Acceptable risks could be concluded for grid application to residential lawns at the Tier 2 level of assessment, noting this use pattern only applies to Western Australia as specified on registered labels (Table 64).

Table 64: Tier 2 scenarios showing acceptable runoff risks of diazinon to aquatic species (RAL 0.15 µg/L)

Region	Seasonal rate over 10 ha (g/ha)	Rainfall (mm)	Slope (%)	Kd (mL/g)	Runoff (mm)	PEC (µg/L)	RQ
Control of Argentine ants in lawns (grid application)							
New South Wales & ACT	40	24	4.6	4.7	1.8	0.16	1.0
South Australia	40	25	2.3	4.7	1.7	0.066	0.44
Western Australia	40	39	2.3	4.7	0.92	0.024	0.16

Seasonal exposure rate over 10 ha from Table 63 (worst-case)

Tier 3 assessments

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

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

The first relates to fraction of catchment treated at a given time. The current approach in the APVMA manual assumes for in-stream analysis that 20% of a catchment is treated at a given time, and all treated area contributes to runoff. This has been shown to potentially underestimate exposure for some situations such as cereals and pasture, and overestimate exposure for cropping situations where growing occurs over smaller areas such as horticultural crops. The updated MCAS-S data on a 1 km² scale have been assessed for major land uses and proportions of catchments grown to a particular land use have now been assessed. These values, while stated in MCAS-S as being “Catchment” are probably more appropriate to be considered a basin level so may underestimate exposure in smaller catchments. However, overall, the results are considered applicable as a general indication of the dominance of a particular land use within a catchment scale assessment. In order to identify a fraction of catchment for a particular land use, catchments where ≥90% of the land use in a region was found were used for the analysis. The fraction of catchment was then taken as the 90th percentile value from this range of catchments. This value was lower than the highest catchment but tended to be higher than the majority of catchments. Nonetheless, it is considered sufficiently conservative to include situations where higher contributions in sub-catchment areas are found and these data are not available.

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

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

Regions showing acceptable risk without restrictions are summarised in Table 65; regions showing unacceptable risks at any time are summarised in Table 66; regions showing acceptable risks with restrictions are summarised in Table 67.

Table 65: Tier 3 scenarios showing acceptable runoff risks of diazinon to aquatic species without restrictions

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Soil drench in ornamentals (also covers pre-plant dip)									
Queensland & NT	1.85	0.001	3.2	Winter	25	13	1.0	0.09	99
					75	29	2.3	0.26	>99
NSW & ACT	1.85	0.001	3.2	Winter	25	17	1.3	0.06	>99
					75	46	2.8	0.23	>99
Victoria	1.24	0.001	3.2	Autumn	25	18	1.3	0.04	97
					75	32	2.9	0.10	>99
Tasmania	5.38	0.001	3.2	Summer	25	12	1.3	0.20	>99
					75	23	3.0	0.58	>99
South Australia	1.22	0.001	3.2	Autumn	25	19	1.4	0.04	97
					75	31	3.0	0.09	>99
Western Australia	1.64	0.001	3.2	Summer	25	19	1.3	0.01	>99
					75	34	2.9	0.06	>99
Pre-plant dip of pineapples									
Fitzroy	1.89	0.007	7.3	Apr	25	14	0.8	0.06	91
					75	43	1.9	0.18	90

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Banana butt treatments									
Cape York	0.75	0.001	2.4	Nov	25 75	14	0.6	0.02	94
Vegetable crops									
NSW and ACT	1.85	0.076	74	Summer	25 75	17	1.3	0.05	92
Tasmania	5.38	0.067	62	Autumn	25 75	12 21	1.3 2.7	0.15 0.40	92 >99
Western Australia	1.64	0.020	20	Summer	25 75	19 34	1.3 2.9	0.01 0.04	92 98

Only worst-case scenarios are presented for each region; seasonal catchment exposure rates from Table D1 have been readjusted to account for the fractions of a full catchment treated; risks are considered acceptable where $\geq 90\%$ of receiving waters are protected.

Table 66: Regions showing unacceptable runoff risks of diazinon to aquatic species at any time

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Control of mealy bug or pineapple scale in pineapples (lowest rate)									
Mary Burnett	1.56	0.092	137	Feb	25 75	14 42	1.0 3.0	0.06 0.19	93 82
SE Queensland	1.68	0.046	69	Jul	25 75	13 28	1.3 2.8	0.06 0.15	87 79
Banana butt treatments									
Mackay/Whitsunday	2.02	0.279	667	Feb	25 75	16 51	0.8 2.4	0.08 0.33	71 93
Fitzroy	1.89	0.007	17	Feb	25 75	14 35	0.9 2.7	0.06 0.22	90 88
Mary/Burnett	1.56	0.092	220	Feb	25 75	14 42	1.0 3.0	0.05 0.21	88 64

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
SE Queensland	1.68	0.046	110	Jun	25 75	12 32	1.2 3.1	0.04 0.18	85 69

Vegetable crops

Mackay/Whitsunday	2.02	0.279	258	Mar	25 75	16 50	0.8 2.4	0.13 0.35	84 98
Mary/Burnett	1.56	0.092	85	Feb	25 75	14 42	1.0 3.0	0.08 0.24	96 89
SE Queensland	1.68	0.046	43	Jul	25 75	13 28	1.3 2.8	0.07 0.19	90 83

Only best-case scenarios are presented for each region; seasonal catchment exposure rates from Table D1 have been readjusted to account for the refined fractions catchment treated; risks are considered acceptable where ≥90% of receiving waters are protected.

Table 67: Regions showing acceptable runoff risks of diazinon with timing restrictions

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
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Control of mealy bug or pineapple scale in pineapples

Fitzroy (3× 1,040 g ac/ha) ⁵	2.97	0.057	196	Jan	25 75	13 33	0.9 2.5	0.07 0.20	91 89
				Feb	25 75	14 35	0.9 2.7	0.08 0.21	92 91
				Mar	25 75	14 42	0.9 2.5	0.08 0.24	91 90
				Apr	25 75	14 43	0.8 1.9	0.08 0.24	88 87
				May	25 75	15 41	0.8 2.3	0.08 0.23	92 91

⁵ Higher rates are not supported in Fitzroy

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)					
				Jun	25 75	12 31	0.8 1.9	0.06 0.19	93 92					
				Jul	25 75	13 37	0.8 2.1	0.07 0.22	87 85					
				Aug	25 75	12 32	0.8 1.8	0.06 0.19	87 84					
				Sep	25 75	13 33	0.8 1.7	0.06 0.20	88 86					
				Oct	25 75	13 28	0.8 1.8	0.07 0.17	89 89					
				Nov	25 75	13 27	0.8 2.0	0.07 0.16	89 89					
				Dec	25 75	13 30	0.9 2.1	0.06 0.18	91 89					
										3x 1560	3x 2400			
				Wet Tropics	2.97	0.057	196	Jan	25 75	18 63	0.8 2.8	0.17 0.47	86 98	77 96
				Feb	25 75	17 64	0.8 2.9	0.16 0.47	96 99	93 98				
				Mar	25 75	17 65	0.7 2.9	0.16 0.47	98 >99	95 99				
				Apr	25 75	15 44	0.7 2.0	0.13 0.41	94 98	90 97				
May	25 75	14 34	0.6 1.5	0.12 0.34	90 96	85 94								
Jun	25 75	13 30	0.6 1.3	0.11 0.30	88 94	82 90								
Jul	25 75	12 27	0.6 1.2	0.11 0.28	84 92	77 88								

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)		
Region 1	1	25	75	Aug	25	12	0.6	0.10	79	71	
					75	27	1.2	0.27	90	84	
	2	25	75	Sep	25	12	0.6	0.10	74	66	
					75	27	1.2	0.27	85	80	
	3	25	75	Oct	25	12	0.6	0.11	70	61	
					75	31	1.4	0.31	85	78	
	4	25	75	Nov	25	14	0.6	0.12	67	57	
					75	39	1.8	0.38	84	76	
	5	25	75	Dec	25	15	0.7	0.13	70	61	
					75	50	2.2	0.44	93	88	
	Region 2	1	25	75	Aug	25	12	0.6	0.10	79	71
						75	27	1.2	0.27	90	84
2		25	75	Sep	25	12	0.6	0.10	74	66	
					75	27	1.2	0.27	85	80	
3		25	75	Oct	25	12	0.6	0.11	70	61	
					75	31	1.4	0.31	85	78	
4		25	75	Nov	25	14	0.6	0.12	67	57	
					75	39	1.8	0.38	84	76	
5		25	75	Dec	25	15	0.7	0.13	70	61	
					75	50	2.2	0.44	93	88	
Region 3		1	25	75	Aug	25	12	0.6	0.10	79	71
						75	27	1.2	0.27	90	84
	2	25	75	Sep	25	12	0.6	0.10	74	66	
					75	27	1.2	0.27	85	80	
	3	25	75	Oct	25	12	0.6	0.11	70	61	
					75	31	1.4	0.31	85	78	
	4	25	75	Nov	25	14	0.6	0.12	67	57	
					75	39	1.8	0.38	84	76	
	5	25	75	Dec	25	15	0.7	0.13	70	61	
					75	50	2.2	0.44	93	88	
	Region 4	1	25	75	Aug	25	12	0.6	0.10	79	71
						75	27	1.2	0.27	90	84
2		25	75	Sep	25	12	0.6	0.10	74	66	
					75	27	1.2	0.27	85	80	
3		25	75	Oct	25	12	0.6	0.11	70	61	
					75	31	1.4	0.31	85	78	
4		25	75	Nov	25	14	0.6	0.12	67	57	
					75	39	1.8	0.38	84	76	
5		25	75	Dec	25	15	0.7	0.13	70	61	
					75	50	2.2	0.44	93	88	

Pre-plant dip of pineapples

Wet Tropics	2.97	0.057	59	Jan	25 75	18 63	0.8 2.8	0.11 0.31	97 >99
				Feb	25 75	17 64	0.8 2.9	0.11 0.31	>99 >99
				Mar	25 75	17 65	0.7 2.9	0.11 0.31	>99 >99
				Apr	25 75	15 44	0.7 2.0	0.09 0.27	99 >99
				May	25 75	14 34	0.6 1.5	0.08 0.22	97 99
				Jun	25 75	13 30	0.6 1.3	0.07 0.20	96 98
				Jul	25 75	12 27	0.6 1.2	0.07 0.18	94 98
				Aug	25 75	12 27	0.6 1.2	0.07 0.18	92 97
				Sep	25 75	12 27	0.6 1.2	0.07 0.18	90 95

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
				Oct	25 75	12 30	0.6 1.4	0.07 0.21	88 95
				Nov	25 75	14 39	0.6 1.8	0.08 0.25	86 96
				Dec	25 75	15 50	0.7 2.2	0.09 0.29	88 99
Mary/Burnett	1.56	0.092	96	Jan	25 75	14 40	1.0 2.8	0.04 0.12	94 87
				Feb	25 75	14 42	1.0 3.0	0.04 0.13	>99 97
				Mar	25 75	13 34	0.9 2.4	0.04 0.11	93 90
				Apr	25 75	12 32	0.9 2.2	0.03 0.10	88 82
				May	25 75	13 49	0.9 3.5	0.04 0.14	88 78
				Jun	25 75	13 33	0.9 2.4	0.03 0.11	94 88
				Jul	25 75	17 39	1.2 2.7	0.05 0.12	89 84
				Aug	25 75	12 30	0.8 2.1	0.03 0.10	86 81
				Sep	25 75	14 32	1.0 2.3	0.04 0.10	83 79
				Oct	25 75	14 35	1.0 2.5	0.04 0.11	71 63
				Nov	25 75	12 37	0.9 2.6	0.03 0.12	81 70
				Dec	25 75	14 38	1.0 2.7	0.04 0.12	87 78

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
SE Queensland	1.68	0.046	48	Jan	25	14	1.4	0.04	85
					75	36	3.6	0.12	77
				Feb	25	14	1.4	0.04	93
					75	36	3.6	0.12	88
				Mar	25	13	1.3	0.04	91
					75	32	3.2	0.11	86
				Apr	25	13	1.3	0.04	90
					75	29	2.9	0.10	85
				May	25	13	1.3	0.04	91
					75	33	3.3	0.11	86
				Jun	25	12	1.2	0.04	93
					75	32	3.1	0.11	89
				Jul	25	13	1.3	0.04	94
					75	28	2.8	0.10	90
				Aug	25	12	1.2	0.03	91
					75	24	2.4	0.09	87
				Sep	25	12	1.2	0.03	86
					75	23	2.3	0.08	81
				Oct	25	13	1.3	0.04	83
					75	28	2.8	0.10	73
				Nov	25	13	1.3	0.04	86
					75	30	3.0	0.11	78
				Dec	25	13	1.3	0.04	86
					75	33	3.2	0.11	76

Banana butt treatments

Wet Tropics	2.97	0.057	136	Jan	25	18	0.8	0.16	86
					75	63	2.8	0.56	97
				Feb	25	17	0.8	0.14	96
					75	64	2.9	0.56	98

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
				Mar	25 75	17 65	0.7 2.9	0.14 0.57	98 >99
				Apr	25 75	15 44	0.7 2.0	0.11 0.46	95 98
				May	25 75	14 34	0.6 1.5	0.10 0.36	91 95
				Jun	25 75	13 30	0.6 1.3	0.08 0.32	90 93
				Jul	25 75	12 27	0.6 1.2	0.07 0.29	87 91
				Aug	25 75	12 27	0.6 1.2	0.07 0.28	82 88
				Sep	25 75	12 27	0.6 1.2	0.07 0.28	78 84
				Oct	25 75	12 31	0.6 1.4	0.07 0.33	75 83
				Nov	25 75	14 39	0.6 1.4	0.10 0.42	70 81
				Dec	25 75	15 50	0.7 2.2	0.11 0.50	72 91
Burdekin	0.80	0.132	315	Jan	25 75	17 50	1.0 2.9	0.03 0.12	96 >99
				Feb	25 75	16 53	0.9 3.2	0.03 0.12	>99 >99
				Mar	25 75	15 50	0.9 3.0	0.03 0.12	98 >99
				Apr	25 75	14 39	0.8 2.3	0.02 0.10	96 >99
				May	25 75	12 28	0.7 1.7	0.02 0.07	94 >99

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Northern NSW	1.68	0.046	69	Jun	25 75	13 29	0.8 1.7	0.02 0.07	95 99
				Jul	25 75	13 29	0.7 1.7	0.02 0.07	79 96
				Aug	25 75	13 29	0.8 1.7	0.02 0.07	66 86
				Sep	25 75	15 34	0.9 2.0	0.03 0.09	56 88
				Oct	25 75	13 36	0.8 2.1	0.02 0.09	49 77
				Nov	25 75	14 33	0.8 2.0	0.02 0.08	61 96
				Dec	25 75	14 42	0.9 2.5	0.03 0.10	88 >99
				Jan	25 75	13 35	1.1 2.8	0.11 0.44	92 82
				Feb	25 75	13 37	1.1 2.8	0.11 0.45	96 90
				Mar	25 75	13 36	1.0 2.7	0.10 0.44	96 90
				Apr	25 75	13 36	1.0 2.8	0.10 0.45	96 90
				May	25 75	14 34	1.1 2.5	0.11 0.42	89 97
Northern NSW	1.68	0.046	69	Jun	25 75	14 39	1.1 3.1	0.12 0.48	91 99
				Jul	25 75	12 29	0.9 2.2	0.08 0.36	99 95
				Aug	25 75	12 33	0.9 2.5	0.08 0.41	97 89

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)				
				Sep	25 75	12 24	0.9 1.9	0.08 0.29	92 86				
				Oct	25 75	13 28	1.0 2.2	0.10 0.35	85 76				
				Nov	25 75	13 32	1.0 2.4	0.10 0.39	89 78				
				Dec	25 75	13 28	1.0 2.2	0.10 0.35	90 82				
				Vegetable crops									
				Victoria	1.24	0.092	90	Autumn	25 75	18 32	1.3 2.9	0.03 0.08	78 95
				Spring	25 75	17 28	1.3 2.6	0.03 0.07	86 97				
				Summer	25 75	20 34	1.4 3.4	0.04 0.09	63 93				
Winter	25 75	17 30	1.2 2.1	0.03 0.07	91 >99								
South Australia			96	Autumn	25 75	19 31	1.4 3.0	0.03 0.07	79 95				
				Spring	25 75	19 28	1.3 2.7	0.03 0.06	84 97				
				Summer	25 75	19 34	1.3 3.0	0.03 0.08	64 92				
				Winter	25 75	18 26	1.3 2.7	0.03 0.06	92 99				
Wet Tropics	2.97	0.057	56	Jan	25 75	18 63	0.8 2.8	0.20 0.55	94 >99				
				Feb	25 75	17 64	0.8 2.9	0.19 0.55	99 >99				

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
				Mar	25 75	17 65	0.7 2.9	0.18 0.55	>99 >99
				Apr	25 75	15 44	0.7 2.0	0.16 0.48	98 >99
				May	25 75	14 34	0.6 1.5	0.14 0.39	95 98
				Jun	25 75	13 30	0.6 1.3	0.12 0.35	94 97
				Jul	25 75	12 27	0.6 1.3	0.12 0.32	91 96
				Aug	25 75	12 27	0.6 1.2	0.12 0.32	88 95
				Sep	25 75	12 27	0.5 1.2	0.12 0.32	84 92
				Oct	25 75	12 31	0.6 1.4	0.12 0.36	82 92
				Nov	25 75	14 39	0.6 1.8	0.14 0.44	79 92
				Dec	25 75	15 50	0.7 2.2	0.15 0.51	82 97
Burdekin	0.80	0.132	129	Jan	25 75	17 50	1.0 2.9	0.04 0.12	99 >99
				Feb	25 75	16 53	0.9 3.2	0.04 0.12	>99 >99
				Mar	25 75	15 50	0.9 3.0	0.04 0.12	>99 >99
				Apr	25 75	14 39	0.8 2.3	0.03 0.10	98 >99
				May	25 75	12 28	0.7 1.7	0.03 0.08	97 >99

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
				Jun	25 75	13 29	0.8 1.7	0.03 0.08	98 >99
				Jul	25 75	13 29	0.7 1.7	0.03 0.08	87 >99
				Aug	25 75	13 29	0.8 1.7	0.03 0.08	77 97
				Sep	25 75	15 34	0.9 2.0	0.04 0.09	67 98
				Oct	25 75	13 36	0.8 2.1	0.03 0.10	56 96
				Nov	25 75	14 33	0.8 2.0	0.03 0.09	71 99
				Dec	25 75	14 42	0.9 2.5	0.04 0.11	>99 >99
				Jan	25 75	13 33	0.9 2.5	0.08 0.23	92 91
				Feb	25 75	14 35	0.9 2.7	0.09 0.24	93 92
				Mar	25 75	14 42	0.9 2.5	0.09 0.28	93 91
				Apr	25 75	14 43	0.8 1.9	0.09 0.28	90 89
				May	25 75	15 41	0.8 2.3	0.10 0.27	93 93
Fitzroy		6.8		Jun	25 75	12 31	0.8 1.9	0.07 0.22	94 93
				Jul	25 75	13 37	0.8 2.1	0.08 0.25	89 88
				Aug	25 75	12 32	0.8 1.8	0.07 0.22	89 87

Region	Slope (%)	Fraction catchment treated	Catchment exposure (g/ha)	Timing	Stream flow (%)	Rainfall (mm/d)	Rain duration (h)	Runoff (%)	Waters protected (%)
Region 1	15	0.05	10	Sep	25	13	0.8	0.08	90
					75	33	1.7	0.23	88
				Oct	25	13	0.8	0.08	91
					75	28	1.8	0.20	91
				Nov	25	13	0.8	0.08	91
					75	27	2.0	0.19	91
				Dec	25	13	0.9	0.08	93
					75	30	2.1	0.21	92
				Jan	25	13	0.8	0.08	91
					75	33	1.7	0.23	88
				Feb	25	13	0.8	0.08	91
					75	33	1.7	0.23	88

Seasonal catchment exposure rates from Table 63 have been readjusted to account for the refined fractions catchment treated; risks are considered acceptable where $\geq 90\%$ of receiving waters are protected.

Appendix E – PBT and POP assessments

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

Persistence criterion

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

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

The half-lives of diazinon in water or sediment did not exceed 60 or 180 days, respectively. In 2 water/sediment systems, the geomean DT_{50} values were 4.3 days in water and 13 days in sediment (Corden 2004). The half-life of diazinon in soil did not exceed 180 days. The geomean DT_{50} in four aerobic laboratory soils was determined to be 11 days (Haynes 2004, Seyfried 1994). Furthermore, the maximum DT_{50} in soil under field conditions was determined to be 27 days (Offizorz 1990a). It can thus be concluded that diazinon does not meet the persistence criterion.

Bioaccumulation criterion

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

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

Diazinon is considered not bioaccumulative based on a maximum fish BCF of 500 (Fackler 1988).

Toxicity criterion

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

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

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

The lowest aquatic long-term effect value is below 10 µg/L (lowest NOEC is 0.17 µg/L, Surprenant 1998d). Therefore, diazinon is considered to meet the toxicity criterion.

Potential for long-range environmental transport

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

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

Diazinon is volatile; however, the modelled atmospheric half-life is <2 days (Comb 2002); therefore, it is unlikely to travel long distances through the air. There is no evidence to suggest diazinon is being transported long distances in the environment.

Conclusion

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

Appendix F – public consultation

The APVMA received 10 submissions in response to the proposed regulatory decision. Summaries of these submissions are listed in Table 68, and the APVMA's response is provided below. Where permission has been given, the full submission is published on the [APVMA website](#).

Table 68: Submissions in response to the proposed regulatory decision on the reconsideration of diazinon

	Submitter	Comments
1	AUSVEG Limited	Argues that finite residues of diazinon are not expected in certain situations and that use of diazinon in those situations should be supported.
2	Cattle Australia	Reports that use of diazinon ear tags is required for effective control of buffalo fly affecting cattle, with implications for animal welfare and biosecurity as well as financial impacts if buffalo fly is left untreated.
3	Elanco Australia Pty Ltd	Reports that use of diazinon ear tags is required for effective control of buffalo fly affecting cattle, with implications for animal welfare and biosecurity as well as financial impacts if buffalo fly is left untreated. Requests extension to phase out period.
4	Holder	No information to submit
5	Member of public	Support for “ban” of chlorpyrifos and diazinon
6	National Working Party on Grain Protection	Supports proposed decision
7	NSW Farmers	Acknowledges scientific basis of proposed decision. Reports that removal of diazinon from use on animals may lead to development of resistance to alternative chemicals among pest populations. Reports that loss of diazinon will have negative animal welfare and financial impacts on livestock producers.
8	Nutrien Ag Solutions Limited	Reports that use of diazinon ear tags is required for effective control of buffalo fly affecting cattle and requests extended phase out period for ear tag products.
9	Sanonda (Australia) PTY LTD	Supports proposed decision
10	Wool Producers Australia	Acknowledges scientific basis of proposed decision. Reports that removal of diazinon from use on animals may lead to development of resistance to alternative chemicals among pest populations. Queries references to ‘available information’ in reports.

Submissions supporting the proposed decision (number 4,5,6 and 9)

Submissions that support the APVMA's proposed decision are acknowledged

Submissions concerned with animal welfare, financial impact or biosecurity (number 2, 3, 7, 8, 9 and 10)

Several submissions provided substantially similar information in relation to the use of diazinon in veterinary products to control biting insects in livestock, including buffalo fly in cattle, and blowfly in sheep. These submissions noted that using pesticides with alternate modes of action in successive treatments is an important strategy to delay development of pesticide resistance within pest populations. These submissions further noted that a limited number of products are registered for control of biting insects, buffalo fly and blowfly in livestock, and asserted that if the APVMA cancels the registration of diazinon products used for these purposes resistance to other chemicals registered for control of these pests may develop more rapidly.

All these submissions requested that the APVMA consider an extended phase out period, if the decision is made to cancel the registration of diazinon products, as proposed. Several submissions also urged the APVMA to gather additional data, or to delay making a decision so that further data might be collected.

APVMA response:

The APVMA acknowledges the importance of alternative modes of action for managing resistance to pesticides within pest populations. It is not the APVMA's role to identify chemicals that may be used to control a pest, or to carry out research to support existing chemical products. It remains open to industry peak-bodies or holders to commission studies that may be able to address the concerns identified in the Diazinon Review Technical Report, however these would need to be assessed separately and the APVMA is not able to delay a decision to accommodate any trials that may be conducted.

The Agvet Code provides a maximum duration of one year for a permit for possession, custody and use taken to be issued under section 45B, in the event of cancellation of a product's registration. There is no option for the APVMA to further extend this deemed permit.

Submission from AUSVEG (number 1)

AUSVEG submitted a summary of studies that did not detect quantifiable residues of diazinon in various crop commodities following use on soil at sowing or transplanting. AUSVEG's submission puts forward that these types of uses should be considered acceptable and that the risk to trade is low.

APVMA response:

The APVMA's residue assessment for diazinon concluded that it is not possible to establish a diazinon residue definition for risk assessment for plant commodities based on the available dataset. This means that there is not enough information about the metabolism and breakdown of diazinon for the APVMA to identify an acceptable level for residues of diazinon and its breakdown products in plant commodities. This is consistent with the position established internationally.

Acronyms and abbreviations

Shortened term	Full term
ac	active constituent
AF	assessment factor
APVMA	Australian Pesticide and Veterinary Medicines Authority
AR	applied radioactivity
BBCH	Biologische Bundesanstalt, Bundessortenamt and Chemical Industry
BCF	bioconcentration factor
BOM	Bureau of Meteorology
bw	body weight
cm	centimetre(s)
CS	capsule suspension
d	day(s)
DAT	days after treatment
DDD	daily dietary dose
ds	dry soil
DT ₅₀	period required for 50 percent dissipation
EC	emulsifiable concentrate
EC _x	concentration causing X% effect (ErC _x is used for growth rate; EbC _x is used for biomass)
EFSA	European Food Safety Authority
ER _x	rate causing X% effect
ExpE	exposure estimate
g	gram(s)
GI	gastrointestinal
GLP	good laboratory practice
GR	granular formulation
GS-31144	2-(1-hydroxyl-1-methyl)-ethyl-4-methyl-6-hydroxypyrimidine

Shortened term	Full term
h	hour(s)
ha	hectare(s)
HC ₅	hazardous concentration for 5% of the species
IFD	intensity frequency distribution
IPM	integrated pest management
Kd or Kf	(Freundlich) adsorption constant
kg	kilogram(s)
Koc or Kfoc	(Freundlich) organic carbon partition coefficient
kg	kilogram(s)
L	litre(s)
LC _x	lethal concentration to X% of the tested population (LC _{xcorr} is a corrected value to account for bioavailability in the test system)
LD _x	lethal dose to X% of the tested population
LDD _x	lethal daily dose to X% of the tested population
LOC	level of concern
LR _x	lethal rate to X% of the tested population
m	metre(s)
max	maximum
MCAS-S	multi-criteria analysis shell for spatial decision support
mg	milligram(s)
mL	millilitre(s)
mm	millimetre(s)
nm	nanometre(s)
NOEC	no observed effect concentration (NOEC _{corr} is a corrected value to account for bioavailability in the test system)
NOEL	no observed effect level
NRA	National Registration Authority
NSW	New South Wales

Shortened term	Full term
OC	organic carbon
OH	hydroxyl radical
Pa	pascal(s)
PBT	persistent – bioaccumulative – toxic
PEC	predicted environmental concentration
PERAMA	Pesticide Environmental Risk Assessment Model for Australia
pKa	negative logarithm (to the base 10) of the dissociation constant
POP	persistent organic pollutant
Pow	octanol-water partition coefficient
RAL	regulatory acceptable level
RQ	risk quotient
SDRAM	spray drift risk assessment manual
SSD	species sensitivity distribution
TWA	time-weighted average
µg	microgram(s)
UK	United Kingdom
USA	United States of America
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VIS	visible
yr	year(s)

Glossary

Term	Description
active constituent	The substance that is primarily responsible for the effect produced by a chemical product
acute exposure	Contact between a pesticide and a target occurring over a short time (e.g., less than a day)
acute toxicity	Adverse effects of finite duration occurring within a short time (up to 14 d) after administration of a single dose (or exposure to a given concentration) of a test substance or after multiple doses (exposures), usually within 24 h of a starting point (which may be exposure to the toxicant, or loss of reserve capacity, or developmental change, etc.)
adsorption constant	A measure of the tendency of a chemical to bind to soils
adverse effect	Change in the morphology, physiology, growth, development, reproduction or life span of an organism, system, or subpopulation that results in impairment of the capacity to compensate for additional stress, or an increase in susceptibility to other influences
aged residue	Residues of a pesticide or its degradates in soil that have diffused into intra-particulate regions following application and have become less accessible to mass transfer and bioabsorption processes, although still amenable to solvent extraction
aquatic	Relating to water or sediment, as distinct from land or air
assessment factor	Reductive factor by which an observed or estimated endpoint of a pesticide is divided to arrive at a regulatory acceptable level
bioaccumulation	Progressive increase in the amount of a substance in an organism or part of an organism that occurs because the rate of intake exceeds the organism's ability to remove the substance from the body
bioconcentration	Uptake of a pesticide residue from an environmental matrix, usually through partitioning across body surfaces to a concentration in the organism that is usually higher than in the environmental matrix
bioconcentration factor	Ratio between the concentration of pesticide in an organism or tissue and the concentration in the environmental matrix (usually water) at apparent equilibrium during the uptake phase
bound residue	Residue associated with one or more classes of endogenous macromolecules that cannot be disassociated by extraction or digestion without alteration
capsule suspension	A stable suspension of capsules in a fluid normally intended for dilution with water before use
chronic exposure	Continued or intermittent long-term contact between an agent and a target
chronic toxicity	Adverse effects following chronic exposure
concentration	Amount of a material, agent (e.g., pesticide) dissolved or contained in unit quantity in a given medium or system
degrade	Chemical that is formed when a substance breaks down

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

Term	Description
integrated pest management	Use of pest and environmental information in conjunction with available pest control technologies to prevent unacceptable levels of pest damage by the most economical means and with the least possible hazard to persons, property, and the environment
larva	Recently hatched insect, fish, or other organism that has different physical characteristics than those seen in the adult, requiring metamorphosis to reach the adult body structure
leaching	Downward movement of pesticides into a soil profile with soil water
metabolite	Substance formed as a consequence of metabolism in an organism
microcosm or mesocosm	Man-made study system containing associated organism and abiotic components that is large enough to be representative of a natural ecosystem, yet small enough to be experimentally manipulated. Microcosms are generally smaller indoor systems; mesocosms are larger outdoor systems
mineralisation	Conversion of an element from an organic form to an inorganic form. Mineralisation of pesticides most commonly refers to the microbial degradation to carbon dioxide as a terminal metabolite
no observed effect level	Greatest concentration or amount of a substance, found by experiment or observation, which causes no detectable adverse alteration of morphology, functional capacity, growth, development, or life span of the target organism under defined conditions of exposure
non-target species	Organisms that are not the intended targets of a particular use of a pesticide
organophosphorus	Generic term for pesticides containing phosphorus but commonly used to refer to insecticides consisting of acetylcholinesterase inhibiting esters of phosphate or thiophosphate
partition coefficient	log Pow is the logarithm (base-10) of the partition coefficient between n-octanol and water
persistence	Residence time of a chemical species (pesticide and/or metabolites) subjected to degradation or physical removal in a soil, crop, animal, or other defined environmental compartment
photolysis	Chemical decomposition induced by light or other radiant energy
regulatory acceptable level	Criterion or standard that is considered safe or without appreciable risk
runoff	Portion of the wet precipitation on the land that ultimately reaches streams and, eventually, the sea
solubility in water	The mass of a given substance (the solute) that can dissolve in a given volume of water
surface water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors which are directly influenced by surface water
terrestrial	Relating to land, as distinct from water or air

Term	Description
vapour pressure	The pressure at which a liquid is in equilibrium with its vapour at a given temperature. It is a measure of the tendency of a material to vaporise. The higher the vapour pressure the greater the potential.
volatilisation	Evaporation of pesticides during and after application
watercourse	<p>A river, creek or other natural watercourse (whether modified or not) in which water is contained or flows (whether permanently or from time to time); and includes:</p> <ul style="list-style-type: none">• a dam or reservoir that collects water flowing in a watercourse• a lake or 'wetland' through which water flows• a channel into which the water of a watercourse has been diverted• part of a watercourse <p>an estuary through which water flows.</p>
wetland	<p>An area of land where water covers the soil—all year or just at certain times of the year. They include:</p> <ul style="list-style-type: none">• swamps, marshes• billabongs, lakes, lagoons• saltmarshes, mudflats• mangroves, coral reefs• bogs, fens, and peatlands. <p>A 'wetland' may be natural or artificial and its water may be static or flowing, fresh, brackish or saline.</p>

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