Section 3 Part 4

RESIDUE ASSESSMENT

Contents

5.1 INTRODUCTION

Diazinon was first reported in the chemical literature in 1953, and was subsequently patented and introduced by J.R. Geigy S.A. (now Novartis Crop Protection AG). It is being reviewed as part of the second cycle of the NRA's Chemicals Review Program. This evaluation presents the residue findings of that review. Re-evaluation of residue data is appropriate as diazinon has been in common use since the 1960's and many of the associated MRLs were established in the early 1960's and throughout the 1970's on the basis of residue studies which met the standards at that time but may not be appropriate today.

Diazinon is an organophosphorus insecticide and acaricide, which displays broad-spectrum activity against a variety of pests. These include sucking, chewing and boring insects as well as soil-living insects. It is generally applied by dermal or foliar contact, or oral delivery. Diazinon is used world wide on many commodities. For agricultural applications it is used either as a foliar or soil spray, or applied as a granule to the soil. Common veterinary applications principally involve its use as a dip or spray treatment against lice and flies.

Major target crops, which are included on product labels, are leafy, fruiting, stem and root vegetables, deciduous fruit, rice and maize. Minor crops for use include berries, cereals, citrus, grapes, mushrooms, nut trees and sugar beet. Use patterns have changed in recent years and the current major crop uses are pineapples and onions. Common uses which generally do not offer residue concerns include ornamentals, turf, grass and in nurseries. Diazinon is used in dips, jetting sprays, spot treatments, backrubbers and eartags for treating sheep, cattle, pigs and goats in cases of lice infestation and fly-strike.

Material specifically submitted for the review and from submissions previously made for registration purposes was considered in the residue evauation. Because diazinon has a long registration history, it is possible that all residue studies previously submitted for evaluation were not retrieved. Information in the Commonwealth Department of Primary Industries and Energy's National Residue Survey, Food Standards Australia New Zealand's Australian Market Basket Survey, diazinon evaluations by the FAO/WHO Joint Meeting on Pesticide Residues (JMPR) and the NRA's draft efficacy and trade reports (NRA Draft Efficacy and Trade Assessment Report Diazinon. May 1998 – Internal NRA document) on diazinon were also used or noted in the residue evaluation.

This report consists of an appraisal of the data and information presented and a series of recommendations. Information on Australian label use patterns and Australian MRLs, metabolism, analytical methodology, residue and other data presented on diazinon is also presented, as are considerations of the fat solubility and dietary intake of diazinon. Summaries of the Australian and of relevant overseas results are provided as attachments to the report where they have not been presented in summary form as part of the report.

5.1.1 Identity[1]

Active constituent: Diazinon
NRA file numbers: P44033, P44290, P44451, P44289, P44291, P44430, P44561, P46132
Trade Names: Diazinon
ISO Common name: Diazinon
Chemical name:
IUPAC *O,O*-diethyl *O*-2-isopropyl-6-methylpyrimidin-4-yl phosphorothioate

[1] From "A World Compendium The Pesticide Manual Incorporating the Agrochemicals Handbook", Eleventh Edition, Editor: Clive Tomlin, 1997.

CA *O,O*-diethyl *O*-[6-methyl-2-(1-methylethyl)-4-pyrimidnyl]phosphorothioate
CAS No.: [333-41-5]
Development codes: G-24480
Official code: OMS 469; ENT 19 507

5.1.2 Physical and chemical properties

Molecular formula: $C_{12}H_{21}N_2O_3PS$; Molecular weight: 304.3; Boiling point: 125°C/1 mm Hg; Vapour pressure: 1.2 x 10 mPa; Solubility: 60 mg/L (water, 20°C), completely miscible with common organic solvents.

5.1.3 Octanol-water partition coefficient

K_{ow} (log P) = 3.30. The FAO Manual on the Submission and Evaluation of Pesticide Residues Data for the Estimation of Maximum Residue Levels in Food and Feed (FAO, Rome, 1997, p.40) states that when the log P value exceeds 4, the compound would generally be designated as fat-soluble. Under this definition, diazinon is not considered fat-soluble. However residue studies generally reveal that it has a propensity for deposition in fat, and therefore most of the MRLs set for animal commodities are set with a designation 'in the fat', signifying that the MRL applies to the fat portion of the commodity.

5.1.4 Formulations

The NRA's records refer to registrations of blowfly/wound dressings, long-wool jetting solutions, sheep dipping/spraying solutions, flea collars, insect dusts/sprays, dog washes/shampoos, flea and tick sprays, cattle eartags, solution and dust spot treatments, yard and kennel insecticides, and solutions for spraying in gardens and on crops.

5.1.5 Australian MRLs

The current Australian MRLs for diazinon in food commodities are presented as follows (Table 1, *MRL Standard*, NRA, current at 8 May 2000).

Commodity	***MRL (mg/kg)***	***Year set***
Cereal grains	0.1	1974
Citrus fruits	0.7	1971
Edible offal (mammalian)	0.7	1990
Eggs	*0.05	1986
Fruits [except citrus fruits; olives; peach]	0.5	1971
Kiwifruit	0.5	1985
Meat (mammalian) [in the fat]	0.7	1990
Milks [in the fat]	0.5	1974
Olive oil, crude	2	1977
Olives [unprocessed]	2	1977
Peach	0.7	1971
Poultry, edible offal of	*0.05	1990
Poultry meat	*0.05	1986
Sugar cane	0.5	1975
Sweet corn (corn-on-the-cob)	0.7	1977
Tree nuts	0.1	1976
Vegetables oils, crude [except olive oil, crude]	0.1	1977
Vegetables	0.7	1974

*MRL was adopted from Codex.

The first recommendation for diazinon MRLs was made in 1962 by the Pesticides and Agricultural Chemicals Sub-Committee (PACSC) of the National Health and Medical Research Council (NHMRC). At this time, MRLs of 2 mg/kg were recommended for all commodities treated with diazinon based on a level regarded as acceptable when the toxicity of diazinon was considered. In 1964 under a petition from the Tasmanian authorities, and reconsideration of the toxicity of diazinon, the general tolerance for diazinon in all commodities was lowered to 0.75 mg/kg. Several international tolerances for diazinon were well advanced in the Codex, and in March of 1971 the PACSC recommended that these tolerances be adopted as Australian MRLs. MRLs of 0.7 mg/kg were recommended for peaches, citrus fruits and cole crops with all other fruits and vegetables subject to an MRL of 0.5 mg/kg. An MRL of 0.7 mg/kg for diazinon in the meat of cattle and sheep was recommended.
Also in 1971, the PACSC recommended the inclusion of diazinon use in pasture and forage crops in Section III of the *MRL Standard* of the time, which was to 'specify substances which when used according to registered directions should not result in residues of any significance remaining in or upon food'. In 1974, diazinon uses in pasture and forage crops were incorporated into the list, which was the equivalent at that time of the current Table 5 of the *MRL Standard*. However, this recommendation is not reflected in either Table 4 or Table 5 of the current *MRL Standard*.

The Codex MRL of 0.1 mg/kg for diazinon in cereal grains was adopted in 1974 to permit the use of diazinon for plague locust control and treatment of grain storage structures and transport vehicles. An MRL of 0.7 mg/kg for diazinon in the fat of pig meat was recommended at the same meeting to account for the registered use for control of lice in pigs. Adoption of many Codex MRLs in August of 1974 saw a change in the vegetables MRL to 0.7 mg/kg and, on application from Ciba-Geigy, a milk and milk products (fat basis) MRL of 0.5 mg/kg was introduced. Consideration of a further application from Ciba-Geigy led to the recommendation of an MRL for diazinon in sugarcane of 0.5 mg/kg in 1975.

The MRL for diazinon in nuts was recommended to the PACSC amongst a group of other minor-use recommendations in 1976. In 1977, harmonisation with Codex MRLs introduced new Australian MRLs for vegetable oil (except olive oil), 0.1 mg/kg; sweetcorn, 0.7 mg/kg; olives (unprocessed), 2 mg/kg; and olive oil, 2 mg/kg. The latter two MRLs were introduced in spite of the fact that there is no registered Australian use-pattern in olives.

The New Zealand Ministry for Agriculture Forestry and Fisheries (MAFF) requested a diazinon tolerance in kiwi fruit in 1978 due to a use-pattern in N.Z. The Committee recommended a kiwifruit MRL of 0.03 mg/kg based on residues in the edible portion of the fruit only, followed by a change to a wholefruit MRL of 0.3 mg/kg in 1979. In 1980, it was decided that MRLs which relate to cattle and sheep meat could be extended to goats. This resulted in an extension of the cattle, sheep and pig meat (in the fat) MRL to include goats. The N.Z. MAFF requested in 1985 that the original tolerances set for kiwifruit have the provisional status attached to them in error removed. The PACSC agreed to this and recommended a kiwifruit MRL of 0.5 mg/kg with the deletion of the whole fruit and edible portion MRLs that had been set previously.

It appears that the poultry meat and egg MRLs were introduced in 1986 as part of the revision of the *MRL Standard*, which occurred over that year. However there was no discussion in the PACSC minutes concerning the introduction of these MRLs. Consideration of a submission from Ciba-Geigy in 1990 for an MRL is horse meat and edible offal led to the changing of the meat of cattle, pigs, goats and sheep (in the fat) MRL to a mammalian meat (in the fat) MRL of 0.7 mg/kg and the recommendation of an edible offal (mammalian) MRL of 0.7 mg/kg based on argument that offal

residues of diazinon would not exceed those in fat (this was in accordance with accepted Codex principles at the time). It is assumed that the poultry offal MRL was introduced at the same time according to the same rationalisation used for mammalian offal.

5.2 Appraisal

The appraisal has evaluated the data and information available to determine whether current Australian MRLs remain supportable on residue grounds. Details of the residue trials are presented in Part 2, Section 7 of this report.

When the available data were insufficient, it was originally recommended that the present MRL be given a temporary status. Conversion of these temporary MRLs to full MRLs would have then been reliant on registrants undertaking relevant residue studies and submitting these to the NRA for evaluation within appropriate time frames. Following the consideration of comments received, including written undertakings to produce residue data to support continued use of diazinon in onions, pineapples, bananas and mushrooms, it is now proposed to delete all unsupported MRLs and reinstate MRLs once adequate residue data has been evaluated.

The evaluation also addresses diazinon metabolism, analysis in foods, fat solubility and levels in food available for consumption. The findings of the appraisal are summarised below. Detailed discussion of these aspects is presented in the second part of this report.

5.2.1 Animal Metabolism

In rats (Section 5.12.1), orally administered, radiolabelled diazinon was readily excreted (principally in urine). A minimal amount of the applied dose was found within tissues, and of this the majority was in fat. More than 90% of the applied dose could be accounted for in 168 hours of dosing, and depletion in the tissues and organs occurred to such an extent that negligible residues were observed after 2 days. The two metabolites which contributed to the majority of the recovered radioactivity in urine and faeces were G-27550 (2-isopropyl-6-methyl-4(1H)-pyrimidinone) and GS-31144 (2-(α-hydroxyisopropyl)-6-methyl-4(1H)-pyrimidinone) (chemical structures are shown in Appendix 1), neither of which contain the thiophosphate moiety.

Treatment of lactating goats (Section 5.12.2) with four consecutive daily doses of 200 ppm radiolabelled diazinon in the diet once again showed that diazinon was readily excreted. An average of 75% of the total dose was recovered in the excreta (~65% in urine). Sampling of tissues occurred 24 hours after the final dose. The percentage of the total dose present in the tissues was 0.9%, and the highest residue present in a single tissue occurred in kidney (2 ppm). Very little radioactivity was found in milk (0.3%). G-27550 and GS-31144 were the main components of the residues found in the excreta and most tissues. Diazinon made up the majority of the residue in fat.

Two sheep (Section 5.12.3) were dermally exposed to ^{14}C-diazinon with a treatment containing 40 mg/kg bw. The animals underwent 3 consecutive daily treatments and were sacrificed 6 hours after the final treatment. The highest concentrations of radioactivity found in the tissues were located in kidney (9.4 ppm) and back fat (7.3 ppm). Once again the major metabolites found in the tissues were GS-31144 and G-27550 (for chemical structures, refer to Appendix 1), except for fat which contained only labelled-diazinon as a residue. Diazinon also constituted a major proportion of the residue found in heart and leg muscle.

^{32}P-labelled diazinon was used to quantify the distribution of radioactivity in the blood, milk, urine and faeces of cows, which had been dosed at a rate of 20 mg/kg orally (Section 5.12.5). Blood

radioactivity fell below quantifiable levels after 96 hours. Milk radioactivity showed a marked fall after 36 hours and diazinon was not quantifiable in samples analysed after this time. Excretion via milk did not account for more than 0.01% of the total dose after 24 hours. Excretion of radioactivity in urine accounted for 74% of the total dose within 36 hours. After 96 hours, only traces of radioactivity were detectable in faeces.

Characterisation of ^{32}P-labelled diazinon in dog tissues (Section 5.12.6) after oral administration at a rate of 225 mg/kg revealed that urine, stomach contents and fat accounted for the majority of the dose at 10 hours after treatment. In another study, female beagles (n=2) were intravenously injected with diazinon (^{14}C-ethoxy) at 0.2 mg/kg. Two other beagles were orally dosed with ring ^{32}P-labelled diazinon at 4 mg/kg. Blood samples were taken for 7 hours after treatment and urine was collected at the end of 24 hours. Urine recovery of radioactivity was 58% of the administered dose within 24 hours for the ^{32}P-labelled dose. The two major metabolites in this case were found to be the pyrimidinols G-27550 and GS-31144. Unchanged diazinon was not observed in urine. It was concluded that diazinon metabolism in the dog is rapid and relatively complete, showing gross similarities to the behaviour in rats in terms of the metabolites formed.

5.2.2 Plant Metabolism

Plant metabolism studies were reviewed in 1993 by the Joint Meeting on Pesticide Residues (JMPR) for the Codex Committee on Pesticide Residues (CCPR). Plant metabolism studies were not provided to the Chemical Review Program in support of agricultural uses, as the key manufacturers of diazinon-based agricultural products in Australia (Novartis, Crop Care and Rhone Poulenc) have withdrawn their support for registration of these products.

The 1993 JMPR summary of diazinon metabolism in plants covers studies in apples, beans, maize, lettuce, potatoes, rice and rotational crops. A metabolic pathway for diazinon in plants has been elucidated as a result of these studies, and identical metabolites were found in apples, beans, maize, lettuce, potatoes and rice. A diagram to represent metabolism in plants is given in Appendix 1. The key plant metabolites are the pyrimidinols G-27550 and GS-31144 resulting from hydrolysis of the thiophosphate ester, and hydrolysis of the thiophosphate ester followed by oxidation of the methine carbon of the isopropyl group, respectively. Other metabolites result from oxidation of the various methyl substituents of the pyrimidinol G-27550, and subsequent conjugation of the group of isomeric hydroxy-pyrimidinols to glucose and malonyl-glucose.

5.2.3 Metabolism Overview

The metabolism of diazinon in animals was adequately detailed in the reports evaluated. The animal metabolism studies identify diazinon as a readily excreted and metabolised pesticide, despite its propensity for deposition in fatty tissues. While deposition of diazinon residues occurred mainly in fat, this effect was not bioaccumulative and even fat residues decreased rapidly with time (days). In general, it was found that when diazinon was administered orally to animals, disposition involved rapid absorption and elimination. The two main metabolites found in all tissues except fat and excreta were the pyrimidinols G-27550 and GS-31144. These metabolites do not display the level of cholinesterase inhibitory activity that is observed with diazinon and the metabolites that contain an intact pyrimidinyl phosphorus ester bond. Therefore, the most significant compound, from a residue perspective, is diazinon. The metabolic pathway for diazinon is animal species-dependent. The proposed metabolic pathways of diazinon in mammals are provided in Appendix 1.

The same pyrimidinol metabolites (G-27550 and GS-31144) found to constitute the majority of the residue from diazinon in animals have also been shown to be the main compounds resulting from plant metabolism of diazinon.

5.2.4 Methods of residue analysis

The reports evaluated confirm that determination of diazinon is readily achieved at satisfactory limits of quantitation and with adequate recoveries in a wide variety of plant and animal matrices. The methods reviewed use traditional extraction and clean-up techniques with gas chromatographic determination. Although not required by the residue definition, diazoxon and G-27550 are also determinable by one of these methods of analysis.

5.2.5 Residue definition

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.

5.2.6 Diazinon residues resulting from supervised trials

Australian residue data are 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. The results from a processing study which investigated the level of diazinon residues in butter and cream derived from the milk of treated cows is also included in these data. In the evaluation process, use patterns of the pioneer products by Novartis Animal Health were generally used to define 'the use pattern'. A tabulated summary of the residue trials conducted is given on page 30 of this report.

Australian residue data for diazinon use in crops were not presented to the Chemical Review Program.

5.2.7 Use Patterns

Diazinon is used in a wide range of products, most notably as an ectoparasiticide in sheep and cattle. It is used in collars and washes for external parasite control in companion animals. There are registered products for use in farm buildings, kennels, stables and piggeries. Use on lawns and turf is recommended for control of Argentine stem weevil, African black beetle, mole cricket and grass eating caterpillars, Argentine ants, cutworms, couch tip maggot, couch mite, couch mealy bug and couch flea beetle. Use of diazinon-based products in commercial and industrial buildings involves label warnings which specify that the products are not to be used 'where there is exposed food, food utensils or food processing machinery' or 'in food preparation areas, eg. kitchen, tea room'. Home garden uses include as an ant dust/spray around paths, gardens and building foundations. It is currently registered in a product used as an insecticidal surface spray, the label of this product giving similar restrictions to those above, warning that in using the product do not 'allow spray to drift onto exposed food, food utensils or food processing machinery'.

Crop Uses

The major manufacturers of diazinon-based products for agricultural uses have decided not to renew registration on these products. The Crop Care product, Crop King Diazinon 800 EC, is no longer being offered for sale and registration has not been renewed. Novartis (previously Ciba-Geigy) and Rhone-Poulenc Rural Pty Ltd did not renew registration of their products in 1998-9. The companies currently hold no stock themselves and they expected distributed stock to be exhausted by December 1999. Novartis indicated that although they will not be supporting the crop uses of diazinon, they will support registration of the active and products designed for animal use. There are currently two registered diazinon products for agricultural use and one product, in a 5L pack only, aimed primarily at turf use which also recommends use on vegetables and pasture. Table 1 shows the use patterns for products designed for use in crops. Data in Tables 1 and 2 were obtained from product labels.

Table 1. Agricultural products containing diazinon

Product Name	Company Name	Crop	Withholding period
Country Diazinon 800 Insecticide	A & C Rural Pty. Ltd.	crops, orchards, vegetables	14 days (stock and food)
Pro-Am Diazinon A-Tee	Robert Linton/Wesfarmers Dalgety Ltd.	pasture, vegetables	2 days (stock), 14 days (food)
Barmac Diazinon	Barmac Industries Pty. Ltd.	crops, orchards, vegetables	2 days (stock), 14 days (food)

A comprehensive tabulation of agricultural use-patterns associated with currently registered agricultural products appears in Appendix 3 'Australian use-patterns for diazinon agricultural products'.

Veterinary Uses

Products registered for use on companion animals are not discussed here. Predominantly, diazinon-based products are used for the treatment of blowfly, lice and ked in sheep and buffalo fly in cattle. Table 2 shows the use patterns for some of the products registered for this purpose.

Table 2. Examples of veterinary products containing diazinon and their use patterns

Product Name	Company Name	Animal and maximum application rate	Withholding period
David Grays Diazinon Sheep Dip, Jetting Fluid and Blowfly Dressing	David Gray & Co. Pty. Ltd.	Sheep, 0.1 g a.i./L (lice), 0.2 g a.i./L (fly), 0.4 g a.i./L (jetting & replenish)	Nil
Coopers 4 in 1 Dip	Schering-Plough Animal Health Ltd.	Sheep, 0.15 g a.i./L	14 d
Coopers Di-Jet Sheep Dip/Jetting Fluid, Cattle and Pig Spray	Schering-Plough Animal Health	Sheep, 0.2 g a.i./L Cattle, 0.5 g a.i./L Pigs, 0.5 g a.i./L Goats, 0.5 g a.i./L	14 d (meat) 3 d (meat), nil (milk) 14 d (meat) 14 d (meat), 48 hr (milk)
Coopers Fly Strike Powder	Schering-Plough Animal Health Ltd.	Sheep, cattle, pigs, goats, used as 15 g a.i./L spot treatment	3 d (cattle), 14 d (sheep, pigs, goats)
Topclip Blue Shield Sheep Dip, Jetting Fluid and Blowfly Dressing	Novartis Animal Health Australasia Pty. Ltd.	Sheep, 0.2 g a.i./L (dip), 0.4 g a.i./L (jetting)	14 d
Nucidol 200 EC Insecticide & Acaricide	Novartis Animal Health Australasia Pty. Ltd.	Cattle: Lice 0.5 g a.i./L (high volume 4-5L per beast) or 1 g a.i./L (low volume 2-3L per beast), Fly 0.8 g a.i./L & 500 mL per beast, Back rubber 100 g a.i./10 L oil Pigs: 0.5 g a.i./L Goats: 0.5 g a.i./L	3 d No milk withholding for cattle or goats 14 d 14 d
Spike Insecticidal Cattle Ear Tags	Novartis Animal Health Australasia Pty. Ltd.	1 tag per ear of animal (tags contain 200 g/kg)	Nil
Y-Tex Optimizer Insecticidal Cattle Ear Tags	Flycam Pty. Ltd.	1 tag per ear of animal (200 g a.i./kg)	Nil
Coopers Blaze Long Woolled Sheep Lice Treatment	Schering-Plough Animal Health Ltd.	96 g a.i./L + cypermethrin – 5.25 mL/sheep (1.5 – 4 months wool), 10.5 mL/sheep (5 – 9 months wool)	14 d
Coopers Blitz Sheep Blowfly Suppressant	Schering-Plough Animal Health Ltd.	96 g a.i./L + cypermethrin – 10.5 mL/sheep (1 – 9 months wool)	14 d
KFM Blowfly Dressing	Nufarm Ltd.	30 g a.i./L + tar etc. as a spot treatment; 1 L/5 L water as a spot treatment	Nil
Diazol Sheep Dip, Jetting Fluid and Blowfly Dressing	Makhteshim-Agan (Aust.) Pty. Ltd.	Sheep, 200 g a.i./L Dip: 1 L/1000 L, Jet 400 mL/200 L, Dressing 5 mL/1 L	14 d
Virbac Jetdip 4 in 1 Sheep Dip	Virbac (Australia) Ltd.	Sheep, 0.2 g a.i./L	14 d (meat), 2 months (wool)
Virbac Jetdip Sheep Jetting Fluid & Blowfly Dressing	Virbac (Australia) Ltd.	Sheep, 200 g a.i./L Dip 0.1 – 0.2 g a.i./L, Jet 0.4 g a.i./L (in Qld. only double concentration is permitted when fly pressure is a maximum)	14 d (meat), 2 months (wool)

5.3 Reevaluation of the Current MRLs

Current relevant MRLs for diazinon are as follows:

Commodity	Australian MRL (mg/kg)	Codex MRL (mg/kg)
Almond hulls	-	5.0
Almonds	-	0.05
Blackberries	-	0.1
Boysenberry	-	0.1
Broccoli	-	0.5
Cabbages, head	-	2.0
Cantaloupe	-	0.2
Carrot	-	0.5
Cereal grains	0.1	-
Cherries	-	1.0
Chinese cabbage (type pe-tsai)	-	0.05
Citrus fruits	0.7	-
Common bean (pods and/or immature seeds)	-	0.2
Cucumber	-	0.1
Currants, Black, Red, White	-	0.2
Edible offal (mammalian)	0.7	-
Eggs	*0.05	-
Fruits [except citrus fruits; olives; peach]	0.5	-
Garden pea, shelled	-	0.2
Hops, dry	-	0.5
Kale	-	0.05
Kidney of cattle, goats, pigs and sheep		0.03
Kiwifruit	0.5	0.2
Kohlrabi	-	0.2
Lettuce, head	-	0.5
Lettuce, leaf	-	0.5
Liver of cattle, goats, pigs and sheep		0.03
Maize	-	*0.02
Maize forage	-	10.0
Meat of cattle, pigs & sheep	-	0.7 [in the fat]
Meat (mammalian) [in the fat]	0.7	-
Milks	0.5 [in the fat]	0.02 (F)
Olive oil, crude	2	-
Olives [unprocessed]	2	-
Onion, bulb	-	0.05
Peach	0.7	0.2
Peppers, sweet	-	0.05
Pineapple	-	0.1
Plums (including prunes)	-	1.0
Pome fruits	-	2.0
Potato	-	*0.01
Poultry, Edible offal of	*0.05	-
Poultry meat	*0.05	-
Prunes	-	2.0
Radish	-	0.1
Raspberries, Red, Black	-	0.2
Spinach	-	0.5
Spring onion	-	1.0
Squash, summer	-	0.05
Strawberry	-	0.1
Sugar beet	-	0.1
Sugar beet leaves or tops	-	5.0

Sugar cane	0.5	-
Sweet corn (corn-on-the-cob)	0.7	0.02
Tomato	-	0.5
Tree nuts	0.1	-
Vegetable oils, crude [except olive oil, crude]	0.1	-
Vegetables	0.7	-
Walnuts	-	*0.01

(F) - For a "milk product" with a fat content less than 2%, the MRL applied should be half that specified for milk. The MRL for "milk products" with a fat content of 2% or more should be 25 times the MRL specified for milk, expressed on a fat basis.

Japanese and U.S. MRLs for diazinon are detailed in Appendix 2 for comparison against those listed above. In relation to the current MRLs (as set out in Table 1 of the *MRL Standard*), the following conclusions were reached in the initial diazinon review report:

5.3.1 Cereals, Nuts, Fruits and Vegetables

MRLs associated with crop uses include cereal grains (0.1 mg/kg), citrus fruits (0.7 mg/kg), fruits (except citrus, olives, peach) (0.5 mg/kg), kiwifruit (0.5 mg/kg), olive oil, crude (2.0 mg/kg), olives [unprocessed] (2.0 mg/kg), peaches (0.7 mg/kg), sugar cane (0.5 mg/kg), sweet corn (corn-on-the-cob) (0.7 mg/kg), tree nuts (0.1 mg/kg), vegetable oils, crude [except olive oil, crude] (0.1 mg/kg) and vegetables (0.7 mg/kg). No residue studies were presented for these commodities for the Chemical Review of diazinon. However, an extensive periodic review of diazinon in crops was conducted by the 1993 JMPR. Use of these data has allowed the adoption of several Codex MRLs as temporary MRLs until Australian residue data can be generated to support agricultural use-patterns. The lack of Australian residue studies submitted to the review means that the current MRLs for 'fruit' and 'vegetables' can not be supported. The Codex residue definition for diazinon is diazinon parent.

The registrations of the pioneer product and one image product for use on crops have been allowed to lapse by the respective registrants. The majority of the individual commodity and group MRLs, originally to be recommended as temporary MRLs, do not appear to be required as the remaining registrants of diazinon-based products for crop use do not choose to submit residue data to support their products. As a commitment to generate data has not been forthcoming except in the case of onions, pineapples, bananas and mushrooms, the MRLs for all other commodities are to be suspended in line with the review recommendations.

Individual fruit and vegetable residue data, reviewed by the 1993 JMPR, are discussed below in terms of the registered use-pattern in the country where the data were generated, and the relevance of these use-patterns to Australian GAP. In cases where the overseas and Australian use-patterns are comparable, a recommendation to adopt the Codex MRL as a temporary MRL for the particular commodity was made. Commodities identified to the review as having 'essential' diazinon use-patterns associated with them have been addressed first. Where appropriate, those uses identified as 'non-essential' have been accommodated with temporary group MRLs that covers both the 'essential' and 'non-essential' uses. Commodities of secondary consideration are addressed briefly, later in the evaluation. The relevant residue data have been summarised, but are not reproduced in this evaluation. The reader is referred to the published data should further detail be required (Diazinon, *Report of the Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group on Pesticide Resides, Pesticide Resides in Food*, 1993).

5.3.2 Beans and Peas

The maximum Australian use-pattern for diazinon in beans is 560 g a.i./ha (700 mL EC product/ha) sprayed onto crops as necessary according to pest pressure from bean caterpillar. Use-patterns involving lower rates are specified for control of bean fly and blossom thrips (24 g a.i./100 L). Maximum numbers of sprays and minimum spray intervals are not specified on product labels, except for bean fly control where weekly intervals are recommended after 3 sprays at 3, 7 and 14 days after plant emergence. A pre-planting use-pattern is also available for control of seed maggot – 2400 – 4000 g a.i./ha sprayed onto soil before sowing and worked into a depth of 5 to 8 cm. The withholding period for all of these use-patterns is 14 days.

Treatment of peas with diazinon falls under the Australian use-pattern specified as 'sundry vegetables' - unlimited boom spray treatments of EC using a rate of 560 – 1120 g a.i./ha as required for control of caterpillar and cutworm. The rate is varied according to crop size. A minimum spray interval is not specified for this use. The withholding period is 14 days.

Data presented to the 1993 JMPR for common beans, dwarf french beans and yardlong beans were generated according to Canadian, Swiss, Thai and U.S. GAP. Of the data presented from these 4 countries, the critical GAP was from Thailand for yardlong beans which was 5 foliar sprays of EC formulation at 3.9 and 7.8 kg a.i./ha using spray concentrations of 0.18 and 0.36 kg a.i./100L, respectively. At 14 days after the final application, residues in beans were <0.01 – 0.02 mg/kg. The Codex MRL estimated from these trial data was 0.20 mg/kg based on a PHI of 7 days. In view of the higher application rates used in the international trials and the observance of a withholding period shorter than that specified under Australian GAP, the Codex MRL is appropriate for adoption as a temporary MRL in beans. A temporary MRL of 0.2 mg/kg for diazinon in beans will be recommended while appropriate Australian residue data are generated for the purpose of establishing a permanent MRL.

Data presented to the 1993 JMPR for peas were generated according to U.S. GAP. Twenty trials involved a single (granular or EC) pre-plant application of diazinon at 4.4 kg a.i./ha, followed by 3-5 foliar sprays of EC or WP formulation at 0.83 kg a.i./ha using spray concentrations of 0.11-0.45 kg a.i./100L. At 14 days after the final application, residues in peas were <0.01 – 0.09 mg/kg. The Codex MRL estimated from these trial data was 0.20 mg/kg based on a PHI of 7 days. The application rate in the U.S. trials was 0.75x the maximum rate under Australian GAP and U.S. GAP permits a shorter withholding period than Australian GAP. The Codex MRL is considered appropriate for adoption as a temporary MRL in peas. A temporary MRL of 0.2 mg/kg for diazinon in peas will be set to permit the generation of appropriate Australian residue data in support of a permanent MRL.

5.3.3 Beetroot and Carrot

The maximum Australian use-pattern for diazinon in beetroot is 800 g a.i./ha (1L product/ha) of EC applied to advanced crops, with spraying as necessary for control of webworm. Maximum number of sprays, minimum spray intervals and typical spray volumes are not specified on product labels. The withholding period is 14 days.

The maximum Australian use-pattern for diazinon in carrot is 1.6 kg a.i./ha (1.4 L product/ha) of EC applied to advanced crops, with spraying as necessary according to pest pressure from caterpillars and cutworms. Rates as low as half the maximum rate are acceptable for use on small plants, the maximum rate being recommended for larger plants. Maximum numbers of sprays, minimum spray

intervals and typical spray volumes are not specified on product labels. The withholding period is 14 days.

Data presented to 1993 JMPR for sugarbeet were generated according to German, Swiss and U.S. GAP. Of the data presented from these 3 countries, the critical GAP from the US involved 1 application at 5.5 kg a.i./ha as a granular pre-plant treatment + 5 foliar spray treatments at 0.55 kg a.i./ha. At 14 days after the final application, residues in roots and tops were <0.01 – 0.10 mg/kg and <0.02 – 2.51 mg/kg, respectively. The Codex MRL estimated from these trial data was 0.10 mg/kg.

Data presented to the 1993 JMPR for carrots were generated in Germany, the Netherlands, Switzerland and the U.S.A., however only the U.S. data were generated according to that country's GAP. The critical GAP from the U.S. involved 1 application at 4.4 kg a.i./ha as a granular pre-plant treatment plus 5 foliar spray treatments at 0.55 kg a.i./ha. At 14 days after the final application, residues were below 0.3 mg/kg, and at 7 days, residues were below 0.5 mg/kg. The Codex MRL estimated from these trial data was 0.50 mg/kg based on a 7 day withholding period.

In view of the higher application rate and unlimited number of sprays possible under Australian GAP, neither of the Codex MRLs are appropriate for adoption as a temporary MRL in root vegetables. The existing MRL of 0.7 mg/kg for vegetables is amended to a temporary MRL of 0.7 mg/kg for diazinon in root vegetables, to cover use in beetroot and carrots while appropriate Australian residue data are generated for the purpose of establishing a permanent MRL.

5.3.4 Cauliflower

The maximum Australian use-pattern for diazinon in cauliflower is 1.6 kg a.i./ha (1.4 L product/ha at a spray concentration of 52-112 g a.i./100L) of EC applied to advanced crops, with spraying at 10-14 day intervals. Rates as low as half the maximum rate are acceptable for use on small plants, the maximum rate being recommended for larger plants. The withholding period is 14 days.

Data presented to JMPR were considered insufficient for the purpose of estimating an MRL. German trial data were considered unacceptable, as there was no GAP for diazinon use in cauliflowers in Germany. The German data could be compared to Swiss GAP (multiple applications at a rate of 0.1 g a.i./metre of row), however 3 trials were considered too small for the purpose of estimating an MRL. U.S. data were presented for broccoli and head cabbages, which, in conjunction with the cauliflower data, allow useful extrapolation to a group MRL for brassica vegetables under which diazinon use in cauliflower would be covered. The Australian use-pattern in broccoli and head cabbages is the same as that specified on labels for cauliflower.

Data presented to JMPR for broccoli were generated according to U.S. GAP. Ten trials were presented and the maximum treatment rate involved 1 application of diazinon at 4.4 kg a.i./ha as a granular pre-plant treatment, followed by 5 foliar spray treatments at 0.55 kg a.i./ha (using either an EC or WP product as the basis of the spray mixture). At 7 days after the final application, the maximum residue was 0.23 mg/kg, and at 14 days withholding the maximum residue was 0.10 mg/kg. The Codex MRL estimated from these trial data was 0.50 mg/kg based on a 7 day withholding period.

Data presented to JMPR for head cabbages were generated in Germany, Switzerland and the U.S., however only those trials conducted according to U.S. GAP were considered for the purpose of estimating an MRL in cabbage. Twenty trials were presented and the maximum treatment involved 1 application of diazinon at 4.4 kg a.i./ha as a pre-plant treatment, followed by 5 foliar sprays at 0.55 kg a.i./ha (using either an EC or WP product as the basis of the spray mixture). At 7 days after the final application, the maximum residue was 1.80 mg/kg, and at 14 days the maximum residue was 1.13

mg/kg. The Codex MRL estimated from these trial data was 2 mg/kg based on a 7 day withholding period.

The application rate for brassica vegetables is ~3 times higher under Australian GAP compared with the U.S. GAP used in trials presented to JMPR. Australian GAP also permits an unlimited number of sprays as opposed to a restricted number of sprays under U.S. GAP. Despite these differences, the current Australian MRL of 0.7 mg/kg for 'vegetables' which covers use in brassica vegetables is less than half the Codex MRL estimated for head cabbage by the 1993 JMPR. A temporary MRL of 2 mg/kg for diazinon in brassica (cole or cabbage) vegetables, head cabbages and flowerhead brassicas is recommended to cover use in cauliflower and other brassicas while appropriate Australian residue data are generated for the purpose of establishing a permanent MRL.

5.3.5 Cucurbits

Two Australian use-patterns exist for crops which fall into the fruiting vegetables, cucurbits grouping. Product labels permit an unlimited number of sprays at 280 g a.i./ha for control of thrips in all cucurbit crops. The maximum use-pattern described for chokos, cucumbers, gherkins, marrows, pumpkin and squash allows unlimited spray treatments at 560 – 1120 g a.i./ha for control of caterpillars and cutworms. A minimum spray interval is not specified for either of these uses. The withholding period for both use-patterns is 14 days.

Data presented to the 1993 JMPR for diazinon in cucumber, cantaloupe, summer squash and zucchini were generated according to U.S. GAP. Japanese and Swiss trials were also presented for cucumber. In four Japanese trials in cucumber, a maximum treatment of 3 spray applications of EC formulation at a rate of 0.8 kg a.i./ha using a spray concentration of 0.04 kg a.i./100L was employed. Diazinon residues in cucumber ranged from 0.002 – 0.012 mg/kg at 10 days after the final application and 0.002 – 0.003 mg/kg at 15 DAT (only 2 trials sampled at the 15 day timepoint, the other two sampled only after 31 days). The Swiss trial involved a single treatment with a dustable powder formulation at 0.8 kg a.i./ha to cucumber and diazinon was detected at 0.03 mg/kg at 5 DAT. In ten U.S. trials, cucumber crops received a single, pre-planting treatment of 4.48 kg a.i./ha as a granular formulation followed by 5 foliar sprays with either a WP or EC formulation at a rate of 0.84 kg a.i./ha. Samples were collected at 0, 3 and 7 DAT in the majority of trials and at 14 days in 2 trials. Diazinon residues in cucumber at 7 DAT ranged from <0.01 – 0.4 mg/kg, and were <0.01 mg/kg in both 14 day samples. On the basis of these data, a Codex MRL of 0.1 mg/kg was set for diazinon in cucumbers. Note that the residue at 0.4 mg/kg from the U.S. trials was discounted as an outlier, on the basis of a residue of 0.2 mg/kg at 3 DAT observed in the same trial.

Fourteen trials in cantaloupe were conducted according to U.S. GAP. The use-pattern involved a single pre-plant application of a granular formulation at a rate of 4.4 kg a.i./ha, followed by five foliar sprays at weekly intervals with WP or EC formulations at a rate of 0.83 kg a.i./ha. Samples were collected at 0, 3 and 7 days in all trials and at 14 days in two trials. At 7 days after the final spray, diazinon residues ranged from 0.02 – 0.18 mg/kg. Residues in the 14 day samples were 0.01 and 0.02 mg/kg. The JMPR recommended a Codex MRL of 0.2 mg/kg for diazinon in melon on the basis of the data where a 7 day PHI had been observed.

Eight trials in summer squash and four trials in zucchini were conducted according to U.S. GAP. The use-pattern involved a single, pre-plant treatment using a granular formulation at 4.48 kg a.i./ha followed by 5 foliar sprays at weekly intervals using either WP or EC formulations at 0.83 kg a.i./ha. Summer squash samples were collected at 3 and 7 days after the final spray in most trials, at 3, 7 and 14 days in 2 trials, and at 3 and 14 days in two further trials. At 7 DAT, diazinon residues in squash ranged from <0.01 – 0.03 mg/kg, and at 14 DAT were <0.01 – 0.01 mg/kg. Zucchini samples were

collected at 3 and 7 days after the final spray. Diazinon residues were between <0.01 and 0.05 mg/kg at 7 DAT. On the basis of these data, an MRL of 0.05 mg/kg was recommended for summer squash.

The data presented to the JMPR for cucumbers and melon represent residues derived from crop treatment at a rate of 0.75x of the maximum Australian label rate, and MRLs were recommended with the consideration of a 7 day PHI. At 14 days after the final spray treatment in the overseas trials, diazinon residues were typically <0.05 mg/kg in the crops analysed. Consideration of the international data, along with the observance of a 14 day WHP as part of the Australian use-pattern, permits the recommendation of a temporary MRL of T 0.2 mg/kg for diazinon in fruiting vegetables, cucurbits while appropriate Australian residue data are generated for the purpose of establishing a permanent MRL.

5.3.6 Garlic, Onion and Leek

The maximum Australian use-pattern for foliar treatment with diazinon in garlic and onions is 560 g a.i./ha (700 mL EC product/ha at a spray concentration of 52 g a.i./100L), with spraying at 10 day intervals as required for control of onion thrip and onion seedling maggot/fly. A pre-plant use-pattern also applies to onions, and permits spray application of up to 4 kg a.i./ha to soil before sowing. The withholding period for both of these uses is 14 days.

Diazinon use in leeks is approved in two current NRA minor-use permits (PER2492 and PER3293). The use-pattern requested in leeks is as per the label directions for onions, with a WHP of 14 days. Residue data will be required to consider renewal of these permits.

No data were presented to the 1993 JMPR for use of diazinon in garlic. Onion residue data, generated in Finland, Germany, Switzerland and the U.S.A., were reviewed. Only the U.S. data comparable to that country's GAP were considered. The maximum treatment in the U.S. trials involved 1 application of diazinon at 4.4 kg a.i./ha as a pre-plant treatment, followed by 3 foliar sprays at 0.55 kg a.i./ha, using either an EC or WP product for the sprays. At 10-11 days after the final application, residues ranged from <0.01 – 0.04 mg/kg. At 14 days, residues ranged from <0.01 – 0.02 mg/kg. The Codex MRL for onions estimated from these data was 0.05 mg/kg based on a 10 day withholding period.

The Australian and U.S. maximum application rates are very similar, the only difference being that the current Australian labels permit unlimited numbers of sprays. Despite this difference, adoption of the Codex MRL for onions as a temporary MRL of T 0.05 mg/kg for diazinon in bulb vegetables is recommended to cover use in garlic and onions until appropriate Australian residue data are generated to establish permanent MRLs for these commodities.

5.3.7 Macadamia nut

The maximum Australian use-pattern for foliar treatment with diazinon in macadamia nuts is thorough spray coverage of the tree canopy at a spray concentration of 100 g a.i. (as the E.C.)/100L of water, applied at monthly intervals to control macadamia felted coccid or macadamia leaf miner. The withholding period for this use is 14 days.

Residue data for macadamia nuts were not presented to the 1993 JMPR. However, residue data for almonds and walnuts were reported in the JMPR review and, on the basis of these data, a group MRL in tree nuts can be recommended to permit use of diazinon in macadamia nuts.

Data presented to JMPR for almonds were generated according to U.S. GAP. Thirteen trials were presented and the maximum treatment involved 1 spray of diazinon at 3.3 kg a.i./ha at the dormant

period, followed by 3 foliar sprays at 3.3 kg a.i./ha, using either an EC or WP product. At 45 days after the final application residues were <0.01 – 0.02 mg/kg in nuts. Residues up to 0.08 mg/kg were observed at 0 DAT. The Codex MRL estimated from these data was 0.05 mg/kg. It was unclear from the report what the corresponding withholding period was for this MRL.

Data presented to JMPR for walnuts were generated according to U.S. GAP. Twenty-four trials were presented and the maximum treatment involved 1 application of diazinon at 3.3 kg a.i./ha at a dormant period, followed by 3 foliar sprays at 3.3 kg a.i./ha, using either an EC or WP product. At 45 days after the final application residues were <0.01 mg/kg. Samples collected at 0, 14 and 28 days after the final application also showed no detectable residues. The Codex MRL estimated from these trial data was *0.01 mg/kg based on a nil withholding period (0 DAT).

On the basis of these data, a temporary MRL of 0.1 mg/kg is recommended for treenuts, to cover the use of diazinon in macadamia nuts. Although a nil withholding period may be recommended on the basis of the data presented to the JMPR, the current 14 day withholding period for macadamia nuts should be retained until appropriate Australian residue data are generated for the purpose of establishing permanent MRLs.

5.3.8 Mushroom, Sweetcorn and Capsicum

Two Australian use-patterns exist for treatment of mushrooms with diazinon. These are treatment of compost at spawning as 112 g a.i./10L water/tonne moist compost, and/or 24 g a.i./10L water/tonne moist compost applied as a spray over the top of the casing soil immediately after casing. The withholding period for this use is 14 days.

Use of diazinon in sweetcorn and capsicum has been identified as non-essential by a survey of grower peak bodies by the Chemical Review Program. The maximum Australian use-pattern in sweetcorn allows unlimited sprays at 560 – 1120 g a.i./ha for control of caterpillars and cutworms. The use-pattern is the same for capsicum, the number of applications being reliant only on cutworm pest pressure. A minimum spray interval is not specified for either of these uses. The withholding period for both use-patterns is 14 days.

Data from the Netherlands were presented to the 1993 JMPR for mushrooms which did not reflect the current withholding period for GAP in that country. The JMPR did not estimate an MRL on the basis of those data. The maximum rate in the studies was 50 g a.i./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.

Ten trials conducted according to U.S. GAP were presented to the 1993 JMPR for green peppers/capsicum. The use-pattern involved a single, granular, pre-plant treatment at 4.48 kg a.i./ha followed by 5 foliar sprays of 0.56 kg a.i./ha at weekly intervals with either a WP or EC formulation. Diazinon residues in capsicum were <0.01 – 0.09 mg/kg at 3-4 days after the final spray, and 0.01 – 0.02 mg/kg at 14 DAT (results from only 2 trials). A Codex MRL of 0.05 mg/kg in sweet peppers was recommended on the basis of these data.

Thirty-six trials conducted according to U.S. GAP were presented to the 1993 JMPR for sweet corn, and a further 4 trials conducted according to Thai GAP were also considered. The use-pattern in the U.S. trials involved a single, granular, pre-plant treatment at 4.4 kg a.i./ha, followed by 5 foliar sprays at fortnightly intervals with either a WP or EC formulation at a rate of 1.38 kg a.i./ha. Thai trials were conducted using 4 EC spray applications at rates of 0.65 and 2.12 kg a.i./ha. Diazinon residues in sweet corn were <0.01 mg/kg at 10 - 14 days after the final spray. A Codex MRL of 0.02 mg/kg was recommended based a WHP of 7 days.

Despite the absence of applicable Australian or overseas data for diazinon use in mushrooms, a temporary MRL of 0.05 mg/kg for fruiting vegetables other than cucurbits is recommended to cover use of diazinon in mushrooms, capsicum and sweetcorn until appropriate Australian residue data are generated for the purpose of establishing permanent MRLs in these commodities.

5.3.9 Pineapple

Two Australian use-patterns for foliar treatment of pineapple with diazinon are approved. The first involves spraying at a spray concentration of 52g a.i./100L, at up to 3000L/ha (1560 g a.i./ha), at 2-3 week intervals or as required for pineapple scale. The second involves unlimited boom spray treatments at a rate of 3L product/ha (2400 g a.i./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 presented by the U.S. 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 a.i./100L, or 3 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 a.i./ha. At 7 days after the final application, residues in whole fruit ranged from <0.02 – 0.07 mg/kg. The Codex MRL estimated from these trial data was 0.10 mg/kg. However, in view of the much higher application rate and unlimited number of sprays possible under Australian GAP, the Codex MRL is not appropriate for adoption as a temporary MRL in pineapple. A temporary MRL of 0.5 mg/kg for diazinon in pineapple is recommended while appropriate Australian residue data are generated for the purpose of establishing a permanent MRL.

5.3.10 Celery and Rhubarb

Use of diazinon in celery and rhubarb fall under the use-pattern described for 'sundry vegetables' on product labels. This use-pattern involves unlimited boom spray treatments of EC using a rate of 560 – 1120 g a.i./ha as required to control caterpillar and cutworm. The rate is varied according to the plant size. A minimum spray interval is not specified for this use. The withholding period is 14 days.

Limited residue data in artichoke and witloof chicory (both members of the stalk and stem vegetable grouping along with celery and rhubarb) were presented to the 1993 JMPR. These data were considered insufficient for the purpose of recommending Codex MRLs in these two commodities. In light of the lack of Australian and overseas data to support the use of diazinon in celery or rhubarb, a temporary MRL of 0.7 mg/kg for diazinon in stalk and stem vegetables is recommended to permit the generation of appropriate Australian residue data to establish a permanent MRL for this crop grouping, or alternatively individual MRLs for celery and rhubarb.

5.3.11 Silverbeet and Lettuce

The maximum Australian use-pattern for diazinon in silverbeet is 800 g a.i./ha (1L EC product/ha) applied to advanced crops, with spraying as necessary according to pest pressure from webworm. Maximum numbers of sprays, minimum spray intervals and typical spray volumes are not specified on product labels. The withholding period is 14 days.

Use of diazinon in lettuce has been identified by the QDPI as non-essential. The current Australian use-pattern for lettuce is that described for 'sundry vegetables' on product labels, ie. unlimited boom spray treatments of EC formulation at 560 – 1120 g a.i./ha as required for control of caterpillar and

cutworm. The spray concentration is varied according to crop size. A minimum spray interval is not specified for this use. The withholding period is 14 days.

Residues of diazinon in silverbeet were not considered as part of the 1993 JMPR review. However, diazinon use in other leafy vegetables, including lettuce, was reported. Their consideration included Thai data for Chinese cabbage and kale, Dutch, Swiss and U.S. data for head lettuce, U.S. data for leafy lettuce and Italian, Swiss and U.S. data for spinach. A group MRL for leafy vegetables (including brassica leafy vegetables) requires consideration of data in leafy lettuce, spinach and Chinese cabbage.

Thai data for Chinese cabbage were not generated according to Thai GAP as the 14 day WHP associated with that use-pattern was not addressed by the trials. Samples from the 4 trials were collected at 0, 1, 3 and 5 days in all trials, and at 7 and 10 days in 2 of the trials. The use-patterns involved 4 treatments using an EC formulation at rates of 0.373 - 2.31 kg a.i./ha and spray concentrations of 0.06 – 0.228 kg ai./100L. At 5 days after the final application, residues in whole plants ranged from 0.03 – 1.34 mg/kg. At a 10 day WHP, residues were 0.04 and 0.08 mg/kg in samples treated at 0.373 kg a.i./ha and 0.746 kg a.i./ha, respectively. Thai data for kale showed residues in the range <0.02 – 0.05 mg/kg at 14 DAT for crops treated 5 times at rates up to 3.6 kg a.i./ha using a spray concentration of 0.36 kg a.i./100 L. The MRL estimated from these trial data was 0.05 mg/kg for diazinon in Chinese cabbage and kale.

U.S. trial data in head and leafy lettuce did not address the 10 day WHP required under U.S. GAP, however samples were collected at 0, 7, 14 and 21 days after the final spray application of diazinon which permitted an estimate of the residue level at 10 days to be made. In these trials (43 in all), lettuce crops were treated with a single pre-plant application of either GR or EC formulation at a rate of 4.48 kg a.i./ha followed by 5 foliar treatments at weekly intervals (EC or WP formulation) at a rate of 0.56 kg a.i./ha. Residues in head lettuce ranged from <0.01 – 0.15 mg/kg at 14 DAT. Residues in leafy lettuce ranged from 0.01 – 0.15 mg/kg at 14 DAT. On the basis of these data, a Codex MRL of 0.5 mg/kg was recommended for both head and leaf lettuce. Dutch and Swiss data addressed PHIs of 2 and 70 – 76 days, respectively. These data were not considered by the JMPR in determining an appropriate MRL for lettuce. Due to the withholding periods observed, the lettuce data were not comparable with the Australian use-pattern.

Italian and Swiss trial data for spinach gave diazinon residues at <0.02 and 0.04 mg/kg at 14 days after a single treatment at 0.30 kg a.i./ha and 0.36 kg a.i./ha, respectively. Eight U.S. trials in spinach involved treatment of the crop with the same use-pattern described for head and leafy lettuce above, ie. a single pre-plant application of either GR or EC formulation at a rate of 4.48 kg a.i./ha followed by 5 foliar sprays with either an EC or WP formulation at a rate of 0.56 kg a.i./ha. Diazinon residues in spinach ranged from <0.01 – 0.37 mg/kg at 14 DAT. The JMPR concluded that the residue situation in spinach was comparable to that observed in lettuce and a Codex MRL of 0.5 mg/kg for spinach and withholding period of 10 days was recommended to cover this use-pattern.

In view of the much higher application rate available for use under Australian GAP in lettuce compared with U.S. GAP and unlimited number of sprays possible under Australian GAP, the Codex MRLs set in various leafy vegetables are not appropriate for adoption as temporary MRLs in leafy vegetables. However, the international data show enough consistency in residues across the various crops in the leafy vegetable group to recommend a temporary MRL of 0.7 mg/kg for diazinon in leafy vegetables (including brassica leafy vegetables) to permit the generation of appropriate Australian residue data to support the establishment of a permanent MRL.

Crop uses of diazinon identified as being not essential.

A number of 'non-essential' uses of diazinon were identified by the Chemical Review Program by survey of a large number of grower peak bodies and State Departments, these being current use-patterns where acceptable alternatives for control presently exist. Amongst these were control of citrus leaf miner in citrus, thrips in bananas, and cutworms in sweetcorn, peas, capsicum and lettuce. In cases where the 'non-essential' use in a commodity falls within the Codex commodity grouping for which an 'essential' use of diazinon has been identified, a group MRL has been set to cover both uses. For example, diazinon residues in lettuce are not discussed here, but rather with silverbeet in the section above as both commodities fall into the leafy vegetables (including brassica leafy vegetables) commodity grouping.

5.3.12 Apple and Pear

The maximum Australian use-pattern for diazinon in apples and pears is 52 g a.i./100L of EC, with spraying as necessary from November to March for greedy scale. Maximum numbers of sprays and minimum spray intervals are not specified on product labels. The withholding period is 14 days.

Five Swiss trials and 7 U.S. trials in apples conducted according to GAP, and 6 trials conducted according to U.S. GAP in pears were provided to the 1993 JMPR. German trial data in apples and pears were also presented, however these data were not generated according to German GAP. In the Swiss trials, 3-4 sprays using a WP formulation at 0.8 kg a.i./ha (0.04 kg a.i./100L) followed by 2 sprays at 1.2 kg a.i./ha (0.06 kg a.i./100L) were applied. A single Swiss trial involved 5 sprays at 0.75 kg a.i./ha (0.0375 kg a.i./100L). The U.S. trials in both apples and pears involved a single spray treatment using 3.36 kg a.i./ha at the dormant stage followed by 6 foliar sprays at 1-2 week intervals at 3.36 kg a.i./ha and spray concentrations of 0.12 – 0.36 kg a.i./100L.

Diazinon residues in apples and pears at 14 days after the final spray were <0.01 – 1.32 mg/kg. An MRL of 2 mg/kg (PHI 14 days) was recommended by the JMPR.

The Swiss data were based on a spray concentration which ranged from 77 – 115% of the maximum spray concentration allowable under Australian GAP. The JMPR recommendations are therefore considered suitable for the purpose of setting a temporary MRL for diazinon in pome fruit of T 2 mg/kg to permit the generation of appropriate Australian residue data, should interest be shown in continuation of this use-pattern.

5.3.13 Banana

The maximum Australian use-pattern for diazinon in bananas is 100 g a.i./100L (no rate specified on the label) of EC, with spray application in spring and again in late summer to control banana beetle borer. A second use-pattern involves spray treatment as required of the emerged, bagged fruit (direct spray into bags) at 40 g a.i./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 1993 JMPR considered 1 Australian trial, 3 trials in Costa Rica and 3 trials in Honduras. None of the trials addressed their respective GAP. The maximum use-pattern in these trials involved 3 foliar sprays at 2-5 week intervals at spray concentrations of 40 – 90 g a.i/100L. The Australian trial showed residues at <0.01 mg/kg at 76 days after the final spray. The Costa Rican and Honduran trials provided residue data for pulp and peel separately, with no analyses for whole fruit. It was not indicated whether the fruit was bagged or unbagged during the spray treatments. At 14 days after the final spray, diazinon residues were <0.02 mg/kg in pulp and peel.

The JMPR were unable to recommend a Codex MRL in bananas on the basis of the limited data available. These data are also considered inappropriate for the purpose of setting a temporary Australian MRL in banana, as the majority of the trials do not address residues in the whole fruit. The previous level of 0.5 mg/kg for diazinon in 'fruits' is to be used as a temporary MRL in banana, T 0.5 mg/kg.

5.3.13 Citrus

The maximum Australian use-pattern for diazinon in citrus is 100 g a.i./100L (no per hectare rate specified on the label) of EC, with spray as necessary to control grasshoppers, and at a minimum interval of 10 days to control citrus leaf miner. The withholding period is 14 days.

Limited data were presented to the 1993 JMPR for oranges (8 trials) and mandarins (3 trials) and the withdrawal of the Codex MRL for diazinon in citrus of 0.7 mg/kg was recommended. Spanish and Portuguese data in oranges and Spanish data for mandarins involved a maximum of 4 sprays at 0.06 kg a.i./100L (formulation type not specified). At 14 days after the final spray, residues ranged from 0.06 – 0.20 mg/kg in oranges and from 0.09 – 0.13 mg/kg in mandarins.

The Spanish and Portuguese trials address 0.6x the maximum Australian use-pattern in citrus and are considered inappropriate for the purpose of establishing a temporary MRL in citrus. The current MRL of 0.7 mg/kg for diazinon in citrus fruits is to be made temporary to permit the generation of appropriate Australian residue data should this use-pattern be required.

Other label uses

Survey work conducted by the Chemical Review Program has not revealed current use of diazinon in pastures, lucerne, cereal crops (including maize and sorghum), oilseed crops, soya bean, sugarcane, blueberries, grapevines, hops, kiwifruit, potato or stone fruit despite these uses appearing on the label of the currently registered generic products.

5.3.14 Pasture and Lucerne

Diazinon does not have Table 4 entries associated with its use in crops used for animal feed. Residue data in pastures and lucerne are a requirement for the retention of these two label uses. Metabolism data (considered in Part 2, Section 4 of this report) indicate that feeding at levels up to 200 ppm in the feed results in finite residues in animal tissues. However up to 75% of the dose could be accounted for in excreta at 24 hours after dosing, and >96% was eliminated in faeces and urine after 168 hours withdrawal. Despite the evidence to suggest that diazinon feeding has minimal impact on animal commodity residues, residue data are required to establish the level of diazinon residues in feed commodities. Appropriate animal transfer data are also required to indicate that animal feeding does not result in violation of MRLs for animal commodities which have been set on the basis of veterinary use-patterns.

5.3.15 Cereals

Diazinon use in cereal grains could not be supported by the 1993 JMPR due to the lack of appropriate data (too few trials, trials not addressing the country's GAP). The lack of appropriate data for consideration as part of this evaluation suggests that deletion of the current MRL of 0.1 mg/kg for

diazinon in cereal grains is appropriate, to be replaced in the interim by a temporary MRL of T 0.1 mg/kg.

The sunset date for the temporary MRLs is 31 December 2002. However, should interest be expressed in maintaining any of these current use-patterns as part of diazinon registrations, the sunset date should be considered an appropriate date for final expressions of interest to generate residue data to support the continuation of these uses.

5.3.16 Oilseeds

Diazinon use in oilseeds could not be supported by the 1993 JMPR due to the lack of appropriate data (too few trials conducted by a single country over a single season). Oilseed crops, except for cotton, are currently covered by an MRL for diazinon in vegetable oils, crude [except olive oil, crude] of 0.1 mg/kg. The lack of appropriate data for consideration as part of this evaluation suggests that deletion of the current MRL of 0.1 mg/kg for diazinon in vegetable oils is appropriate, to be replaced in the interim by a temporary MRL of T 0.1 mg/kg for oilseeds.

Despite the label use for cotton and other oilseeds, it appears that these uses have never been justified in Australia on a residue basis. There are no current MRLs for diazinon in cotton seed, rape seed or sunflower seed. In the absence of data, temporary MRLs cannot be recommended, and stakeholders should be informed that use in cotton and oilseed crops is not advised until residue data have been generated to support the use-pattern on current labels.

The sunset date for the temporary MRL in vegetable oils is 31 December 2002. However, should interest be expressed in maintaining any of the current use-patterns as part of diazinon registrations, the sunset date should be considered an appropriate date for final expressions of interest to generate residue data to support the continuation of these uses.

5.3.17 Soya bean

The Australian use-pattern for diazinon in soya beans involves spray treatments as required at a maximum rate of 680 g a.i./ha for control of spur throated locust and migratory locust. The maximum number of retreatments and the minimum retreatment interval are not specified on product labels. The withholding period is 14 days.

The 1993 JMPR review of diazinon does not contain residue data for diazinon in soya beans. Despite the Australian label use for soya beans, it appears that this use has never been justified on a residue basis. There is no current MRL for diazinon in soya beans. In the absence of data, a temporary MRL cannot be recommended, and stakeholders should be informed that use in soya beans is not advised until residue data have been generated to support the use-pattern on current labels.

5.3.18 Sugarcane

The Australian use-pattern for diazinon in sugarcane involves spray treatments as required at a maximum rate of 680 g a.i./ha to control spur throated locust and migratory locust. The maximum number of retreatments and the minimum retreatment interval are not specified on product labels. The withholding period is 14 days.

Residue data for diazinon in sugarcane were not presented to the 1993 JMPR. The current MRL of 0.5 mg/kg for diazinon in sugarcane is to be made temporary to permit the generation of appropriate Australian residue data, should this use-pattern be required.

5.3.19 Blueberries

The Australian use-pattern for diazinon in blueberries involves spray treatments as required at a maximum rate of 56 g a.i./100 L to control scale insects. The maximum number of retreatments and the minimum retreatment interval are not specified on product labels. The withholding period is 14 days.

Data for diazinon use in strawberries, blackberries, boysenberries, cranberries, currants and raspberries were presented to the 1993 JMPR. Thirty-nine trials in strawberries were conducted according to New Zealand and U.S. GAP using either a WP or EC formulation, or a combination of both. The use-pattern in the U.S. trials involved 1 pre-plant application at 1.12 kg a.i./ha, followed by 3 foliar spray applications at 1.12 kg a.i./ha at weekly intervals. Samples were collected at 3, 5 and 7 days in most of the U.S. trials. At 7 days after the final spray, diazinon residues in strawberries ranged from <0.01 – 0.11 mg/kg. The New Zealand trials involved a single foliar application at rates up to 1.0 kg a.i./ha. Samples were collected at 0, 3, 5 and 7 days after the final treatment in these trials, and the residues found were in the range 0.01 – 0.02 mg/kg at 7 DAT. The Codex MRL recommended on the basis of these data was 0.1 mg/kg, taking into consideration the GAP which requires a 5 day withholding period.

Sixteen U.S. trials in blackberries were conducted according to U.S. GAP, using either WP or EC formulations, or a combination of the two. Crops were treated once prior to planting at 2.2 kg a.i./ha (0.12 kg a.i./100L), and then with 5 foliar sprays at 1.1 kg a.i./ha (0.06 kg a.i./100L) at fortnightly intervals. Samples were taken at 7 and 14 days after the final spray treatment. At 7 DAT, which is the recommended WHP according to U.S. GAP, residues ranged 0.01 – 0.09 mg/kg, and at 14 DAT residues ranged <0.01 – 0.08 mg/kg. An MRL of 0.1 mg/kg for diazinon in blackberries was recommended.

Four U.S. trials in boysenberries were conducted according to GAP. The crops were treated according to the same pre-plant and spray regime described for blackberries above. At 7 DAT, samples contained residues of 0.03 – 0.06 mg/kg, and at 14 DAT residues were <0.01 – 0.02 mg/kg. An MRL of 0.1 mg/kg was recommended for boysenberries, based on these data and a 7 day withholding period.

Three Canadian trials in cranberries involved treatment with 1 or 2 sprays of a granular formulation at a rate of 3.36 or 6.72 kg a.i./ha. Samples taken at 51-59 days contained no detectable residues. However these sampling intervals did not address Canadian GAP and so these results were not used to recommend an MRL.

Sixteen German and 1 Swiss trial for diazinon use in currants were conducted according to their respective GAPs. The crops were treated with up to 2 foliar sprays at a maximum rate of 0.8 kg a.i./ha (0.04 kg a.i./100L). Residue levels were determined in samples taken before the final spray and at 0, 7, 10, 14 and 21 days after the final treatment. GAP in these two countries requires a 10 day WHP to be observed, and at 10 DAT residues were in the range <0.02 – 0.34 mg/kg. At 14 DAT residues were in the range <0.02 – 0.21 mg/kg. A WHP of 14 days was recommended along with an MRL of 0.2 mg/kg for diazinon in currants.

U.S. trials in raspberries were largely conducted according to GAP (spray concentrations were higher or lower in some trials). Crops were treated once prior to planting at 2.2 kg a.i./ha (0.12 – 0.6 kg a.i./100L spray concentration), followed by 5 foliar sprays at 1.1 kg a.i./ha (0.06 – 0.3 kg a.i./100L) at fortnightly intervals using either WP or EC products, or a combination of both. Samples were

collected at 0, 7, 14 and 21 days in 8 trials and at 7 and 14 days only in the remaining 12 trials. At 7 DAT, residues were in the range 0.01 – 0.18 mg/kg and at 14 DAT residues were <0.01 – 0.04 mg/kg. A Codex MRL of 0.2 mg/kg was recommended for raspberries on the basis of a 7 day WHP.

Consideration of the numerous overseas data permits the recommendation of a temporary MRL of T 0.2 mg/kg, with a 14 day withholding period for diazinon in blueberries, to enable Australian residue data to be generated (should this use-pattern be required).

5.3.20 Grapevines

The Australian use-pattern for diazinon in grapevines involves spray treatments as required at a maximum rate of 52 g a.i./100 L to control Australian Plague Locust. The maximum numbers of retreatments and minimum retreatment intervals are not specifically expressed on product labels. The spray season is specified as November-December, with a single spray in early November to be followed by another spray in late December and a follow-up spray (if necessary). This implies a maximum of 3 sprays per season with an approximate two month interval between the 1st two sprays. The withholding period is 14 days.

Residue data for diazinon in grapes, strawberries, cranberries, currants, blackberries, boysenberries and raspberries were presented to the 1993 JMPR for review.

Trials in grapes were conducted in France (9), Germany (3), Switzerland (1) and the U.S.A. (18). Only the U.S. trials were conducted according to U.S. GAP. However, all of the trials involved treatment of the crop at rates higher than permitted under Australian GAP, although in some cases only a single spray was used. The highest rate was used in a German trial and involved a single spray treatment with EC formulation at 0.98 kg a.i./ha (0.098 kg a.i./100 L spray concentration), followed by 3 sprays at 6.76 kg a.i./ha (0.20 kg a.i./100 L spray concentration). The U.S. trials used 5 spray treatments with either EC or WP formulations at 1.12 kg a.i./ha. At 14 days after the final spray, diazinon residues in grapes varied from <0.01 – 1.9 mg/kg. Wine residues were also determined in the majority of the European trials and were found to be <0.001 - <0.02 with sampling at 35-83 DAT. On the basis of these data, the JMPR did not recommend an MRL for diazinon in grapes as the relevant GAPs were not adequately addressed. However, consideration of these data for comparison with Australian GAP allows a temporary MRL of 2 mg/kg to be set for diazinon in grapes. The generation of appropriate Australian residue data should be considered if this use-pattern is required.

5.3.21 Hops

The Australian use-pattern for diazinon in hops involves a maximum of 2 sprays at a concentration of 52 g a.i./100 L with a 10 day application interval, to control common and southern armyworm. The withholding period is 14 days.

U.S. residue data for diazinon in hops were presented to the 1994 JMPR. Five trials were conducted according to GAP and two at double the label rate. The crops were treated once at either 1.1 kg a.i./ha (1x) or 2.2 kg a.i./ha (2x), and samples were taken at 14, 21 and 28 DAT. Both green and dry samples were examined for residues. At 14 DAT residues in the green hops were 0.06 – 0.16 mg/kg and were 0.11 – 0.43 mg/kg in the dry samples. Samples treated at the 2x rate contained 0.21 – 1.5 mg/kg (green) and 0.60 – 0.62 mg/kg (dry) at 14 DAT. By 28 DAT residues had fallen below the limit of quantitation in dry samples treated at the 1x rate. An MRL of 0.5 mg/kg was recommended for diazinon in hops.

Despite the Australian label use for hops, it appears that this use has never been justified on a residue basis. There is no current Australian MRL for diazinon in hops. Adoption of the Codex MRL as a temporary Australian MRL of T 0.5 mg/kg is recommended for hops, to permit the generation of appropriate Australian residue data should this use-pattern be required.

5.3.22 Kiwifruit

The Australian use-pattern for diazinon in kiwifruit involves spray treatments as required at a maximum spray concentration of 56 g a.i./100L, for control of leafroller caterpillar and cluster caterpillar. A 10 day minimum retreatment interval is recommended on labels. The withholding period is 14 days.

Two Italian and 4 New Zealand trials conducted according to their respective GAP were presented to the 1993 JMPR for use of diazinon in kiwifruit. A use-pattern of 7 foliar sprays at 0.96 – 1.2 kg a.i./ha or to run-off (0.05 kg a.i./100L spray concentration) was used in the New Zealand trials. The Italian crops were treated with a single spray at 0.9 – 1.2 kg a.i./ha (0.06 kg a.i./100L spray concentration). Samples were collected at 0, 14, 28, 35 and 42 days in the Italian trials, and at 0, 7, 14, 21 and 28 days in the New Zealand trials. At 14 DAT residues were 0.11 – 0.97 mg/kg, and at 28 DAT (WHP according to N.Z. GAP) residues were 0.05 – 0.19 mg/kg. A Codex MRL of 0.2 mg/kg was recommended on the basis of a 28 day WHP.

The current Australian MRL for diazinon in kiwifruit of 0.5 mg/kg was set in 1985 by the PACSC of the NHMRC. The discussion on the setting of this MRL suggests that in the first instance only residue data on the edible portion (without skin) was considered and an MRL of 0.03 mg/kg recommended at that time (1978). It is unclear whether further data on the whole commodity were considered in recommending the whole commodity MRL of 0.5 mg/kg in 1985. On the basis of the more current overseas data presented to the JMPR, a temporary Australian MRL of T 1.0 mg/kg for diazinon in kiwifruit is recommended to permit the generation of appropriate Australian residue data, should this use-pattern be required.

5.3.23 Potato

The Australian use-pattern for diazinon in potatoes involves sprays as required at a maximum rate of 800 g a.i./ha for control of potato moth. A 14 day minimum retreatment interval is recommended on labels. The withholding period is 14 days.

Four Canadian trials, 1 French trial and 23 U.S. trials conducted according to GAP were presented to the 1993 JMPR. The use pattern in the U.S. trials involved a pre-plant treatment at 4.4 kg a.i./ha using either a GR or EC formulation, followed by 5 foliar sprays at weekly intervals at a rate of 0.55 kg a.i./ha using either WP or EC formulations. The Canadian and French trials involved a single, granular treatment at either 2.25 or 10 kg a.i./ha at 1 month after planting. At 14 DAT in the U.S. trials no detectable residues were observed. However, in 2 trials the residues were 0.01 mg/kg at 21 DAT. A Codex MRL of *0.01 mg/kg was recommended for potatoes.

Australian GAP permits unlimited sprays at an application rate which is ~1.5x that of the U.S. trials. The Codex MRL is not appropriate for adoption as a temporary Australian MRL. The temporary MRL of T 0.7 mg/kg recommended for root and tuber vegetables allows a higher application rate and several applications (as permitted by current labels). This will cover the use of diazinon in potatoes during generation of appropriate Australian residue data, should the use-pattern in potatoes need to be maintained.

5.3.24 Stone fruit

The Australian use-pattern for diazinon in stone fruit involves sprays as required up to the point of budswell at a maximum rate of 52 g a.i./100L for control of San Jose scale, green peach aphid and black cherry aphid. Maximum numbers of sprays and minimum retreatment intervals do not appear on labels. Although application up to budswell is recommended on the labels, unlimited treatments are permitted after the commencement of fruiting, should disease or pest pressure demand further control. The withholding period is 14 days.

Residue trials in cherries, peaches, plums and prunes were considered by the 1993 JMPR. Eleven German trials, 3 Swiss trials and 29 U.S. trials were conducted according to GAP for cherries. The maximum treatment rate in the U.S. trials involved a single application of 3.3 kg a.i./ha at the dormant stage, followed by 4 foliar sprays of 3.3 kg a.i./ha (0.083 – 0.33 kg a.i./100L spray concentrations) at 7-14 day intervals using EC and/or WP formulations. At 10 DAT in the U.S. trials, residues were <0.01-0.73 mg/kg and at 20 DAT residues were <0.01 – 0.28 mg/kg. European trials treated cherries with 1 to 4 sprays at 12 – 75 g a.i./100L using either EC or WP formulations. Residues at 14 days after the final treatment were <0.02 – 0.26 mg/kg.

Five German, 1 Portuguese, 1 Swiss and 17 U.S. trials conducted according to GAP were presented for peaches. The maximum use-pattern was in the U.S. trials which involved a single application of 3.3 kg a.i./ha at the dormant stage, followed by 4 foliar sprays of 3.3 kg a.i./ha at 7-14 day intervals using EC and/or WP formulations. At 9-10 DAT in the U.S. trials, residues were <0.01-1.18 mg/kg and at 19-20 DAT residues were <0.01 – 0.11 mg/kg. The European trials treated peaches with 2 – 4 sprays at 23.5 or 40 g a.i./100L. At 14 days after the final spray residues were <0.02 – 0.13 mg/kg.

Eleven German, 1 Swiss and 21 U.S. trials conducted according to GAP for plums were considered by the 1993 JMPR along with 13 U.S. trials in prunes. The maximum use-pattern was in the U.S. trials, which involved a single application of 3.3 kg a.i./ha to the dormant stage, followed by 4-5 foliar sprays at 3.3 kg a.i./ha at weekly intervals. The U.S. trials in prunes treated the crop according to the same spray regime. At 10 DAT, U.S. plum samples contained <0.01 – 0.78 mg/kg and at 20 DAT residues were <0.01 – 0.53 mg/kg. Residues in prunes were <0.01 – 1.90 at 10 DAT and <0.01 – 0.01 mg/kg at 20 DAT. European trials in plums used 2 – 5 sprays at spray concentrations of 23.5 – 70 g a.i./100L. Residues in plums at 14 DAT were <0.02 – 0.09 mg/kg.

Codex MRLs of 1 mg/kg for cherries, 0.2 mg/kg for peaches, 1 mg/kg for plums (including prunes) and 2 mg/kg for dried prunes were recommended. Consideration of a group MRL in stone fruit requires residue data for peaches, plums and cherries. On the basis of these data, a temporary group MRL of T 1 mg/kg for stone fruit is appropriate while Australian residue data are generated to support either a group MRL or MRLs for individual stone fruit commodities (should the use of diazinon in stone fruit be maintained). A minimum retreatment interval of 14 days is recommended for inclusion on the product labels.

5.3.25 Olives

No Australian use-pattern exists for diazinon in olives. An extensive electronic search of previously registered products did not reveal any lapsed use-patterns for diazinon in this commodity. Use-patterns are described for various orchard crops on the existing registered product labels, however there is no specific reference to olives. Despite the absence of a use-pattern, MRLs for unprocessed olives and olive oil appear in the *MRL Standard*. The origin of these MRLs is not known.

Deletion of the current MRLs for unprocessed olives and olive oil is recommended.

5.4 Processed commodities from plants

Processing data for plant-derived commodities were not presented to the Chemical Review Program. The 1993 JMPR examined processed fractions prepared from diazinon-treated apples, grapes, lettuce, endive, maize, pineapples, potatoes, sugar beet and tomatoes. Wine prepared from harvest grapes and crude olive oil were also examined. In general, diazinon residues were reduced or not detectable in the processed commodities that are considered important for human consumption, ie. juice, sugar and wine. Concentration of residues was observed in crude olive oil and in pomace fractions, with pomace being used primarily as animal feed. The relevant processing factors are given below.

Processing data for pineapples from Costa Rican and Honduran trials showed that upon processing to juice, the majority of the diazinon residue remained with the filter cake. The processing factors for juice from whole fruit containing finite residues were <0.20, 0.60, 0.16, 0.21, <0.33, <0.50, 0.42, 0.25, <0.20 and 0.29. These figures provide an average processing figure for juice of 0.32. The associated processing factors for the filter cake were 0.90, 11.8, 0.61, 0.81, 0.83, 0.75, 1.63, 1.19, 0.40 and 0.71. An average processing factor for filter cake from these data is 1.96.

Apples containing 0.98 mg/kg diazinon after treatment were processed into culls (2.2 mg/kg), wet pomace (1.4 mg/kg), dry pomace (0.4 mg/kg), fresh juice (0.02 mg/kg), canned juice (no detectable residues), canned slices (no detectable residues), frozen slices (no detectable residues) and apple sauce (no detectable residues). The relevant processing factors are therefore: culls, 2.24; wet pomace, 1.43; dry pomace, 0.41; fresh juice, 0.02; canned juice, <0.01; canned slices, <0.01, frozen slices, <0.01 and apple sauce, <0.01.

Grapes containing 0.06 mg/kg diazinon at 7 DAT by normal GAP were processed into wash water (<0.01 mg/kg), stems (0.04 mg/kg), destemmed grapes (0.06 mg/kg), wet pomace (0.13 mg/kg), dry pomace (0.36 mg/kg), unclarified juice (0.02 mg/kg), filter cake (<0.01 mg/kg), "Agrol" settlings (<0.01 mg/kg), clarified juice (<0.01 mg/kg) and canned juice (<0.01 mg/kg). The relevant processing factors are therefore: wash water, <0.17; stems, 0.67; destemmed grapes, 1.0; wet pomace, 2.17; dry pomace, 6.0; unclarified juice, 0.33; filter cake, <0.17; "Agrol" settlings, <0.17; clarified juice, <0.17 and canned juice, <0.17.

Potatoes containing no detectable residues at harvest (<0.01 mg/kg) after treatment according to GAP were processed into culls (<0.01 mg/kg), wet peel (<0.01 mg/kg), sliced and peeled potato (<0.01 mg/kg), wash water (<0.01 mg/kg), chips (<0.01 mg/kg), flakes (<0.01 mg/kg), dry peel chips (0.02 mg/kg) and dry peel flakes (0.03 mg/kg).

Sugarbeet containing no detectable residues (<0.01 mg/kg) at harvest after treatment according to GAP were processed into cossettes (<0.01 mg/kg), molasses (<0.01 mg/kg), sugar (<0.01 mg/kg) and pulp (0.01 mg/kg). Only sugarbeet pulp showed a concentration of residue.

Processing data for the 4 commodities discussed above are relevant to Australian use-patterns. Other processing data involved treatment of crops which do not appear on Australian product labels.

Further processing data are required to support use of diazinon in cereal grains (flour, bran and germ), citrus fruits (juice and pomace), canola and cotton seed (the latter two for the purpose of determining the validity of the current vegetable oils MRL).

5.5 Animal MRLs

5.5.1 Eggs and Poultry

MRLs for eggs, poultry meat and the edible offal of poultry are associated with the agricultural uses of diazinon. There are no veterinary products which involve direct application of diazinon to poultry, and hence residues in these commodities are derived from feeding diazinon-treated agricultural commodities. The MRLs for diazinon in these commodities are: eggs *0.05 mg/kg; poultry, edible offal of *0.05 mg/kg; and poultry meat *0.05 mg/kg. Animal transfer data for diazinon in poultry were presented to the 1996 JMPR. These data are discussed in Section 5.6 Animal Transfer Studies. The data are adequate to permit maintenance of the current MRLs as temporary MRLs for diazinon in poultry commodities until data to substantiate feed commodities such as cereal grains, oilseeds and meal are provided.

5.5.2 Edible Offal [mammalian]

The MRL of 0.7 mg/kg for mammalian offal was set in 1990 by the National Health and Medical Research Council's Pesticides and Agricultural Chemical Committee (PACC). This followed on from the establishment of separate MRLs for sheep and cattle meat [in the fat] in 1970, pig meat in 1974 and goat meat in 1980. Establishment of a group MRL for meat in 1990 led to the simultaneous establishment of an MRL for mammalian offal. The edible offal MRL was set on the basis that residues would not be expected to be higher than the level in fat of meats, which at the time was in accordance with accepted Codex Alimentarius principles. So this MRL has been set by analogy with the meat MRL rather than by consideration of actual residues present in edible mammalian offal. The table below lists the studies received and gives cross references to other Sections of this report relevant to the discussion of these studies below.

The current use patterns which effect the residues in mammalian offal are:
Dipping application to sheep at 0.2 g a.i./L or by jetting at 0.4 g a.i./L.
Application to cattle against lice at 0.5 g a.i./L (high volume 4-5 L per beast) or 1 g a.i./L (low volume 2-3 L per beast), against flies at 0.8 g a.i./L & 500 mL per beast, or as a back rubber containing 100 g a.i./10 L oil.
Application to pigs at 0.5 g a.i./L and to goats at 0.5 g a.i./L.
Animal housing treatments

There are 14 day withholding periods associated with these use patterns for sheep, pigs and goats. The withholding period for cattle is 3 days.

Residue data evaluated for offal came from an Australian trial on sheep (Section 5.15.2, report no. 86/5/1074), which indicated that the diazinon residues were low in liver (<0.01 – 0.01 mg/kg) and kidney (0.01 – 0.04 mg/kg) from one day after application of the treatment (10 animals plunge dipped at 250 mg a.i./L). However, the highest residues were found in kidney fat (0.27 – 2.20 mg/kg) which showed the highest residue 3 DAT, only falling to below 0.7 mg/kg after 14 DAT. The edible offal MRL was originally based on the maximum residues observed in muscle and fat according to an accepted Codex principle, and appears to greatly overestimate the maximum residues observed. Based on the data from this trial and those discussed below, it would be possible to lower the MRL for edible offal as edible offal residues are generally far lower than those observed in fat and muscle (Tables 16 and 24). This aspect is discussed further under Section 5.10.3.

Residue data were submitted for a Swiss trial (Rep. no. 4003/86) of a microencapsulated product (six sheep, 250 ppm dipping solution, slaughter 14 DAT). Exceedingly low residues in offal (<0.01 mg/kg in

liver and <0.01 mg/kg in kidney) and other tissues, including fat (maximum residue was 0.023 mg/kg) resulted. However, none of the products currently registered for use on animals in Australia involves a microencapsulated formulation, so little consideration of these results has been given with respect to the MRLs.

An Australian trial (Rep. no. 74/9/475) of a powder designed for spot treatment of blowfly strike wounds in sheep involved treatment with either 10g (the recommended rate) or 30g of Dri-Dress powder per animal. Very low residues were observed 10 days after treatment, 0.1 ppm in fat being the maximum observed residue. No residues were detected in liver (< 0.01 ppm). This kind of treatment does not present a residues issue relevant to the edible offal MRL.

Liver and kidney were analysed as part of an Australian trial (Section 5.15.2, rep. no. 86/6/1075) in which steers were spray-treated with diazinon at a rate of 600 mg a.i./L. Groups of animals were slaughtered one day after treatment and at 7 day intervals thereafter. Liver residues were very low and ranged from <0.02 mg/kg at 1 DAT to <0.01 from 7 DAT onwards (Table 28). Kidney residues were also low, ranging from 0.07 mg/kg at 1 DAT to <0.01 mg/kg from 14 DAT onwards. The low residues observed in offal for this study lend weight to the argument that the MRL for edible offal could be reduced from the current value of 0.7 mg/kg.

Two studies presented to the 1996 JMPR for use of diazinon in backrubber treatments did not address residues in edible offal. The impact of this use-pattern on offal residues is unclear.

Goats were spray-treated with a solution containing 600 mg/L of diazinon in an Australian residues trial (Rep. no. 86/7/1084). Liver and kidney samples were obtained at each slaughter interval (1, 3, 7, 14 and 21 days post-treatment). The residue levels were highest 1 DAT (Table 32). Liver contained <0.03 mg/kg 1 DAT and this fell to <0.01 mg/kg after 3 days. Kidney residues were slightly higher, the diazinon content being 0.05 mg/kg at 1 DAT, this level falling to 0.01 mg/kg at 7 DAT and then to <0.01 mg/kg after 14 days.

An overseas residues trial (Section 5.15.5) used twenty pigs which were spray-treated once or twice (at a 10 day interval) with 5 L of diazinon suspension containing a level of 0.025 or 0.05% diazinon. The animals were then slaughtered in pairs at day 1, 3, 7, 14 or 28 for the animals treated singly, and at days 11, 13, 17, 24 or 38 for the animals receiving two treatments. No diazinon residues were found at any time point in liver or kidney.

Summary of Diazinon Residues Studies Submitted to the Chemical Review Program

Product	Animal	Sample size per time point	Dip or Spray Conc^{n} (ppm)	Tissue/Milk	Sampling times after treatment (days)	Comments	Evaluation report reference; Company study number
Neocidol EC 250	cattle	2	600^{D} 600^{S}	edible	1, 7, 14, 21	kidney fat > MRL after WHP	5.15.1; (no study number)
	sheep	2	250^{D} 600^{S}	edible	1, 3, 7, 14, 21	complies with MRL	5.15.1; (no study number)
	sheep	2	250^{D}	edible	1, 3, 7, 14, 21	complies with MRL	
	cattle	2	600^{S}	edible	1, 7, 14, 21	WHP not addressed	
	cattle	5	600^{S}	milk	7, 21, 31, 45, 55, 70, 80 hours	complies with MRL	5.15.2; Rep. No. 86/5/1074 5.15.2; Rep. No. 86/6/1075 5.15.3; Rep. No. 86/6/1076
Neocidol EC 600	goats	2	600^{D}	edible	1, 3, 7, 14, 21	complies with MRL	5.15.1; (no study number)
	goats	5	600^{S}	milk	12, 24, 36, 48, 60, 72, 84 hours	complies with MRL	5.15.1; (no study number)
	goats	2	600^{S}	edible	1, 3, 7, 14, 21	complies with MRL	
	goats	5	600^{S}	milk	7, 24, 30, 48, 54, 72, 78 hours	complies with MRL	5.15.4; Rep. No. 86/7/1084 5.15.4; Rep. No. 87/5/1116
Neocidol 25 E	pigs	2	2 x 250^{S} $(7\text{-}10)^{I}$	edible	1, 3, 7, 14, 28	complies with MRL	5.15.1; (no study number)
	pigs	2	2 x 250^{S} 2 x 500^{S} $(10)^{I}$	edible	1, 3, 7, 14, 28 (after 1st spray and 2nd spray)	complies with MRL	5.15.5; (no study number)

Neocidol 60	sheep sheep	2 2	200[D] 400[D] 200[D]	milk milk	12, 36 hours, 3, 4, 5, 7, 15 days 6 hr, 1, 2, 3, 4, 7, 15, 30 days	complies with MRL complies with MRL	5.15.1; (no study number) 5.15.2; (no study number)
Neocidol Cattle Spray	cattle cattle cattle cattle	ns ns ns 3	1500[S] 1000[S] 1000[S] 500[S]	edible edible milk milk	1, 7, 14 1, 7 1, 2, 4 1, 2, 4	kidney fat > MRL at elevated dose rate kidney fat > MRL at WHP complies with MRL complies with MRL	5.15.2; (no study number) 5.15.2; (no study number) 5.15.2; (no study number) 5.15.2; (no study number) 5.15.2; (no study number)
Neocidol Cattle Dip	cattle cattle cattle	ns ns ns	600[D] 460[D] 3 x 500[D] (3)[I]	edible edible edible	1, 7, 14 1, 7, 14 1, 7, 14	kidney fat > MRL at WHP WHP not addressed WHP not addressed	5.15.2; (no study number) 5.15.2; (no study number) 5.15.2; (no study number)
Not specified	sheep sheep sheep cattle	ns 3 6 3	500[D] 800[J] 250[D] 2 x 600[S] (10)[I]	edible edible edible milk	5 – 33 14 14 12 hr, 1, 3, 7 days (1st spray), 1, 2, 4 (2nd spray)	WHP not addressed complies with MRL microencapsulated formulation complies with MRL	5.15.2; (no study number) 5.15.2; Rep. No. 71/9/353 5.15.2; Rep. No. 4003/86 5.15.3; (no study number)
Product	**Animal**	**Sample size per time point**	**Dip/ Spray Conc[n] (ppm)**	**Tissue/Milk**	**Sampling times after treatment (days)**	**Comments**	**Evaluation report reference; Company study number**
Topclip 40	sheep	ns	250[D,S]	wool	for 5 months	MRL not addressed	
Topclip Gold Shield	sheep sheep	2 4, 6	250[D] 400[D]	fat and wool edible	7, 14, 18, 21, 28 7, 14, 21, 28, 35	extended plunge dip time extended plunge dip time	5.15.2; Rep. No. 90/3/1283 5.15.2; Rep. No. 455/881404

Topclip Dri-Dress	sheep	5	2000 - powder	edible	10	nil residues use pattern	5.15.2; Rep. No. 74/9/475
Topclip Sheep Dip	sheep	ns	200[D]	edible	1, 7, 14	complies with MRL	5.15.2; (no study number)
Nucidol 20	cattle	5, 60	500[S]	milk	12, 24, 36, 48 hours, 5 days	milk complies with MRL, butter and cream > MRL	5.15.3; Rep. No. 74/4/440

ns = not specified
D= Dip treatment
S = Spray treatment
J = Jetting treatment
I = minimum treatment interval (days)
edible = edible tissues ie. liver, kidney, muscle and fat

A review of the MRLs for liver and kidney of cattle, goats, pigs and sheep was undertaken in 1996 by JMPR. This review shows the maximum liver/kidney residue to be 0.03 mg/kg when animals are treated according to GAP. In accordance with this data, the JMPR recommended MRLs of 0.03 mg/kg for liver and kidney of cattle, goats, pigs and sheep. The data presented to the 1996 JMPR in addition to the studies presented to the Chemical Review Program are summarised in the following table.

Residues of diazinon (mg/kg) reported in JMPR 1996 for tissues of sheep treated with dip formulations

Study	Matrix	Days after application	Residue (mg/kg)
Switzerland, Formica, 1974, sheep undergo single dip treatment at 750 mg/L	Liver	10	<0.02

When these data are assessed in conjunction with that presented for the Chemical Review Program, which was derived from 4 sheep (ie. 2 sheep were sacrificed at the slaughter WHP of 14 days in two separate studies; see Tables 16 and 24), 4 cows (same situation as for sheep; see Tables 15 and 28) and twenty pigs (Section 5.15.5), a recommendation to lower the current edible offal (mammalian) MRL is justified. It is recommended that the current edible offal (mammalian) MRL of 0.7 mg/kg be lowered to T 0.03 mg/kg.

5.5.3 Meat (mammalian) [in the fat]

The MRL of 0.7 mg/kg for mammalian meat [in the fat] was set by the PACSC in 1990. This followed on, as discussed above, from the setting of MRLs for individual meat commodities which were set from the early 1970's onwards.

The current use patterns which effects the residue levels observed in mammalian meat are:
Dipping application to sheep at 0.2 g a.i./L or by jetting at 0.4 g a.i./L.
Application to cattle against lice at 0.5 g a.i./L (high volume 4-5 L per beast) or 1 g a.i./L (low volume 2-3 L per beast), against flies at 0.8 g a.i./L & 500 mL per beast, as an eartag containing 20% diazinon per tag, or as a back rubber containing 100 g a.i./10 L oil.
Application to pigs at 0.5 g a.i./L and to goats at 0.5 g a.i./L.
There are 14 day withholding periods associated with these use patterns for sheep, pigs and goats. The withholding period for cattle is 3 days.

In a European study (Section 5.15.1) cattle, sheep, goats and pigs were assessed for residue levels in muscle after treatment with diazinon. Cattle were either dip- or spray-treated with diazinon at 600 ppm. Two animals were then slaughtered at 1, 7, 14 and 21 days after treatment. The maximum diazinon residue (0.06 mg/kg) in muscle was observed at day 1. This fell to 0.01 mg/kg after 7 days and was below 0.01 mg/kg after 14 days. This study did not provide residue data for subcutaneous fat which would be necessary for comparison with, and support of, the current MRL. Omental fat levels in the two animals slaughtered for each data point were 2.5 and 1.4 mg/kg at 1 DAT, which fell to 0.2 and 0.12 mg/kg at 14 DAT.

Sheep were assessed, being either dip-treated at 250 ppm or spray-treated at 600 ppm. Only results for the plunge dip-treated animals were given. Slaughter of two animals for each data point showed residues in muscle tissue of 0.15 and 0.13 mg/kg at 1 DAT, falling to 0.03 and 0.01 mg/kg by 14 DAT (the withholding period). No subcutaneous fat residue data were presented. However, an indication of the residues expected in fat can be gleaned from kidney fat residues which peaked at 2.6 and 1.2 mg/kg at 1 DAT, falling to 0.67 and 0.63 only after 14 days. The application rate in this study was 250 ppm for plunge dipping, which is 25% higher than the recommended label rate of 200 ppm.

Scaling the maximum residues in kidney fat to consider a rate of 200 ppm would require reducing them by 20%, to 0.54 mg/kg and 0.50 mg/kg. Recent FSANZ Market Basket Surveys show no violations of the diazinon meat [in the fat] MRL. When this fact is taken into consideration along with the diminished maximum residues that would be observed at a maximum rate of 200 ppm, the data from this study are considered to support the current meat [in the fat] MRL of 0.7 mg/kg.

Goats treated in a 600 ppm plunge dip showed muscle residues which peaked at 1 DAT (0.14 and 0.06 mg/kg) which fell rapidly to 0.03 and 0.04 mg/kg by 3 DAT. No subcutaneous fat residues were available. However kidney fat and omental fat were assessed and gave quantitatively similar residues, the omental fat residues declining at a faster rate than the kidney fat residues between 1 and 7 days after treatment. Kidney fat contained diazinon residues of 3.4 and 1.1 mg/kg at 1 DAT, which fell to 0.04 and 0.22 mg/kg by 7 DAT.

The last animal species to be assessed as part of this study was the pig. Pigs were treated once or twice (with an interval of 10 days) with spray at 250 ppm and gave muscle residues between 0.04 (1 spray) and 0.02 mg/kg (2 sprays) at 1 DAT. By 7 DAT these muscle residues were 0.02 mg/kg (1 spray) and <0.01 mg/kg (2 sprays). No subcutaneous fat residues were given, but fat values were 0.22 and 0.15 mg/kg at 1 DAT which fell to 0.05 and 0.06 mg/kg at 3 DAT, and then to 0.02 and <0.01 mg/kg by 7 DAT. These fat residues were much lower than the maximum residues observed in individual fat deposits from the other animals.

An Australian residue study on sheep (Section 5.15.2, rep. no. 71/9/353) was conducted in which sheep were jetted with diazinon at a concentration of 0.08% using either an EC or WP formulation. Fat and meat residues were determined 14 DAT (the withholding period). Omental, subcutaneous and kidney fat were analysed after mixing and homogenisation. Muscle diazinon residues were consistently low, the mean value being 0.06 mg/kg [range 0.03 – 0.09 mg/kg] for the WP formulation and 0.05 mg/kg [no range given] for the EC formulation (Table 22). The fat samples contained an average of 0.09 mg/kg diazinon [range 0.05 – 0.16 mg/kg, WP], or 0.13 mg/kg [range 0.08 – 0.16 mg/kg, EC]. These results indicated that the 14 day withholding period allows the tissues to meet the MRL of 0.7 mg/kg, and the data support the current MRL.

In an Australian study (Section 5.15.2, rep. no. 90/3/1283) ten sheep were treated by plunge dipping at 250 mg a.i./L for one minute. Pairs of animals were slaughtered at 7, 14, 18, 21 or 28 days post-dipping and subcutaneous fat sampled. The treatment regime followed the recommended rate, however the author of the study claims that treatment time was four times that usually used and so the residues expected in the wool and fat were expected to be far higher than usual. Subcutaneous fat residues (upon which the meat [in the fat] MRL is based) indicated that high levels of diazinon were present (Table 23). The highest residue in subcutaneous fat (4.4 mg/kg) was found at 7 DAT, and this level dropped to a value below the MRL only after 21 days (0.4 mg/kg). Use of an extended dipping time would be expected to lead to an elevated dose and hence much higher residues than those observed when the animals are subjected to conventional treatment times. As a consequence of this elevated treatment rate, the residue data have not been taken into consideration in assessing the relevance of the current MRL. These data do, however, serve to indicate the propensity of diazinon for deposition in fat, and therefore justify the [in the fat] status of the current mammalian meat MRL.

An Australian trial (Section 5.15.2, rep. no. 86/5/1074) involved treating ten sheep by plunge dipping in a diazinon solution containing 250 mg a.i./L. The animals were slaughtered in pairs at 1, 3, 7, 14 or 21 days after treatment and tissues analysed for diazinon content. Muscle and kidney fat were examined to assess compliance with the MRL. Muscle diazinon residues peaked at 0.14 mg/kg (1 DAT), dropping to 0.02 mg/kg by 14 DAT (Table 24). Kidney fat residues were much higher, peaking at 2.2 mg/kg (3 DAT) and falling to 0.65 mg/kg by 14 DAT. This report comments that the

kidney fat residue falling below 0.7 mg/kg by the end of the 14 day withholding period indicates compliance with the MRL. The maximum residue in kidney fat of 0.65 mg/kg at 14 DAT, just falls below the MRL after the specified WHP, however the application rate used in this study was 250 ppm, which is 25% higher than the recommended label rate of 200 ppm, as discussed for the sheep study (Section 5.15.1) on the previous page. The lower use rate, along with observance of a single MRL violation of the meat [in the fat] MRL by the National Residue Survey from 1995 to 1997, indicate that the current meat [in the fat] MRL of 0.7 mg/kg is adequate.

In a Swiss trial (Section 5.15.2, rep. no. 4003/86) on a microencapsulated formulation of diazinon, six sheep were treated with 250 ppm diazinon for a period of one minute. All of the animals were slaughtered 14 days after treatment and their tissues analysed for diazinon residues. Muscle residues were ≤0.01 mg/kg in all animals (Table 25). Both 'fat' and omental fat residues were reported. The diazinon residues reported for 'fat' ranged from <0.01 to 0.013 mg/kg. Those observed in omental fat ranged from 0.01 to 0.023 mg/kg. With such low fat residues in both cases it can be assumed that subcutaneous fat levels would be equally low and that the samples would support the current MRL. A microencapsulated diazinon formulation is not marketed in Australia for this use pattern.

Additional residue data for muscle and fat from diazinon treated animals were available from the 1996 JMPR review of diazinon. Several trials were presented to the JMPR which were not supplied to the Chemical Review Program. These additional data are summarised in the following table.

Residues of diazinon (mg/kg) reported in JMPR 1996 for muscle and fat of animals treated with spray-on and dip formulations

Study (rates in mg a.i./L)	Matrix	Days after application	Residue (mg/kg)
Australia, Hastie and Cavey, 1962, sheep treated with a single dip at 200 mg/L for 20 seconds	Muscle Kidney fat	1 1 7 14	<0.1 <0.1 – 1.4 1.1-1.4 0.5– 1.4
Switzerland, Formica, 1974, sheep treated with a single dip at 750 mg/L	Muscle Omental fat	10	0.21 – 0.37 2.2 – 2.6
UK, Roberts and MacDonald, 1989, sheep treated with a single dip at 400 mg/L	Omental fat Subcutaneous fat 	7 14 21 28 35 14 21 28 35	1.4, 2.3, 2.8, 1.7 1.1, 1.1, 1.1, 1.3, 1.1, 0.7 0.8, 0.7, 0.7, 0.7, 1.2, 0.8 0.6, 0.5, 0.7, 0.5, 0.5, 0.6 0.2, 0.6, 0.4, 0.4, 0.3, 0.5 1.3, 1.4, 4.3 1.4, 1.0, 1.2 0.9, 0.5, 1.2 0.5, 0.7, 0.7
Australia, Hastie, 1962, cattle treated with 2-3 dips at 500 mg/L	Kidney fat	18 h 90 h 7	3.2 – 3.9 0.0-2.1 0.6-0.8
Australia, Hastie and Cavey, 1962, cattle treated with a single spray at 1500 mg/L (3x high vol. GAP) and 9.5 L/animal (2x high vol. GAP)	Muscle Kidney fat	1 1 7 14	<0.1 1.1, 0.9, 3.2 1.2, 1.2, 1.3 0.4, 0.4, 0.3
Australia, Hastie and Cavey, 1962, cattle treated with a single spray at 1000 mg/L (2x high vol. GAP) and 3.8 L/animal (high vol. GAP is 4.5L)	Kidney fat Subcutaneous fat 	1 3 1 3	1.8, 1.2, 0.9, 1.1, 1.5, 1.1 1.0, 0.8, 0.7, 0.9, 0.9 0.2, 0.1, <0.1, 0.2, 0.3, <0.1 0.3, 0.4, 0.2, 0.7, 0.5
Australia, Rose, 1995; Queensland and NSW, 1996, cattle treated with a single back spray at 553 mg/L (800 mg/L nominal concentration) and 0.5 L/cow	Loin fat Renal fat 	2 4 7 10 14 16 4 7	<0.05 <0.05, 0.08 <0.05 <0.05 <0.05 <0.05 <0.05 <0.05
Switzerland, Morrison, 1994, sheep treated with a single spray at 600 mg/L using an EC 250 formulation and a spray volume of 6L/sheep	Fat (tail base biopsy)	8 28	1.8, 1.6, 3.1, 3.3, 2.6, 3.5 0.1, 0.11, 0.13, 0.17, 0.29, 0.11
Switzerland, Morrison, 1994, sheep treated with a single spray at 600 mg/L using an EC A-139 F formulation and a spray volume of 6L/sheep	Fat (tail base biopsy)	8 28	2.2, 2.4, 2.1, 0.78, 2.7, 3.2 0.14, 0.17, 0.24, 0.15, 0.08, 0.16
Switzerland, Morrison, 1994, sheep treated with a single spray at 600 mg/L using an EC 600 formulation and a spray volume of 6L/sheep	Fat (tail base biopsy)	8 28	2.1, 2.1, 2.1, 2.0, 1.4, 1.9 0.09, 0.06, 0.11, 0.22, 0.10, 0.14

Most of the additional data available to the 1996 JMPR involved treatment of animals at rates well above the registered label rates for diazinon use in sheep and cattle, or samples were collected at sampling times well before or well after the withholding period of 14 days for sheep (and the proposed WHP of 14 days for cattle). Much of this data is therefore not relevant to consideration of the current MRL for meat [in the fat]. The exception appears to be the 1962 trial of Hastie, where sheep dipped at 200 mg a.i./L for 20 seconds showed kidney fat residues of 0.5 – 1.4 mg/kg at 14 DAT. At least one of the animals in this trial therefore showed fat residues in excess of the current MRL of 0.7 mg/kg. However, as discussed previously, NRS survey data for the years 1995-7 show only one violation of the meat [in the fat] MRL and this suggests that the current MRL of 0.7 mg/kg is adequate. The

extremely high result of 1.4 mg/kg in kidney fat from this trial is probably a statistical outlier, particularly since all other trial data considered show considerably lower fat residues at 14 DAT.

Canadian and Australian residue data for eartag use in cattle are available in the 1996 JMPR. These data were generated from back fat, kidney fat, muscle, liver and kidney in cattle treated at a maximal rate of 2 tags per steer containing 20% diazinon. Samples collected at 14 days after application of the tags showed maximal residues of 0.05 mg/kg in back fat, 0.04 mg/kg in kidney fat and <0.01 mg/kg in muscle and offal. A 1990 Australian study for calves treated with a single eartag containing 18% diazinon showed up to 0.03 mg/kg diazinon in fat biopsy samples taken at 7 days after application of the tag. This use-pattern permits compliance with the current MRL of 0.7 mg/kg for diazinon in mammalian meat [in the fat] with nil withholding. Irrespective of when the eartag/s is/are removed, the MRL is never exceeded with this use-pattern. A table of the relevant data is presented below for reference.

Residues of diazinon (mg/kg) reported in JMPR 1996 for cattle tissues of cattle treated with eartags

Study	Matrix	Days after application	Residue (mg/kg)
Canada 1987, 2 tags/steer, 9.6% diazinon	Back fat (omental)	14	0.032, <0.01
		>100	<0.01
	Kidney fat (perirenal)	14	0.035, <0.01
		>100	<0.01
	Muscle	14 - >100	<0.01
Canada 1989, 2 tags/steer, 20% diazinon	Back fat	7	0.01
		14	0.05
		28	0.03, 0.02
	Kidney fat	7	0.03
		14	0.04
		28	0.03, 0.03
	Kidney, liver, muscle	7, 14, 28	<0.01
Australia 1990 1 tag/calf or cow, 18% diazinon	Fat (biopsy)	Calves 7	<0.01-0.03
		42	0.01-0.03
		43	<0.01-0.01
		Cows 7	<0.01-0.01
		44	<0.01

All of the fat samples analysed contained residue levels below the current MRL for meat (mammalian) [in the fat] of 0.7 mg/kg. This was true even when the current 3 day withholding from slaughter period was not observed. A nil slaughter withhold is acceptable for this use-pattern.

A single study which addressed diazinon residues in tissues derived from application as a backrubber treatment was presented to the 1996 JMPR. Groups of 5 2-3 year old Brahman cattle were exposed to a backrubber charged with 500 mL of 200 g/L diazinon EC per 10L of sump oil according to Australian GAP. The groups of animals were exposed for either 10 days and slaughtered 1-2 days after treatment, or for 19 days and slaughtered 4, 7 and 10 days after treatment. Renal and/or loin fat were sampled for residue analysis and the results are shown below.

Residues of diazinon in renal and loin (subcutaneous) fat of groups of 5 cattle after backrubber treatment for 10 or 19 days at 10 g a.i./L with EC formulation

Diazinon, mg/kg, at interval (days after treatment)						
1	2	4		7		10
Loin	Loin	Loin	Renal	Loin	Renal	Loin
0.07	0.08	0.66	0.26	0.1	0.08	0.03
0.04	0.05	0.24	0.16	0.05	0.08	0.03
<0.02	0.04	0.07	0.05	0.14	0.06	0.03
0.31	0.12	0.16	0.16	0.15	0.06	0.1
0.04	0.03	0.34	0.17	0.08	0.04	0.07

An Australian study (Section 5.15.2, rep. no. 74/9/475) involved treatment of blowfly strike wounds in sheep with either 10 g (the recommended rate) or 30 g of Dri-Dress powder per animal. Maximum residues at 10 days after treatment were 0.1 ppm in fat and 0.03 ppm in muscle. Residues from this type of topical spot treatment comply with the current MRLs.

5.5.4 Milks [in the fat]

The MRL of 0.50 mg/kg for milk and milk products [in the fat] was set by the PACSC in 1974.

The current use patterns which effect the residue levels observed in milk are:
Dipping application to sheep at 0.2 g a.i./L or by jetting at 0.4 g a.i./L.
Application to cattle against lice at 0.5 g a.i./L (high volume 4-5 L per beast) or 1 g a.i./L (low volume 2-3 L per beast), against flies at 0.8 g a.i./L & 500 mL per beast, as an eartag containing 20% diazinon per tag, or as a back rubber containing 100 g a.i./10 L oil.
Application to goats at 0.5 g a.i./L.
There are nil milk withholding periods associated with these use patterns for cattle, sheep and goats.

The Codex MRL for (whole) milk is 0.02 mg/kg based on a 3 day withdrawal period. Codex MRLs/EMRLs for fat-soluble pesticide residues in milk and milk products are expressed on a whole product basis. For a "milk product" with a fat content less than 2%, the MRL applied should be half those specified for milk. The MRL for "milk products" with a fat content of 2% or more should be 25 times the maximum residue limit specified for milk, expressed on a fat basis. This means that the Codex MRL of 0.02 mg/kg in milk on a whole product basis is identical to the Australian MRL of 0.5 mg/kg for milk [in the fat] when considering milk products containing more than 2% fat.

The majority of studies on milk residues presented for the chemical review of diazinon analysed for diazinon on a whole milk basis rather than on a fat basis. One study on residues in goat milk after spray treatment of the animals (Section 5.15.2) analysed for percentage fat content in each milk sample, however no indication was given as to whether the residues were determined on an 'in the fat' basis. An Australian study on cattle (Section 5.15.3, rep. no. 86/6/1076) gave whole milk residues for five cows individually sprayed with 10 L of an emulsion containing 600 mg a.i./L (Table 29). The maximum whole milk residue was observed in the first milking (0.35 mg/kg); this compares to the current Australian MRL of 0.02 mg/kg (when expressed on a whole milk basis); falling below the LOQ (0.01 mg/kg) after 3 days (6 milkings).

Another Australian trial (Section 5.15.2) determined whole milk residues upon spraying six cows, three with 9.1 L (2 gallons) of a 500 ppm diazinon solution, and three with 9.1 L (2 gallons) of a 1000 ppm solution. The maximum residue (0.07 mg/kg) after treatment at 1000 ppm was observed at the first milking (Table 27). At the lower treatment rate of 500 ppm, the maximum residue observed was 0.04 mg/kg. At 2 DAT the residues in milk from animals at both treatment rates were below the LOQ (<0.01 mg/kg). The current Australian milk MRL and nil milk WHP was complied with. In contrast with the results obtained in rep. no. 86/6/1076, where treatment of cows at 600 ppm diazinon gave a maximum residue of 0.35 mg/kg in the first milking, use of 500 ppm diazinon in this study gave a maximum residue approximately 9-fold lower (0.04 mg/kg in the first milking).

In a 1968 published study (Section 5.15.3) cows were sprayed twice at an interval of 10 days with 600 ppm diazinon and milk assessed for diazinon residues. The maximum residue (measured in whole milk) of 0.33 ppm occurred 1 day after the second spray, however diazinon residues were also high in the first milking after the first spray treatment. The maximum residue observed here was comparable with the maximum whole milk residue (0.35 mg/kg) observed in the study (Rep. no. 86/6/1076) discussed above. The residues reported in this study therefore vastly exceed the current milk MRL.

In a 1974 Australian study (Rep. no. 74/4/440) a herd of sixty cows was sprayed with a 500 ppm diazinon solution. Milk taken from five individual cows and a bulk sample obtained from the whole herd were analysed. Residue data (average values) for the five cows are presented in Table 30. The maximum whole milk diazinon residue was 0.25 mg/kg in the bulk sample after the first milking

(Table 31), compared to the current Australian MRL of 0.02 mg/kg (when expressed on a whole milk basis). Diazinon residue levels in skim milk (0.04 mg/kg, 0.04% fat), cream (2.4 mg/kg, 59% fat), and butter (5.2 mg/kg, 81.6% fat), were also at a maximum when derived from the first milking. The cream and butter maximum residues violate the current milk (in the fat) MRL of 0.5 mg/kg.

Further residue data for diazinon in milk from spray-on treated cows and dip treated sheep were presented to the 1996 JMPR. The maximum residue observed in whole milk from the first milking was 0.4 mg/kg for these trials. This maximum residue exceeds the current Australian MRL by a factor of 20. The data in general support the Australian data discussed above, where whole milk residues of up to 0.35 mg/kg diazinon were observed. The 1996 JMPR data are summarised in the following tables.

Residues of diazinon (mg/kg) reported in JMPR 1996 for milk of cattle treated with spray-on formulations

Study	Matrix	Days after application	Residue (mg/kg)
Australia, Hastie and Cavey, 1963, Single spray of EC formulation at 1000 mg/L (2x high volume GAP), 7.6 L/animal (High volume GAP)	Whole milk (3 cows)	1 2 3	0.07, 0.05, 0.04 <0.01, <0.01, <0.01 nil, nil, nil
Australia, Hastie and Cavey, 1963, Single spray of EC formulation at 500 mg/L (High volume GAP), 7.6 L/animal (High volume GAP)	Whole milk (3 cows)	1 2 3	0.03, 0.04, 0.04 <0.01, <0.01, <0.01 nil, nil, nil
USA, Matthysse and Lisk, 1963, 2 sprays of EC formulation at 600 mg/L, 11.4 L/cow (high volume) and an interval of 10 days	Bulked, whole milk from 3 cows	0.5 (after 1st spray) 1 3 7 1 (after 2nd spray) 2 4	0.3 0.09 0.03 <0.02 0.3 0.1 0.04
UK, Chilwell *et al*., 1967, Single spray of oil emulsion at 200 mg/L, 10 L/cow (high volume)	Whole milk (3 cows)	2 hr 5 hr 9 hr 24 hr	0.01, 0.02, 0.02 0.06, 0.06, 0.05 0.07, 0.08, 0.09 0.02, 0.02, 0.02
Switzerland, Blass, 1971, 3 sprays of unknown formulation at 500 mg/L (600 mg/L is GAP), 10 L/cow and 4 weekly intervals	Whole milk (4 cows)	0 (after 1st spray) 3 4 6 0 (after 2nd spray) 3 4 6 0 (after 3rd spray) 3 4 6 0 (after 4th spray) 3 4 6	0.2 – 0.4 <0.02 – 0.02 <0.02 <0.02 0.1– 0.2 <0.02-0.04 <0.02-0.02 <0.02 0.06-0.13 <0.02-0.03 <0.02-0.03 <0.02 0.05-0.14 0.02-0.05 <0.02-0.04 <0.02
Switzerland, Blass, 1971, 3 sprays of unknown formulation at 1000 mg/L (1.7 x GAP), 10 L/cow and 4 weekly intervals	Whole milk (4 cows)	0 (after 1st spray) 3 4 6 0 (after 2nd spray) 3 4 6 0 (after 3rd spray) 3 4	0.2 – 0.6 <0.02 – 0.08 <0.02-0.05 <0.02 0.1– 0.2 0.04-0.10 0.02-0.07 <0.02-0.04 0.09-0.10 <0.02-0.08 <0.02-0.05

		6 0 (after 4th spray) 3 4 6	<0.02-0.02 0.05-0.20 0.03-0.04 <0.02-0.05 <0.02
Egypt, Kholif *et al*., 1994, Single spray of EC formulation at 600 mg/L (GAP) and 2L/cow	Whole milk (20 cows)	2 hr 4 hr 6 hr 8 hr 16 hr 24 hr 36 hr 48 hr	0.05 0.2 0.2 0.1 0.05 0.03 not detected not detected

Residues of diazinon (mg/kg) reported in JMPR 1996 for milk of sheep treated with dip formulations

Study	Matrix	Days after application	Residue (mg/kg)
Switzerland, Formica, 1973, single dip treatment at 200 mg/L (0.8 x GAP)	Whole milk	6 hr 1 2 3 4 7 15 30	0.09, 0.09 0.06, 0.03 0.02, 0.01 0.02, 0.01 0.02, 0.01 0.02, 0.01 <0.01, <0.01 <0.01, <0.01
Switzerland, Formica, 1973, single dip treatment at 400 mg/L	Whole milk (3 cows)	6 hr 1 2 3 4 7 15 30	0.18, 0.16 0.10, 0.07 0.04, 0.04 0.03, 0.02 0.02, 0.02 0.03, 0.03 0.01, <0.01 <0.01, <0.01

A single study was available to the 1996 JMPR which analysed milk residues of diazinon from cows treated with a diazinon-based back rub. This 1967 U.S. study assessed treatment of animals by i) hand application of an oil rub made from 56.6 g of 2% diazinon dust with 1% motor oil to the backs of 5 cows daily for 4 days, and ii) application of diazinon to 5 cows by rubbing across the back with a burlap backrubber impregnated with 0.45 kg of 2% diazinon dust. Neither of these treatments is comparable to the Australian GAP. Milk residues from the first type of treatment were <0.05 to 0.52 mg/kg in whole milk half a day after treatment. At 1 to 15 days after treatment whole milk residues were <0.05 mg/kg. Milk residues from the second style of treatment resulted in whole milk residues of <0.05 – 0.23 mg/kg at half a day after the final treatment, and fell to <0.05 mg/kg at 1 to 15 days after treatment. Although the use-patterns described here do not reflect Australian label uses for these products, the studies indicate substantial finite residues in whole milk when a withholding period is not observed. Without further Australian data to support the use of backrubber products in lactating animals, this use-pattern cannot be justified in lactating cows on residues grounds.

Use of diazinon-based eartags in cattle represents an exception to the observations made with respect to milk residues for other diazinon-based products. Literature data available for diazinon residues in milk from the use of diazinon containing eartags is summarised in the table below.

Residues of diazinon (mg/kg) reported in JMPR 1996 for milk of cattle treated with eartags

Study	Matrix	Days after application	Residue (mg/kg)
Canada 1987, 2 tags/cow, 11% diazinon	Whole milk	5 h - 1 day	<0.0005
		3	<0.0005 - 0.0014
		7	0.0012 - 0.0017
		14	0.0011 - 0.0017
		21	<0.0005 - 0.0018
		28	0.00073 - 0.0014
Australia 1989, 2 tags/cow, 18% diazinon	Milk fat	1	<0.01-0.02
		7	<0.01-0.01
		14	<0.01-0.01
		28	0.01-0.02
Australia 1992, two 15 g tags/cow 20% diazinon	Milk fat	1	0.04-0.08
		7	0.12-0.26
		14	0.06-0.18
Australia 1993, two 15 g tags/cow, 20% diazinon	Milk fat	1	<0.01-0.02
		2	<0.01-0.01
		3	<0.01-0.02
		7	0.01-0.02
		10	0.01-0.02
		14	0.02-0.02
		28	0.02-0.02
		42	0.01-0.03
		56	0.01-0.02
		84	<0.01-0.01

The studies summarised above indicate that the residues in milk arising from the use of diazinon eartags will not result in violations of the diazinon milk MRL. The maximum residue in milk fat was 0.26 mg/kg for cows treated with two 20% diazinon tags (2 x the Australian label rate). Sheep and goat milk were also analysed for diazinon residues (Section 5.15.1). Five goats were treated at 600 ppm and two sheep were treated at 200 ppm. The maximum whole milk residues were observed in the first milking for all animals, 0.22 mg/kg for goat milk (Table 20) and 0.09 mg/kg for sheep milk (Table 21). A further study in goats (Section 5.15.4, rep. no. 87/5/1116) involved spraying five animals with 5 L at 600 ppm diazinon and assessing milk residue levels. The maximum residue was 0.25 mg/kg in the first milking (Table 33). Residues dropped to within the limit of detection at 3 DAT. Additional work on milk residues in sheep (Section 5.15.2) after dip treatment at either 400 ppm or 200 ppm diazinon gave maximum residues of 0.18 ppm which decreased to 0.01 ppm after 15 days (400 ppm a.i. applied), and 0.09 ppm which decreased to less than 0.01 ppm after 15 days (200 ppm a.i. applied). However, no indication was given of whether the residues were determined on a fat or whole milk basis.

Of the four milk studies in cattle evaluated, only one study described in Section 5.15.2 supported the current Australian milk (in the fat) MRL of 0.5 mg/kg. The remaining studies (Section 5.15.3) indicated that a milk WHP of 3 days was required in order for the current MRL not to be exceeded. Milk WHPs beyond 12 hours (1 milking) are not acceptable for whole herd treatments. In 2 studies, processing of milk to cream or butter resulted in residues exceeding the MRL by 5 and 10-fold, respectively. In light of these results, and upon further analysis of the data upon which the original PACSC decision was based, it appears that an error was made in setting the original MRL. It appears that the milk [in the fat] MRL of 0.5 mg/kg recommended by the PACSC was based on the absolute maximum whole milk residue observed in trial data presented.

Sheep and goat milk residue studies showed a similar propensity for residues in whole milk to exceed the current milk MRL of 0.02 mg/kg (expressed on a whole milk basis). The mean residue in goat milk from the first milking of five animals treated at 600 ppm diazinon was 0.22 mg/kg (expressed on

a whole milk basis) (Section 5.15.1). In another study, the maximum residue found in the first milking from 5 goats spray-treated at 600 ppm was 0.25 mg/L. (Note that it was not stated whether this residue content was determined on a whole milk or an 'in the fat' basis.) (Section 5.15.4). Two sheep studies (Section 5.15.1 and 5.15.2) reported maximum milk residues of 0.09 mg/kg from the first milking (n=2, rate = 200 ppm for both studies). The maximum residue of 0.09 mg/kg determined in the study detailed in Section 5.15.1 was expressed on a whole milk basis, however the maximum residue determined in the other study (Section 5.15.2) did not specify whether it was expressed on a whole milk or 'in the fat' basis. The residue of 0.09 mg/kg (expressed on a whole milk basis; Section 5.15.1) is more than 4-fold in excess of the current milk MRL of 0.02 mg/kg (expressed on a whole milk basis).

Based on an evaluation of the submitted data, the current milk MRL is not appropriate for animals which have been spray, dip or backrubber treated. Reappraisal of the available data in the 1996 JMPR along with studies presented to the Chemical Review Program suggest that the original PACSC decision to set a milk [in the fat] MRL of 0.5 mg/kg was erroneous. The available data set supports a whole milk MRL of 0.5 mg/kg when use of dip and spray-on products are considered in lactating animals. Changing the milk MRL from 0.5 mg/kg milk [in the fat] to 0.5 mg/kg whole milk would permit the continued use of diazinon-based spray and dip products in lactating animals. However, this change would make the Australian MRL 25 times higher than the Codex MRL for diazinon in milk. The dairy industry has been consulted regarding management of such a comparatively high MRL in dairy exports. The industry has responded by indicating that it supports the continued registration of eartag products in lactating animals, and that spray-on and dip product use-patterns be retained for all categories of dairy cattle except lactating dairy cattle. To facilitate this, it is recommended that label restraints preventing the use of diazinon-based dip and spray products in lactating animals be introduced. The MRL for milk [in the fat] will be retained at 0.5 mg/kg to cover use of eartag products.

5.6 Animal Transfer Studies

Animal transfer studies were not presented to the Chemical Review Program, however transfer studies in cattle and poultry were reviewed as part of the 1996 JMPR review of diazinon. The analytical method used for analysis of samples was AG-550A described in Section 5.13.1.

Four Holstein cows (1 control) were dosed with technical diazinon after the evening milking for 28-30 consecutive days by gelatin capsule at rates equivalent to 40 ppm, 120 ppm and 400 ppm in the diet. Blood samples were taken just before slaughter, composite samples of milk from the morning and evening milkings were taken from each cow before dosing and 1, 3, 7, 14, 21 and 27 days after the 1st dose. Liver, kidney, round muscle, tenderloin muscle, perirenal fat and omental fat were taken within 18-24 hours after slaughter.

Samples were stored at –20^{o}C for 4-5 months before analysis, however data to substantiate storage stability were provided only for diazinon itself in tissues and not milk. The residues determined were corrected for analytical recoveries which ranged from 91 – 115% for samples of liver, kidney, muscle, fat, milk and blood fortified at 0.01 mg/kg.

No residues of diazoxon or hydroxydiazinon were found in milk or tissues with the exception of hydroxydiazinon in omental and perirenal fat which was observed at levels of 0.01 – 0.06 mg/kg for the 400 ppm dose. Diazinon residues are tabulated below.

Residues of diazinon in blood, milk and tissues from dosing dairy cows with diazinon at 40, 120 and 400 ppm in the diet.

Sample	Diazinon, mg/kg, from equivalent of		
	40 ppm	120 ppm	400 ppm
Liver	<0.01	<0.01	<0.01
Kidney	<0.01	<0.01	<0.01 – 0.01
Blood	<0.01	<0.01	<0.01
Muscle, round	<0.01	<0.01	<0.01 – 0.02
Muscle, tenderloin	<0.01	<0.01	0.01 – 0.02
Fat, perirenal	<0.02 – 0.03 (0.02)	0.05 – 0.08 (0.06)	0.15 – 0.58 (0.4)
Fat, omental	0.02 – 0.04 (0.03)	0.07 – 0.1 (0.08)	0.2 – 0.84 (0.6)
Milk Day 1	<0.01	<0.01	<0.01 – 0.05 (0.02)
3	<0.01	<0.01	0.01 – 0.06 (0.04)
7	<0.01	<0.01	0.02 – 0.08 (0.04)
14	<0.01	<0.01	<0.01 – 0.06 (0.03)
21	<0.01	<0.01 – 0.01	<0.01 – 0.03 (0.02)
27	<0.01	<0.01	<0.01 – 0.03 (0.02)

These data establish that direct veterinary treatment with diazinon results in the residues of significance for establishing appropriate MRLs for diazinon in animal commodities and that exposure to diazinon in the feed should not result in violation of those MRLs.

The poultry studies used 4 groups of 5 Leghorn hens, a group of hens being subjected to a dose with technical grade diazinon by gelatin capsule at rates of 0, 0.5, 1.5 and 5 ppm for 28 consecutive days. Eggs were collected from all birds at 0, 3, 7, 14, 21 and 28 days and the hens slaughtered after 28 days. Composite samples of breast and thigh muscle, skin and attached fat, peritoneal fat and liver were taken and stored at –20^{o}C for 5 months before analysis. No detectable residues (<0.01 mg/kg) of diazinon, diazoxon or hydroxydiazinon were found in any of the samples for any dose rate. Poultry are not directly treated with diazinon for veterinary purposes. Therefore this study supports the current MRLs of *0.05 mg/kg for eggs, *0.05 for poultry offal and *0.05 mg/kg for poultry meat.

5.7 Animal feed commodities

Currently there are no Table 4 entries in the *MRL Standard* for diazinon. No Australian data were presented for diazinon residues in important animal feed commodities derived from crops which appear on agricultural product labels. Residue data for diazinon in significant feed commodities such as pastures, lucerne, cereal fodder and forage, citrus peel, legume hay and sugarcane fodder and forage are required to support feed commodity MRLs.

5.8 Residues Overview

No Australian data were submitted in support of agricultural uses of diazinon to the Chemical Review Program. Entries into the *MRL Standard* have been through consideration of overseas data submitted to the 1993 and 1994 JMPRs. This has permitted the removal of the general 'fruit' and 'vegetable' entries in the *MRL Standard* and has revealed the absence of appropriate MRLs in the case of some registered use-patterns (eg. cotton and oilseeds) and in one case the absence of a use-pattern for an established MRL (olives). In general, overseas residue data were useful for the purpose of

establishing appropriate temporary MRLs only when the Australian use-pattern used less chemical than the overseas GAP or when a maximum number of sprays and minimum treatment interval could be determined from the registered labels. In general, labels for diazinon-based agricultural products permit unlimited sprays without a defined minimum retreatment interval for many commodities. Given higher treatment rates and an unlimited number of sprays for Australian GAP, extrapolation of a Codex MRL to the Australian situation was not considered appropriate in some cases, and the existing MRL has been given temporary status.

The maximum diazinon residues in mammalian tissues and milk were generally adequately detailed in the reports evaluated. Residue studies supported the data generated in diazinon metabolism studies. Decline of diazinon residues in the studies evaluated in Part 2, Section 5.15, confirm that diazinon is readily excreted and metabolised. As noted earlier, deposition of diazinon residues occurred mainly in the fat, however the effect was not bioaccumulative and even fat residues decreased rapidly with time (days). No violations of the current MRLs for meat and offal were observed when the use patterns in the studies complied with those recommended on product labels.

In general the residue data evaluated support the current MRLs for meat (mammalian) [in the fat]. Edible offal residues were much lower than the current edible offal MRL of 0.7 mg/kg, and were typically < 0.1 mg/kg. In 1996, JMPR undertook a review of offal MRLs on the basis of data generated under GAP. These data indicate that the maximum offal residue observed was 0.03 mg/kg, and consideration of these data in conjunction with the studies presented for evaluation under the Chemical Review Program justifies lowering the edible offal (mammalian) MRL to 0.03 mg/kg.

Data for diazinon residues in milk from animals treated with spray-on, dip and backrubber products were not determined on a fat basis, but rather on a whole milk basis. These whole milk residues indicate that expected residues at nil milk withholding are in large excess of the current milk [in the fat] MRL of 0.5 mg/kg which transforms to approximately 0.02 mg/kg when expressed on a whole milk basis. The maximum residue in whole milk was 0.40 mg/kg when used at a rate of 0.5 g a.i./L. This residue level is 20 times the current milk MRL. The submitted data indicate the current MRL is inappropriate for support of spray-on, dip and backrubber products in lactating animals. A label statement which prevents use of these products on lactating animals is to be included on registered product labels.

5.9 Other Issues

5.9.1 Fate of residues in storage and processing

One processing study (Section 5.15.3, rep. no. 74/4/440) has been supplied which addresses diazinon residues in cream, butter and skim milk from cows spray-treated with diazinon. Concentration factors with respect to diazinon were significant in those products which contain a higher fat content than whole milk. The concentration factors were 18-fold for butter, 9.6-fold for cream, and 0.14-fold for skim milk. As discussed above, the milk (in the fat) MRL of 0.5 mg/kg in conjunction with a nil withholding period did not accommodate incurred milk residues for spray and dip products. Consistent with this finding, this processing study reported that residue concentrations in cream and butter exceeded the milk (in the fat) MRL of 0.5 mg/kg.

Several processing studies in agricultural commodities were available in the 1993 JMPR review. Additional processing data would be required to address concerns of residue levels in animal feeds. Studies to determine residues in citrus peel and oilseed meal are required, provided these use-patterns are to be maintained. Should the use-pattern in cereal grains be maintained, processing data for flour, bran and germ are required.

5.9.2 Fat Solubility

Residue and animal metabolism data which have been examined in this evaluation identify diazinon as a fat-soluble pesticide. The Codex Alimentarius Commission also defines diazinon as being fat-soluble.

Residue studies on food producing animals reveal that tissue residues attain plateau values, even after multiple consecutive treatments, and that residues in fat deplete to below the LOQ within 21 days after exposure is ceased. This behaviour suggests that the fat solubility of diazinon is not a significant concern *per se*.

5.9.3 Residues in food in commerce or at consumption

The National Residue Survey (NRS) conducts organophosphate screening on grain, animal commodities and other foods which allows detection and determination of diazinon residues. Results from the 1997 survey indicate only one MRL violation in meat for organophosphates in 5895 samples tested. This violation involved chlorpyrifos. Analysis of residues in grains and milled products failed to detect diazinon residues. Organophosphate residues were not detected in onions, macadamia or pecan nuts (which formed the basis of the horticultural testing program).

The 1996 ANZFA Australian Market Basket Survey analysed for diazinon residues in foods. Finite diazinon residues were detected only in apples. None of the samples contained diazinon residues in violation of the MRL for fruit.

The ADI for diazinon is 1.0 µg/kg body wt/day. Dietary intake calculations for infants, children, young adults and adults ranged from daily intakes of 0.07% of the ADI for girls, aged 12 years and older, to 1.47% of the ADI for toddlers aged two years (information sourced from the 1996 ANZFA Australian Market Basket Survey).

5.9.4 Non-food uses

Diazinon is currently registered for use in a variety of applications for insect control in domestic and commercial buildings and on turf, lawns and in home gardens. Such situations are not expected to result in any significant transfer of diazinon into food commodities provided that label instructions are followed.

5.10 Regulatory Issues

5.10.1 Current General Entries for Fruits and Vegetables

There are currently two general entries for “Fruits” and “Vegetables” for diazinon, being 0.5 mg/kg and 0.7 mg/kg, respectively. No data have been presented to support these MRLs. These types of general entries are now superseded by MRLs for the specific commodities. Group entries such as “fruits” and “vegetables” also lead to artificially high dietary intake calculations. These can cause unwarranted health concerns, and although dietary surveys such as ANZFA’s Market Basket Survey can alleviate these concerns through presenting actual survey data, the Market Basket Survey does not address all significant pesticides.

This residue evaluation recommends that the current "fruit" and "vegetable" MRLs be replaced by appropriate individual commodity and Codex classified group MRL entries on a temporary basis. This will allow continuation of many uses (including minor uses) until new data are generated.

Additionally, the recommendation of a temporary group MRL should not preclude residue data generation for a single commodity type in that crop grouping. Support of a permanent MRL in that single commodity only should be considered if use of diazinon on other commodities in the group is not considered an essential use-pattern. For example, if cauliflower is the only brassica crop upon which use of diazinon is considered essential, then generation of residue data for cauliflowers only is required, not data sufficient to recommend an MRL in the group 'brassica (cole or cabbage) vegetables, head cabbages, flowerhead brassicas'.

5.10.2 "Essential" uses of diazinon in crops

Grower groups along with the QDPI have indicated that diazinon is still frequently used on pineapple, onion, garlic, mushrooms, macadamia nuts, cauliflower, rhubarb, silverbeet, carrots and beetroot. They wish MRLs to be retained to support these uses. However, no Australian data were submitted to the Chemical Review Program to support MRLs for the individual commodities or commodity groups. Australian and overseas residue data in crops have been submitted for review purposes at the international level and are summarised in JMPR (1993 and 1994). These published data have been assessed to determine appropriate temporary MRLs for some of these crops, and to determine further Australian residue data requirements to support permanent MRLs for these 'essential' uses.

The following residue data are required when diazinon is recommended for future uses in crops, including glasshouse and mushroom house uses.

- Residue data on vegetables or fruit for which continued registration of diazinon is sought. Where appropriate, residue trials on representative crops will be accepted for the establishment of a group MRL. Use of diazinon for control of pests in the following crops is considered essential by user groups:
  Beans, peas, beetroot, carrot, cauliflower, rockmelon, cucumber, small zucchini, garlic, onions, macadamia nuts, mushrooms, pineapple, celery, rhubarb and silverbeet.
  Use of diazinon to control pests in the following crops was considered non-essential by surveyed user groups:
  Apple, pear, banana, citrus, pasture, lucerne, cereal grains, oilseeds, soya beans, sugarcane, blueberries, grapes, hops, kiwifruit, potato, stone fruit, sweet corn, capsicum, lettuce, broccoli, cabbage, brussels sprouts.
  Continued registration of use-patterns associated with any crop will require the generation of supporting Australian residue data.

- Argument may be presented for consideration of the use of diazinon in some crops as minor-uses, and residue data requirements for these crops will be subject to the *NRA Minor-Use Information Sheet*.

- Residue data for representative vegetable and fruit crops for the label specified uses in glasshouses. For example, if a use-pattern in tomatoes requires maintenance on the product labels, residue data for glasshouse crops of this commodity may be required.

- Residue data for major processed commodities derived from cereal grain crops (flour, bran and germ) and citrus fruits (juice and pomace, which may be fed to animals) will be required if these use-patterns are to be maintained.

- Residue data for diazinon in significant animal feed commodities such as pastures, lucerne, cereal fodder and forage and sugarcane fodder and forage will be required to support feed commodity MRLs. These data will only be required if use-patterns in these crops are to be maintained.

Registrants are advised to refer to NRA Residue Guideline No. 8, *Stability of Residues During Storage*, for storage stability studies. Metabolism studies in animals indicate rapid elimination of diazinon and metabolites from animal tissues and milk when animals are dosed at rates of up to 200 ppm in the feed. Animal transfer data will not be required for animal feed commodities.

Residue data are required to be submitted to the NRA for evaluation by the end of the year 2002, or at a date to be decided by the Chemical Review Program of the NRA.

5.10.3 Animal Commodities

With respect to those cattle products for which the slaughter WHP is currently 3 days, the residues data for muscle and fat (Tables 15 and 28) indicate that the current slaughter WHP of 3 days is too short. As a consequence, this could lead to violations of the meat (in the fat) MRL of 0.7 mg/kg. It is recommended that products with a cattle slaughter WHP of 3 days have this WHP extended to 14 days to alleviate this concern. Cattle eartag products containing diazinon underwent residues evaluation as part of their registrations in 1994, have been reviewed in the 1996 JMPR (some of the data presented to the JMPR were the same as those submitted for the registration of the two Australian diazinon eartag products) and were not re-evaluated here. A nil withholding period was recommended for these products at that time. No change to this WHP is considered necessary.

The current edible offal MRL greatly overestimates the expected level of diazinon residues in this commodity. The data made available through the Chemical review Program, along with a review of offal MRLs made by the 1996 JMPR, suggest that this MRL can usefully be lowered from 0.7 mg/kg to 0.03 mg/kg. Lowering the magnitude of the edible offal MRL to a level that is consistent with that seen when Good Agricultural Practice (GAP) is observed facilitates the detection of when a product has been used in a manner contrary to the registered use patterns.

5.11 Recommendations

5.11.1 Changes to the *MRL Standard*

Agricultural commodity MRLs and animal commodity MRLs for indirect treatment.

The following changes to the diazinon entries in Table 1 of the *MRL Standard* are recommended.

Codex Classification	Commodity	NRA MRL
Diazinon DELETE:		
GC 0080	Cereal grains	0.1
FC 0001	Citrus fruits	0.7
MO 0105	Edible offal (mammalian]	0.7
PE 0112	Eggs	*0.05
	Fruits [except citrus fruits; olives; peach]	0.5
FI 0341	Kiwifruit	0.5
OC 0305	Olive oil, crude	2
FT 0305	Olives [unprocessed]	2
FS 0247	Peach	0.7
PO 0111	Poultry, Edible offal of	*0.05
PM 0110	Poultry meat	*0.05
GS 0659	Sugar cane	0.5
VO 0447	Sweet corn (corn-on-the-cob)	0.7
TN 0085	Tree nuts	0.1
OC 0172	Vegetable oils, crude [except olive oil, crude]	0.1
	Vegetables	0.7

DIAZINON ADD:		
FI 0328	Banana, dwarf	T 0.5
FI 0327	Banana	T 0.5
VP 0061	Beans, except broad bean and soya bean	T 0.2
FB 0020	Blueberries	T 0.2
VB 0040	Brassica (cole or cabbage) vegetables, head cabbages, flowerhead brassicas	T 2
VA 0036	Bulb vegetables	T 0.05
GC 0080	Cereal grains	T 0.1
FC 0001	Citrus fruits	T 0.7
MO 0105	Edible offal (mammalian)	0.03
PE 1112	Eggs	T *0.05
VC 0045	Fruiting vegetables, cucurbits	T 0.2
VO 0050	Fruiting vegetables, other than cucurbits	T 0.05
FB 0269	Grapes	T 2.0
DH 1100	Hops, dry	T 0.5
VL 0053	Leafy vegetables (including brassica leafy vegetables)	T 0.7
FI 0341	Kiwifruit	T 1.0
VP 0063	Peas (pods and succulent seeds)	T 0.2
FI 0353	Pineapple	T 0.5
FP 0009	Pome fruit	T 2.0
PO 0111	Poultry, Edible offal of	T *0.05
PM 0110	Poultry meat	T *0.05
VR 0574	Root and tuber vegetables	T 0.7
VS 0078	Stalk and stem vegetables	T 0.7
FS 0012	Stone fruits	T 1.0
GS 0659	Sugar cane	T 0.5

TN 0085	Tree nuts	T 0.1
OC 0172	Vegetable oils, crude [except olive oil, crude]	T 0.1

Conversion of temporary MRLs to full MRLs will depend on supply of acceptable, preferably Australian, residue data.

Temporary MRLs are recommended to expire on 31 December 2002 or at a date to be decided by the NRA.

5.11.2 Animal commodity MRLs for direct veterinary treatment

The MRL ML 0106 Milks [in the fat] of 0.5 mg/kg is not considered to adequately cover milk from animals which have been spray or dip treated with diazinon-based products. However, the milk [in the fat] MRL of 0.5 mg/kg is to be retained, to cover residues in milk derived from animals treated with diazinon-based eartags only. The use of diazinon-based dip and spray products on lactating animals is to be withdrawn, as the dairy industry indicated that it did not support an Australian milk MRL which is higher than the Codex MRL. In addition, the dairy industry indicated that it supports the retention of the spray and dip use-patterns for all categories of dairy cattle except lactating dairy cattle.

It is recommended that the MRL MO 0105 Edible offal (mammalian) of 0.7 mg/kg be deleted from the *MRL Standard* and be replaced by the MRL MO 0105 Edible offal (mammalian) of 0.03 mg/kg. The current poultry commodity MRLs in the *MRL Standard* are to be made temporary pending the submission of appropriate animal feed commodity data (refer to table on p. 41).

5.11.3 Slaughter/milk withholding periods for direct veterinary treatment

It is recommended that the slaughter withholding period for cattle be extended from 3 days to 14 days for all use patterns except cattle ear tags. The existing nil withholding period should be retained for the diazinon ear tag products. The current slaughter withholding period for sheep, pigs and goats (each 14 days) are to remain unchanged.

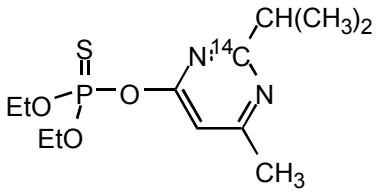
It is recommended that the slaughter withholding period for cattle be extended from 3 days to 14 days for all use-patterns except cattle eartags. The existing nil withholding period should be retained for the diazinon eartag products. The current slaughter withholding period for sheep, pigs and goats (each 14 days) are to remain unchanged. Correspondence from Novartis Animal Health Australasia advised that, as a consequence of a review of organophosphates and carbamates being conducted by the US EPA, Novartis Crop Protection US will be seeking the revocation of US diazinon tolerances for sheep commodities. The proposed action stems from dietary exposure concerns relating to infants. The letter from Novartis Animal Health Australasia also states that the proposed timeframe for revoking the tolerances is the end of 2000. The same correspondence indicates that in cases where US tolerances for sheep commodities are revoked, the Meat and Livestock Australia (MLA) may need to set an Export Slaughter Interval (ESI). It is noted that the currently available residue data are inadequate for the purpose of determining an ESI. This issue may need to be addressed further once the US EPA review outcomes become clear.

With respect to milk, the following label statement is to appear on diazinon-based spray-on and dip products: DO NOT USE IN LACTATING OR PREGNANT COWS/EWES/NANNIES WHERE MILK OR MILK PRODUCTS MAY BE USED FOR HUMAN CONSUMPTION.

PART 2: SUMMARIES OF DATA SUBMITTED IN SUPPORT OF DIAZINON USE

5.12 METABOLISM TRIALS

Chemical structure of ^{14}C-labelled diazinon:



5.12.1 Rats

Characterisation and Identification of Diazinon Metabolites in Rats; Brown, K. and Lai, K., Ciba-Geigy Corporation, North Carolina, USA, ABR-88164, February 1989.

Three groups, each comprising five male and five female rats, were treated intragastrically with doses of ^{14}C-diazinon. The first two groups were treated with single doses of 10 mg/kg and 100 mg/kg respectively. The third group was treated subchronically for 14 days with 10 mg/kg per day of unlabelled diazinon, and on day 15 with a 10 mg/kg dose of ^{14}C-diazinon. Elimination of radioactivity through urine and faeces was monitored for seven days and the animals were sacrificed at the end of that period. The metabolite pattern in urine and faeces was determined by TLC and, in the case of urine only, with reverse phase TLC, MPLC and HPLC. Quantitation was carried out by scintillation counting on resolved components from TLC separation.

Total radioactivity eliminated through urine and faeces after 7 days was 98.4%, 99.4% and 98.5% for low dose, high dose and preconditioned low dose groups, respectively. The majority of this was eliminated through the urine with 95.9%, 96.6% and 95.7% of total radioactivity accounted for in the low dose, high dose and preconditioned low dose group urine, respectively. The corresponding values for faecal elimination were 2.5%, 2.8% and 2.8%. Radioactive levels in tissues were generally very low and ranged from <0.01 ppm to 0.01 ppm in the low dose and preconditioned low dose animals. The exceptions to this range were 0.053 ppm in blood from preconditioned male rats, and 0.029 ppm in both fat and ovaries from low dose females. Tissue levels for high dose animals ranged from 0.001 ppm in muscle to 0.38 ppm in red blood cells. High dose females exhibited 0.94 ppm radioactivity in fat and 0.16 ppm in ovarian tissue.

The distribution of metabolites present in the excreta is elaborated in Table 4.

Table 4. ^{14}C (expressed as a % of the dose) present as various metabolites in rat excreta.

Analyte	G-27550	GS-31144	M3*	Diazinon	G-24576	CGA-14128
Urine	38.2	17.3	9.7	0.11	0.14	0.12
Faeces	0.08	0.02	< 0.01	< 0.01	< 0.01	< 0.01

*M3 was identified as 2-(β-hydroxyisopropyl)-6-methyl-4(1H)-pyrimidinone.
Data are mean values.

Degradation of ^{14}C-labelled Diazinon in the Rat; Mucke, W., Alt, K. O. and Esser, H. O., *J. Agr. Food Chem*., 1970, **18**, 208.

Metabolites of diazinon were isolated and their tissue distribution analysed after feeding male rats daily for four days with 1 mg of diazinon (ratio of 2-^{14}C-labelled to unlabelled material 1:10). Metabolites were isolated from urine collected over the feeding period. Tissue residues were determined after sacrifice of the animals at regular time intervals after the end of the treatment period. TLC and scintillation methods were used for separation and determination of metabolite concentrations, respectively. Table 5 shows the distribution and dissipation of radioactivity in the organs after feeding.

Table 5. Radioactive Content (expressed as percent of dose applied)

Organ	0.25 days	1 day	2 days	5 days	8 days
Oesophagus	0.25	0.02	<0.01	<0.01	<0.01
Stomach	0.25	0.02	<0.01	<0.01	<0.01
Small intestine	0.65	<0.05	<0.05	<0.05	<0.05
Caecum/colon	0.76	<0.05	<0.05	<0.05	<0.05
Liver	0.16	<0.05	<0.05	<0.05	<0.05
Spleen	0.01	<0.01	<0.01	<0.01	<0.01
Pancreas	0.01	<0.01	<0.01	<0.01	<0.01
Kidneys	0.04	<0.01	<0.01	<0.01	<0.01
Lungs	0.02	<0.01	<0.01	<0.01	<0.01
Testis	0.02	<0.01	<0.01	<0.01	<0.01
Muscles	0.77	<0.03	<0.03	<0.03	<0.03
Fat	0.23	0.18	<0.01	<0.01	<0.01
Sum	2.92	0.20	-	-	-

Urine and faeces accounted for 90% of the administered radioactivity after 168 hours. As Table 5 indicates, no accumulation of diazinon or its metabolites occurs in any organ, discernible radioactivity being absent after 2 days.

Urinary metabolites were subjected to isolation and clean-up prior to characterisation using spectroscopic methods. The urinary metabolites were found to be a group of pyrimidinols, two of which were isomeric. The compounds were characterised as G-27550, GS-31144 and the isomer of GS3114 with the hydroxy group attached to one of the terminal methyl groups of the isopropyl functionality. The pathway of metabolic degradation is in agreement with those proposed by other workers discussed earlier.

Percutaneous Absorption of 2Δ-^{14}C-Diazinon in Rats, Williams, S. C. and Marco, G. J., Ciba-Geigy Corporation, North Carolina, U.S.A., ABR-84011, June 1984.

Labelled diazinon dissolved in tetrahydrofuran was dermally applied at levels of 1 mg/kg and 10 mg/kg to male and female albino rats. Urine, faeces and volatiles were collected at 24, 48, 72 and 144 hours after treatment. Treated skin, blood cells, plasma, brain, spleen, heart, muscle, lung, kidney, liver, stomach, gonads and small and large intestines were sampled. Fat was radioassayed only at 2, 72 and 144 hours post-treatment.

In both sexes, the main route of excretion was urinary, averaging 75% of the applied dose, the majority of which was excreted within the first 48 hours. Seven percent or less was recovered in the faeces; volatiles accounted for 10 to 20%. Tables 6 - 9 show the deposition of labelled diazinon in the various tissues sampled at intervals after treatment. None of the tissues analysed showed constant diazinon levels, most

of them peaking with respect to the diazinon level at around 8 hours and quickly depleting thereafter. Residue levels were generally below the level of quantitation 144 hours after treatment.

Table 6. Tissue Diazinon Concentrations (ppm) for Male Rats Dosed Dermally at 1 mg/kg

Tissue	2 hrs	8 hrs	24 hrs	48 hrs	72 hrs	144 hrs
Plasma	0.03	0.09	0.03	0.00	<*0.00	<*0.00
RBC	0.02	0.07	0.02	0.01	<*0.00	<*0.00
Fat	0.07	-	-	-	0.03	0.01
Brain	0.03	0.07	0.02	0.00	<*0.00	<*0.00
Muscle	0.02	0.07	0.02	0.00	<*0.00	<*0.00
Lung	0.04	0.08	0.02	0.00	<*0.00	<*0.00
Heart	0.04	0.06	0.02	0.00	<*0.00	<*0.00
Spleen	0.03	0.08	0.02	0.00	<*0.00	<*0.00
Kidney	0.05	0.15	0.04	0.01	<*0.00	<*0.00
Liver	0.04	0.10	0.03	0.01	<*0.00	<*0.00
Stomach	0.25	0.36	0.11	0.02	0.01	*0.01
Small intestines	0.11	0.16	0.05	0.01	<*0.00	<*0.00
Large Intestines	0.06	0.07	0.15	0.17	0.01	*0.01
Gonads	0.02	0.09	0.03	0.01	<*0.00	<*0.00
Skin wash	5.28	3.90	0.12	0.02	0.01	<*0.00
Skin dissolved	0.55	0.86	0.18	0.09	0.13	0.04

<* = Below the level of quantitation

Table 7. Tissue Diazinon Concentrations (ppm) for Female Rats Dosed Dermally at 1 mg/kg

Tissue	2 hrs	8 hrs	24 hrs	48 hrs	72 hrs	144 hrs
Plasma	0.05	0.17	0.04	0.01	<*0.00	<*0.00
RBC	0.04	0.11	0.03	0.01	<*0.00	<*0.00
Fat	0.06	-	-	-	0.04	<*0.00
Brain	0.04	0.12	0.03	<*0.00	<*0.00	<*0.00
Muscle	0.04	0.12	0.03	0.03	<*0.00	<*0.00
Lung	0.05	0.15	0.03	0.01	<*0.00	<*0.00
Heart	0.04	0.15	0.02	0.00	<*0.00	<*0.00
Spleen	0.04	0.13	0.03	0.00	<*0.00	<*0.00
Kidney	0.08	0.26	0.05	0.01	<*0.01	<*0.00
Liver	0.05	0.17	0.04	0.02	<*0.00	<*0.00
Stomach	0.26	0.43	0.18	0.03	0.01	0.01
Small intestines	0.10	0.24	0.06	0.01	<*0.00	<*0.00
Large Intestines	0.02	0.16	0.14	0.02	0.01	<*0.00
Gonads	0.05	0.18	0.05	0.01	<*0.01	<*0.00
Skin wash	5.40	1.87	0.06	0.01	*0.00	<*0.00
Skin dissolved	0.86	0.67	0.08	0.04	0.02	0.01

Table 8. Tissue Diazinon Concentrations (ppm) for Male Rats Dosed Dermally at 10 mg/kg

Tissue	2 hrs	8 hrs	24 hrs	48 hrs	72 hrs	144 hrs
Plasma	0.30	0.57	0.51	0.07	<*0.04	<*0.05
RBC	0.21	0.40	0.38	0.07	*0.04	*0.05
Fat	0.34	-	-	-	0.63	0.06
Brain	0.25	0.43	0.36	0.05	<*0.04	<*0.04
Muscle	0.23	0.42	0.36	0.06	<*0.04	<*0.04
Lung	0.36	0.50	0.44	0.06	<*0.04	<*0.04
Heart	0.25	0.42	0.42	0.05	<*0.04	<*0.04
Spleen	0.25	0.42	0.38	0.06	<*0.04	<*0.04
Kidney	0.53	0.90	0.86	0.11	0.06	<*0.04
Liver	0.31	0.60	0.58	0.09	*0.04	<*0.04
Stomach	0.28	2.22	2.89	0.35	0.09	0.03
Small intestines	0.63	1.23	1.38	0.13	0.06	<*0.03
Large Intestines	0.13	1.14	1.80	0.31	0.16	<*0.04
Gonads	0.23	0.52	0.48	0.08	0.04	<*0.04
Skin wash	55.58	40.62	6.02	0.94	0.08	<*0.03
Skin dissolved	2.73	6.69	10.08	1.15	0.18	*0.12

Table 9. Tissue Diazinon Concentrations (ppm) for Female Rats Dosed Dermally at 10 mg/kg

Tissue	2 hrs	8 hrs	24 hrs	48 hrs	72 hrs	144 hrs
Plasma	1.61	2.07	0.50	0.07	<*0.05	<*0.04
RBC	0.96	1.34	0.35	0.08	<*0.05	0.04
Fat	1.57	-	-	-	0.28	0.08
Brain	1.14	1.49	0.36	0.05	<*0.04	<*0.04
Muscle	1.01	1.44	0.42	0.05	<*0.04	<*0.04
Lung	1.58	1.71	0.42	0.06	<*0.04	<*0.04
Heart	1.42	1.77	0.37	0.06	<*0.04	<*0.04
Spleen	1.15	1.51	0.39	0.05	<*0.04	<*0.04
Kidney	2.43	2.73	0.70	0.11	<*0.05	<*0.04
Liver	1.68	1.98	0.46	0.08	<*0.05	<*0.04
Stomach	27.91	7.53	2.69	0.27	0.07	*0.06
Small intestines	4.79	3.27	0.73	0.09	<*0.04	<*0.04
Large Intestines	0.78	3.15	1.72	0.47	0.10	<*0.04
Gonads	1.55	1.88	0.65	0.11	0.05	<*0.04
Skin wash	29.98	11.63	0.74	0.04	<*0.03	<*0.03
Skin dissolved	10.29	6.34	1.23	0.19	0.16	*0.88

Skin wash and dissolution studies gave an indication of the rate at which diazinon is dermally transported. Transdermal passage in female animals was higher than for males. In both sexes, peak residue values were reached at around the same time, and excretion rates were very similar.

5.12.2 Goats

Disposition of ^{14}C-Diazinon in Goats; Simoneaux, B.J., Ciba-Geigy Corporation, North Carolina, USA; ABR-88117, October 1988.

Two lactating goats were treated orally with ^{14}C-diazinon at a daily dose of 200 ppm in the diet for four consecutive days. Urine, faeces and milk were sampled daily. Blood radioactivity was determined 48 hours after the first dose and 24 hours after the final dose. Tissues were sampled 24 hours after the last dose. Radioactive balance was determined either by combustion analysis or, for urine and milk, by direct scintillation counting.

The total amount of radioactivity excreted was 74.5% of the administered dose with the majority present in the urine (64%); faeces contained an average of 10% of the administered radioactivity. Radioactivity in the blood accounted for 0.3% of the administered dose, and at sacrifice the total radioactive dose present in tissues was 0.9%. Tissue residues were highest in kidney (2.0 ppm parent equivalents); the average level of radioactivity in other tissues ranged from 0.23 ppm to 1.2 ppm. Radioactivity levels in milk were very low, accounting for only 0.3% in total.

Characterisation of ^{14}C-Diazinon Metabolites in Goats; Simoneaux, B.J., Ciba-Geigy Corporation, North Carolina, USA, ABR-88118, October 1988.

This study continues from the study discussed above. Radioactivity present in urine, faeces, milk and tissues were further separated into organic and aqueous solubles. These extracts were then subjected to TLC separation and the metabolites identified by one- and two-dimensional TLC co-chromatography with known standards. Metabolites isolated in this way were quantified by extraction from the TLC silica into water followed by scintillation counting. Appendix 1 shows the structures and code numbers for a group of metabolites isolated. The levels at which they were present in various excreta and tissues are shown in Table 10.

Table 10. Distribution of radioactivity in excreta and tissues of goats (n=2)

Analyte	Diazinon	G-24576	CGA 14128	G-27550	GS-31144
Urine				4.7 %	12.8 %
Faeces	<0.1 %	0.2 %	0.1 %	2.6 %	1.7 %
Milk				0.2 %	0.18 %
Liver				0.07 %	0.07 %
Kidney				0.01 %	0.02 %
Omental Fat	0.05 %		0.01 %		
Tenderloin				< 0.01 %	< 0.01 %
Leg Muscle	0.02 %			0.36 %	0.41 %
Perirenal Fat	0.02 %				

Data are % of total radioactivity

5.12.3 Sheep

Characterisation and Identification of Major Metabolites in Tissues of Sheep Treated Dermally with ^{14}C-Diazinon; Barr, H.P. and Carlin, T.J., Ciba-Geigy Corporation, North Carolina, USA, ABR-90014, August 1990.

Two sheep were treated dermally once daily for three consecutive days with an acetone solution containing 2270 mg of ^{14}C diazinon. The sheep were sacrificed 6 hours after the final dose. All tissues analysed showed greater than 90% extractability. The metabolites were characterised by two-dimensional TLC and using GCMS. Metabolite profiles in tissue extracts and urine were determined by reverse-phase HPLC.

Tissue concentrations (ppm), in terms of parent equivalents, were: 4.4 in heart; 4.4 in liver; 9.4 in kidney; 7.3 in back fat and 4.0 in leg muscle.

With the exception of fat, the two major metabolites in all tissues were GS-31144 and G-27550; fat contained diazinon as the major residue. Glucuronide conjugates of these pyrimidinols also constitute a significant proportion of the residue present in kidney and liver. Diazinon was present as a major residue in heart and leg muscle. Table 11 shows the major metabolites as a percentage of the overall residue characterised for each tissue and urine.

Table 11. Distribution of diazinon and metabolites in tissues and urine of sheep (n=2)

Metabolite	Fat	Heart	Leg Muscle	Kidney	Liver	Urine
Diazinon	85.2	55.9	59.2	7.3	3.8	-
G-27550	1.6	16.4	23.2	23.8	44.5	10.0
GS-31144	-	12.0	13.0	21.1	17.5	22.7

Data are % TRR for the given tissue or urine

Toxic Metabolites of Diazinon in Sheep; Janes, N. F., Machin, A. F., Quick, M. P., Rogers, H., Mundy, D. E. and Cross, A. J., *J. Agr. Food Chem*., 1973, **21**, 121.

Three diazinon metabolites which demonstrated cholinesterase inhibitory activity were isolated and characterised by spectroscopic methods. In order to obtain sufficient quantities for spectroscopic characterisation, two sheep were dosed by stomach tube with 1 g/kg of diazinon. One was killed and tissues sampled after 48 hours. Urine was collected from the other sheep over 3 days. Two of the metabolites were urinary, and a third metabolite was isolated from fat where it is known to concentrate. All three compounds contained an intact phosphorothionyl ester group, being analogues of diazinon. Metabolites I and II were analogues derived from oxidation of the tertiary carbon of the isopropyl group and the methyl group, respectively. This resulted in a pair of isomeric hydroxy-substituted diazinons. The third metabolite of interest is the isopropenile substituted compound which might conceivably result from dehydration of metabolite I. Metabolite I (hydroxydiazinon) was found in tissues, blood and urine. Metabolite II was found in urine only. Table 12 shows the distribution of diazinon and the characterised metabolites in blood, tissues and urine of the sheep dosed at 1 g/kg and slaughtered at 48 hours.

Table 12. Distribution of diazinon and metabolites in a sheep*

Sample	Time after dosing (hr)	Diazinon (ppm)	Hydroxy-diazinon (ppm)	Isohydroxy-diazinon (ppm)
Blood	3	1.6	1.0	
Blood	6	2.5	1.4	
Blood	24	5.4	1.6	
Blood	30	5.3	1.4	
Blood	48	4.9	1.9	
Liver	48	18	2.1	
Kidney	48	12	0.6	
Brain	48	15	0.7	
Muscle	48	14	0.5	
Fat	48	624	9.2	
Urine	0-2	2.1	0.3	7.2
	2-4	1.1	4.3	38
	4-6	1.4	0.4	6.5
	6-24	2.6	2.6	15
	24-26	2.6	4.4	5.8
	26-30	3.3	6.7	3.2
	30-48	5.0	17	61

*Dose was 1 g/kg diazinon and the sheep was slaughtered 48 h post-treatment.

5.12.4 General

The Metabolism and Elimination of Diazinon from Animals, Animal Tissues and Foodstuffs – A Review, Hastie, B.A., Geigy Agricultural Chemicals, Botany NSW, Australia.

This study discussed the fundamental biochemical processes by which organophosphate insecticides such as diazinon create a toxic effect, focusing on cholinesterase inhibition. All of the metabolism studies were carried out through oral dosing with diazinon. The principal dosing agent was ^{32}P-labelled diazinon.

A study by Robbins, Hopkins and Eddy[1] used ^{32}P-labelled diazinon to quantify distribution of radioactivity in blood, milk, urine and faeces of cows which had been dosed at a rate of 20 mg/kg orally. After 96 hours, blood contained no significant radioactivity and that which was detected prior to 96 hours was attributable to metabolic intermediates. Milk radioactivity showed a marked drop after 36 hours and diazinon was not quantifiable in samples analysed thereafter. A peak in radioactivity was reached at 18 hours, 25% of which was attributable to diazinon. The total amount of diazinon excreted through milk in the period 6 to 24 hours after dosing accounted for 0.01% of the total dose. Rapid excretion of diazinon and its metabolites in urine accounted for 74% of the total dose within 36 hours. The composition of the 36 hr sample was almost entirely metabolised diazinon. After 96 hours only traces of radioactivity were detectable in faeces. ^{32}P-labelled products in urine were principally diethyl phosphorothioic acid and diethyl phosphoric acid.

Millar[2] carried out characterisation of the distribution of ^{32}P-labelled diazinon in dog tissues after oral administration at a rate of 225 mg/kg. The dog was killed after 10 hours and tissues collected for analyses. Table 13 shows the tissue distribution.

Table 13. Diazinon in Tissues (expressed as ppm wet basis)

Sample	Radiochemical method	Enzyme Inhibition Method
Hind leg fat	13.6	12.1
Perirenal fat	81.0	78.4
Omental fat	17.2	16.8
Pericardial fat	39.0	37.0
Kidney	3.2	nil
Liver	16.4	nil
Urine	694	nil
Stomach contents	838	nil

Unchanged diazinon was only present in significant quantities in fat and muscle samples. Radioactivity in the urine and stomach contents was due to diethyl phosphoric and diethyl phosphorothioic acid.

Derbyshire and Murphy[3] analysed diazinon residues in milk from cows fed with silage treated with diazinon. The animals were dosed at levels up to 500 ppm of dry matter intake, however no diazinon was detectable in butter fat. The study concluded that diazinon is altered in the digestive system of dairy cows. Rai and Roan[4] also studied milk from dairy animals fed diazinon at daily rates of 1.06, 5.3 and 10.6 mg/kg over three weeks. Traces of diazinon were found in blood, urine, muscle, liver and fat. Only fat displayed significant residues. Other studies on milk obtained from cows housed in dairy barns sprayed with diazinon or treated with diazinon fly bait revealed no diazinon residues in milk.

Vigne et al[5] assessed the effect of orally administered ^{32}P-labelled diazinon on goats treated at a rate of 6.46 mg/kg. Urine, faeces, blood and milk were examined for radioactivity. A total of 2-3 mg of the original total dose of 235 mg of diazinon could be detected in the analysed samples after 4 days. This indicates rapid metabolism and/or excretion. Cholinesterase determinations indicated that radioactivity present in milk, faeces and blood was not due to diazinon. Diazinon detected in urine did not exceed 2 mg over four days, equivalent to 1% of the administered dose.

Plapp and Casida[6] treated rats with ^{32}P-labelled diazinon at 100 mg/kg *per os*. Urine was analysed for radioactivity, the majority of which was excreted within 24 hours of treatment. Greater than 99% of the recovered radioactivity was present as water-soluble hydrolysis products.

Harrison, Whitten and Maskell[7] investigated blood and tissue residues in animals treated with diazinon dip. Eight sheep were dipped in 0.02% diazinon and eight were dipped in 0.05% diazinon. Two sheep treated at the 0.05% level showed 0.07 ppm diazinon in blood one day after treatment. This level fell to less than 0.03 ppm after 4 days. Meat levels were 0.09 ppm at the 0.01% rate and 0.35 ppm from the 0.05% treatment rate. In a separate study, sheep were orally dosed with diazinon at a rate of 50 mg/kg. Meat, kidney and liver were analysed; no bioaccumulation of diazinon was evident. Metabolism was considered to be more complex in the case of dermal application compared with oral administration.

The Fate of Diazinon in Mammals; Hagenbuch, J. P. and Mucke, W., Ciba-Geigy Limited, Basel Switzerland, October 1985.

This report summarised information on diazinon metabolism in different mammalian species, and general conclusions were drawn regarding the common features of diazinon metabolism in mammals. Intestinal absorption was investigated in rats, cows, goats, guinea pigs and dogs. Diazinon was rapidly and almost completely absorbed from the intestinal tract, as determined from the extent of renal elimination. Dermal

absorption was also high as evidenced by the recovery of 73 – 81% of the administered dose in urine after topical application to rats.

The metabolic pathway was determined and these primary mechanisms for the degradation of diazinon in mammals were identified:

i. Multifunction oxidase/hydrolase mediated cleavage of the ester bond leading to the hydroxy pyrimidine.
ii. Glutathione-mediated cleavage of the ester bond leading to the glutathione conjugate
iii. Transformation of the P-S moiety to the P-O derivative.
iv. Oxidation of the isopropyl substituent leading to the corresponding tertiary alcohol.
v. Oxidation of the methyl substituent leading to the corresponding alcohol.

5.12.5 Cows

Metabolism and Excretion of Phosphorus-32 Labelled Diazinon in a Cow; Robbins, W. E., Hopkins, T. L. and Gaines, W. E., *Agricultural and Food Chemistry*, 1957, **5**, 509.

A cow was dosed orally with 20 mg/kg of ^{32}P-labelled diazinon. Residues in blood, milk, urine and faeces were analysed by thin layer chromatography (TLC). The highest concentration of diazinon was found in the blood 9 hours after treatment. The major metabolites were found to be diethyl phosphorothioic and diethyl phosphoric acids. Low levels of unchanged diazinon were found in the 6 – 24 hr milk samples, the total amounting to 0.01% of the administered dose. More than 80% of the administered radioactivity had been excreted in urine at 36 hours. Cumulative faecal elimination of radioactivity was 7% of the administered dose at 36 hours.

5.12.6 Dogs

Diazinon Metabolism in the Dog; Iverson, F., Grant, D. L. and Lacroix, J., *Bull. of Environmental Contamination & Toxicology*, 1975, **13**, 611.

Two female beagles were intravenously injected with diazinon (^{14}C-ethoxy) at 0.2 mg/kg. Blood samples were drawn at times ranging from 5 min to 7 hr after injection. Urine was collected for analysis at the end of 24 hours. Two other beagles were orally dosed with ring-labelled diazinon at 4 mg/kg. Urine recovery of radioactivity was 58% of the administered dose within 24 hours; the 24 hr urine contained diethyl phosphoric acid (DEP, 16% of total dose) and diethyl phosphorothioic acid (DETP, 42% of total dose).

Ring-labelled diazinon metabolites from the orally dosed animals were chromatographically separated. The two major metabolites were found to be the pyrimidinols G-27550 and GS-31144 which accounted for 10% and 23% of the total radioactivity present in the water-soluble fraction (the fraction left after extraction of urine with organic solvents). The entire fraction accounted for 53% of the total radioactivity. Unchanged diazinon was not observed in the urine. The radioactive component present in the organic phase from urine could not be characterised.

It was concluded that diazinon metabolism in the dog is rapid and relatively complete, and showed gross similarities to the behaviour in rats in terms of the metabolites formed. The levels of metabolites detected varied from those observed in rats, particularly the size of the 'water-soluble' metabolite fraction which accounted for 53% of total radioactivity observed in the dog as compared to only 15% in the rat. Notably, no intact organophosphate metabolites were observed. It could not be concluded that these metabolites are not produced in this species, because the dose rate may have been too low to allow the metabolites to be observed.

5.13 ANALYTICAL METHODOLOGY

5.13.1 Determination of Diazinon in crops

Determination of Diazinon, G-24576 and CGA-14128 Residues in Crops, Crop Fractions, and Animal Tissues and Milk Using Gas Chromatography, L. Hubbard *et al*, Ciba-Geigy Ltd., Method AG-550A, January 1990.

A description of this method was not provided to the Chemical Review Program, however it is reviewed as part of the 1996 JMPR periodical review of diazinon. The summary of the method given there is reproduced here for completeness.

Crops and various animal tissues and milk are extracted with acetone/water, the extract partitioned with petroleum ether/methylene chloride, the organic phase concentrated and the residue dissolved in acetone for analysis using GLC with a flame-photometric detector. A variation of the method is used for some samples: i) For hops the solvent is evaporated and the residue dissolved in hexane and partitioned into acetonitrile before evaporation of the acetonitrile and transfer to acetone for analysis. ii) Corn oil samples are extracted with acetonitrile which is concentrated to dryness, and the residue is dissolved in acetone for analysis. iii) Beef fat samples are extracted with hexane before partition into acetonitrile which is concentrated to dryness, and the residue dissolved in acetone for analysis. A Florisil column clean-up is used to remove material which interferes with GLC.

A validation of method AG550A was provided to the Chemical Review Program. The average recovery across a fortification range of 0.01 – 1.0 ppm was 102% for all crop and animal tissues analysed (apples, lettuce, green beans, corn forage, potatoes, corn grain, tenderloin, fat, milk and liver). The limit of determination given for the method was 0.01 mg/kg for diazinon and metabolites (0.05 mg/kg for hops) with the use of a capillary column for determination. Limits of determination of 0.025 mg/kg for diazinon and 0.05 mg/kg for the metabolites are achievable with packed columns. (*1996 JMPR*) Extractability of ^{14}C residues ranged from 83 – 103% for lettuce, apples and green beans, and from 97.6 – 105% for milk, tenderloin and omental fat. Low extractability was reported for corn forage (53%), potatoes (16.5%) and corn grain (27.3%) and therefore the method was considered unreliable for these samples.

5.13.2 Determination of Diazinon in fat and animal tissues

Gas Chromatographic Determination of Residues of Parent Compound (REM 21/86), Ciba-Geigy Ag, 27 January, 1987.

ANIMAL TISSUE (MUSCLE, LIVER, KIDNEY): The whole sample was cut, chopped, ground or milled to homogenise it before a subsample of 25 g was weighed into a mixer jar and methanol added. The mixture was homogenised, and the slurry filtered under suction through Celite. The filtrate was made up to a volume of 200 mL with methanol. A 20 mL aliquot was diluted with water, saturated sodium chloride solution and n-hexane. The cylinder was shaken well and the hexane layer transferred to a round bottom flask. Two further extractions with hexane were combined with the first and the solvent removed.

The residue was dissolved in hexane and filtered through a phenyl-coated solid phase extraction tube. The tube was washed several times with hexane and these washings were discarded. The diazinon sample was eluted with hexane/ether (9:1) and the eluate evaporated to dryness. The residue was redissolved in hexane and this solution subjected to GC analysis (P/N detection) for determination of total diazinon.

The lowest residue quantitated was 0.01 mg/kg. The recoveries determined for fortification at levels ranging between 0.02 – 0.2 mg/kg were 91% (muscle); 89% (liver); 91% (kidney); 79% and 84% (fat).

FAT: The sample was rendered by heating to 80^{o}C. A subsample was extracted by addition of acetonitrile and warming. Two further extractions with fresh acetonitrile were performed. The combined acetonitrile extracts were mixed with hexane and the mixture shaken and then warmed. The hexane layer was removed, and this procedure repeated twice with fresh hexane. The acetonitrile layer was then evaporated to dryness.

The residue was dissolved in hexane and filtered through a cyano-coated solid phase extraction tube. The tube was washed several times with hexane and these washings were discarded. The diazinon sample was eluted with hexane/ether (9:1) and the eluate evaporated to dryness. The residue was redissolved in hexane and this solution subjected to GC analysis (P/N detection) for determination of total diazinon. The LOQ and recoveries for this procedure were the same as those for the animal tissue determination.

GLC Determination of Diazinon Residues in Fat and Tissues (135), Ciba-Geigy Aust. Ltd., 14 March, 1994.

MUSCLE AND LIVER: The sample was macerated with methanol. The extract was diluted with water and the active ingredient re-extracted into methylene chloride. The solvent was evaporated and the residue cleaned up by an alumina column prior to the final determination by GC (P thermionic detector).

FAT: Fat was ground with anhydrous sodium sulphate and extracted with hot hexane on a boiling water bath. The hexane extract was cleaned up by partitioning with acetonitrile followed by column chromatography and the residue determined by GC as above.
The average recovery for samples fortified at levels of 0.1 mg/kg (muscle, liver, kidney) and between 0.1 and 1.0 mg/kg (kidney fat and omental fat) was 93 %. The limit of detection was 0.01 mg/kg.

Determination of Diazinon and Three of its Potential Metabolites in Animal Tissues (REM 4/74), Ciba-Geigy Ag, 20 May, 1974.

The material to be analysed was macerated and extracted with methanol. The extract was diluted with 1N hydrochloric acid, and diazinon and hydroxydiazinon were re-extracted with chloroform. After neutralisation of the aqueous phase, G-27550 (2-isopropyl-4-methylpyrimidin-6-ol) was extracted with chloroform. Both chloroform extracts containing either diazinon and hydroxydiazinon or G-27550 were evaporated separately and cleaned up by an alumina column or by TLC prior to the final determination by GC (FPD for diazinon and hydroxydiazinon) or the Coulson conductivity nitrogen detector (G-27550). For analysis of diazoxon the tissue sample was extracted with methanol. The resulting extract was filtered, concentrated and diluted with water before being analysed using a cholinesterase inhibition assay. The limits of detection for diazinon and for hydroxydiazinon were 0.01 ppm and 0.02 ppm, respectively. The limit of detection for G-27550 was 0.1 ppm and for diazoxon was 0.01 ppm. Recoveries were determined for each component in each of the tissues (muscle, liver, kidney and fat). For diazinon at fortification levels between 0.1 and 0.5 ppm, the recoveries ranged between 75% and 100% across all tissues. For hydroxydiazinon at fortification levels between 0.1 ppm and 0.5 ppm, the recoveries ranged between 80% and 120% across all tissues. For G-27550 the recoveries, at fortification levels between 0.2 and 1.0 ppm, were 62% through to 101%, and for diazoxon the recoveries, at fortification levels between 0.02 and 0.2 ppm, were between 62 and 112%. Low recoveries were seen for G-27550 in fat of sheep, and diazoxon in liver and kidney of sow.

5.13.3 Determination of Diazinon residues in blood, meat and milk

Determination of Residues of Parent Compound by Gas Liquid Chromatography (GLC) (REM 128.02), Ciba-Geigy Ag., 8 August, 1991.

BLOOD: A 4 mL sample of well-shaken blood was transferred into a 25 mL test tube and saturated NaCl-solution, water and n-hexane were added. The phases were allowed to separate and 3 to 3.5 mL of the organic phase was transferred into a centrifuge tube. The sample was centrifuged until a clear solution was obtained. The total residues were then quantified by GLC using a nitrogen/phosphorus detector (NPD). The limit of quantitation was not determined for the method, but the "lower practical levels" given were 0.005 mg a.i./L for blood and 0.008 mg a.i./kg for milk. The average recovery at fortification levels ranging from 0.01 – 0.1 mg/L was 90%.

MILK: A 20 g sample of well-shaken milk was weighed into a 500 mL jar and 200 mL of acetone/water (9:1) was added. The mixture was blended with an Ultra-Turrax T 25 for 1 min., or on a mechanical shaker for 1 hr. The homogenate was filtered and the extract (20 mL) made up to 50 mL with water. The diluted extract was then passed through a Bond Elut C18-cartridge. The eluate was evaporated to dryness and the residue redissolved in ethyl acetate (3 mL). The total residues were then quantified as for the blood samples. The average recovery at fortification levels ranging from 0.02 to 0.3 mg/kg was 105%.

Diazinon – Gas Chromatographic Residue Determination in Milk and Meat (REM 29/73), Ciba-Geigy Ag, 19 November, 1973.

The material to be analysed was macerated and extracted with methanol (meat) or acetone (milk). The extract was diluted with water and the active ingredient reextracted with chloroform. The solvent was evaporated and the residue cleaned up on an alumina column prior to quantification by GC (FPD and AFID). The limits of detection of the method were 0.25 ng (FPD) and 0.05 ng (AFID) which correspond to 0.01 ppm in both milk and meat. For milk samples, the recovery at fortification levels of 0.033 – 0.33 ppm were 90 –113% (FPD) and 94 – 100% (AFID). For meat samples, the recovery at fortification levels of 0.05 to 0.5 ppm were 96 – 104% (FPD) and 99 – 106% (AFID).

Gas Chromatographic Determination of Diazinon Residues in Milk (132A), Ciba-Geigy Aust. Ltd., February 1986.

Milk samples were extracted with acetone and aliquots taken, diluted with water and diazinon partitioned in methylene chloride. The methylene chloride was removed under vacuum and the residue dissolved in hexane. Further clean-up of the hexane extract was achieved by partitioning with acetonitrile and final clean-up with alumina column chromatography. The concentration of diazinon in this extract was determined by GC (N/P thermionic detector). The average recovery at fortification levels between 0.1 and 1.0 mg/L was 88%. The limit of determination was 0.01 mg/L.

5.13.4 Determination of Diazinon in butter

Determination of Diazinon in Butter (132B), Ciba-Geigy Aust. Ltd., 25 October 1992.

Butter samples were dissolved in hot hexane and the hexane extracts dried through sodium sulphate plugs. Diazinon was partitioned into acetonitrile and the acetonitrile evaporated to dryness. The residue was cleaned up on a basic alumina column prior to quantitation by GC (N/P detector). The average recovery at fortification levels between 0.02 and 0.05 mg/kg was 84%. The limit of determination for the method was 0.01 mg/kg.

5.13.5 Summary

Generally, the methods described for the analysis of diazinon (diazinon is the current Australian residue definition) and some of its metabolites in animal tissues and products are of a good standard, with recoveries suitable for determination of the total diazinon residue. The LOQ for diazinon using Method REM 21/86, 132A and 132B was set at 0.01 mg/kg. For the other methods, an indication of the LOD but not the LOQ was provided. JMPR (1993) states that the LOQ for method AG-550A is 0.01 mg/kg and that in general the methods for analysis of diazinon and its metabolites which employ GC analysis provide LOQs between 0.01 and 0.02 mg/kg.

Analysis of diazinon in crops is generally carried out using method AG-550A; an appropriate validation for method AG-550A was provided but no copy of the method *per se*. The validation data suggested that the method is appropriate for diazinon residue analysis across most crops. Low extractabilities of radioactivity associated with ^{14}C-diazinon residues suggest that the method is inappropriate for determination of diazinon residues in some crops. Since the original sponsor is no longer supporting use of diazinon on crops, this is not an issue.

5.14 RESIDUE DEFINITION

The current residue definition for diazinon is solely the parent compound, although residues present in tissues usually consist largely of the metabolites GS-31144 and G-27550. These two pyrimidinol metabolites are not considered toxicologically significant and therefore are not included in the residue definition.

5.15 RESIDUE TRIALS

5.15.1 General

Residues Expert Report on Diazinon (G-24480), Strittmatter, J., Ciba-Geigy Ltd. Animal Health Division, St. Aubin, Switzerland, September 1992.

This report dealt with various aspects relating to diazinon residue concerns including pharmacokinetics, metabolites and their significance as residues, residue effects, target tissues, MRLs, analytical methods and residue depletion and withholding periods. These considerations were principally made with respect to animal applications of the product and their impact on the commodities derived from these sources, namely meat and milk. Typically animals were treated through dipping, spraying or washing. Table 14 shows the recommended concentrations and treatment intervals involved in use of the product.

Table 14. Use Patterns Studied

Animal	Dip Concentration (ppm)	Spray Concentration (ppm)	Treatment Interval
Cattle	600	600	2 treatments at a 7 to 12 day interval
Sheep	250	600	1 treatment sufficient (2^{nd} treatment after 7 to 10 days required by law in some countries)
Goats		600	2 treatments at a 7 to 12 day interval
Pigs		250	3 treatments at 7 to 10 day intervals

Pharmacokinetics:

Pharmacokinetic studies on sheep (400 ppm dip) indicated that diazinon was rapidly absorbed following dermal application. A maximal concentration in blood (0.042 ppm) was reached within 4 hours after treatment. Concentrations declined thereafter with a mean level at the detection limit (0.005 ppm) being reached by day 7.

Metabolism:

The summary of metabolism studies indicated that diazinon is readily metabolised in all species. The typical route of metabolism is predominantly degradation through cleavage of the pyrimidinyl-phosphorus ester bond by multifunction oxidase and then reaction with hydrolases leading sometimes through diazoxon to the pyrimidinol derivative. Subsequent oxidation at the isopropyl substituent gives secondary and tertiary alcohols. Metabolites which maintain the phosphorus ester bond are transient and only detected after oral administration of a very high dose.

Characterisation and Identification of Major Metabolites in Tissues of Sheep Treated Dermally with ^{14}C-Diazinon; Barr, H.P. and Carlin, T.J., Ciba-Geigy Corporation, North Carolina, USA, ABR-90014, August 1990. This study was reviewed above.

One literature study[8] reported the oral dosing of diazinon to sheep at 1000 mg/kg. Metabolites with intact phosphorus ester linkages were detected in urine, blood and different tissues at this dose. However, in total these metabolites accounted for less than 1% of the dose. Hydroxydiazinon (CGA 14128) accounted for about one tenth of the diazinon content of each tissue. In blood, CGA 14128 accounted for 25 – 70% of the dose and no diazoxon (G 24576) was detected.

Characterisation of ^{14}C-Diazinon Metabolites in Goats; Simoneaux, B.J., Ciba-Geigy Corporation, North Carolina, USA, ABR-88118, October 1988. This study of oral administration to lactating goats was reviewed above.

Oral administration to a dairy cow was carried out using ^{32}P-labelled diazinon which had been diluted with nonradioactive compound at a dose of 20 mg/kg.[9] Blood, milk and urine were analysed and it was found that diazinon was rapidly metabolised and excreted. Unchanged parent accounted for about 18% of

radioactivity in blood. The majority of reactivity was accounted for by diethyl phosphoric and diethyl phophorothioic acids. Metabolism in pigs was not studied.

The primary route of elimination for all species examined was via urinary excretion which typically accounted for 64 – 95% of radioactivity from the administered dose over 7 – 8 days. The remainder of the dose was principally excreted in faeces.

Metabolites were discussed in terms of their significance as residues. The pyrimidinyl metabolites (GS-31144 and G-27550) accounted for a high percentage of residues present in kidney, liver and muscle. However, they displayed no cholinesterase inhibitory activity and displayed a far lower acute toxicity than diazinon. Cholinesterase inhibition was attributed only to those metabolites containing an intact phosphorus ester bond. Therefore the pyrimidinyl metabolites were not considered to be residues of concern.

Metabolites containing an intact pyrimidinyl phosphorus ester bond were considered far more significant as residues due to their cholinesterase inhibitory activity. Typically the residue of significance was diazinon itself. In a dermal study on sheep involving high exposure to diazinon neither G 24576 nor CGA 14128 could be found in tissues. CGA 14128 could only be detected when diazinon was administered at a sublethal dose, and it accounted for a maximum of one tenth of the diazinon content.

Milk from cows that had been sprayed four times at weekly intervals with 500 or 1000 ppm of diazinon contained only diazinon[10]. No diazoxon was detected.

The goat study[11] similarly showed that G 24576 and CGA 14128 were present at levels of 0.009 ppm or less in liver and kidney. CGA 14128 was present at higher levels in fat where it was present at a fifth of the diazinon concentration. Milk contained 0.001 ppm of both compounds.

The conversion from diazinon to CGA 14128, which involves conversion of the sulphur of the phosphorothionate to oxygen was accompanied by an increase in cholinesterase inhibitory capacity. CGA 14128 was shown to be rapidly hydrolysed and therefore its presence in blood was considered transient. The contribution of this compound to cholinesterase inhibition and chronic toxicity is considered only minor. It was argued that diazinon is the only compound of concern with regard to residues in all species.

Residues:

Trials were carried out on fattening cattle, sheep and goats as well as dairy cattle and lactating goats. Each group of animals was treated by dip or spray with the formulation Neocidol EC 250 or Neocidol EC 600 containing 25 or 60% diazinon, respectively. Two fattening animals were slaughtered at different times and samples of muscle, liver, kidney and fat were analysed for diazinon. The results of these trials are presented in Table 15 (cattle), Table 16 (sheep) and Table 17 (goats). Five each of milk-producing cows and goats were sampled at the morning and evening milkings for analysis. The milk residue trial results are shown in Table 19 (dairy cattle) and Table 20 (goats).

Pigs and milk-producing ewes were treated with Neocidol 25 E and Neocidol 60; these products are predecessors of the current formulations and contain the same quantities of diazinon[12,13]. Pigs were sprayed once or twice at an interval of 10 days, at either 500 or 250 ppm diazinon. Only the latter application rate was considered as it represents the recommended rate. Single animals were slaughtered at different times and tissue samples collected. The results are presented in Table 18. Residues in sheep milk were determined after the dipping of 2 ewes at either 400 or 200 ppm. Only the latter concentration was considered in the results, which are presented in Table 21.

Summary of Residue Data from this Report

The above studies demonstrate that diazinon has a propensity for fat. Despite this, diazinon did not bioaccumulate with the use patterns investigated. Diazinon residues were generally at levels at or below the LOQ (0.01 ppm) after 21 days. Diazinon's fat solubility contributes in part to the presence of high residue levels in milk directly after treatment. These residue levels plateau rapidly and then decrease such that milk is relatively residue-free after seven days. However, the current milk (in the fat) MRL of 0.5 mg/kg (which equates to a whole milk MRL of 0.02 mg/kg) in conjunction with a nil milk withholding period is inadequate to account for these residue levels. A slaughter withholding period of at least 14 days for cattle, pigs and sheep would need to be observed in order to comply with the current meat [in the fat] MRLs. Residue data for meat and fat in goats indicates that a slaughter withholding period of at least 7 days is required for compliance with the current meat [in the fat] MRL. However, these data were for only 4 animals (Sections 5.15.1 and 5.15.4) which is inadequate for the purpose of altering the current slaughter withholding period for goats. See overleaf for Tables 15 – 18.

Table 19. Diazinon Whole Milk Residues (ppm) for 5 Friesian Cows After Spraying with Neocidol EC 250 (600 ppm a.i.)

Milking:

1st	2nd	3rd	4th	5th	6th	7th
0.22 ± 0.11	0.08 ± 0.02	0.06 ± 0.01	0.02 ± 0.01	0.02 ± 0.01	< 0.01	< 0.01

Data are mean ± SD

Table 20. Diazinon Whole Milk Residues (ppm) for 5 Goats After Spraying with Neocidol EC 600 (600 ppm a.i.).

Milking:

1st	2nd	3rd	4th	5th	6th	7th
0.22 ± 0.04	0.07 ± 0.02	0.08 ± 0.01	0.03 ± 0.01	0.04 ± 0.01	0.01 ± 0.01	0.02 ± 0.01

Data are mean ± SD

Table 21. Diazinon Whole Milk Residues (ppm) for 2 Sheep After Dipping with Neocidol 60 (200 ppm a.i.).

Milking:

1st	2nd & 3rd	4th & 5th	6th & 7th	8th & 9th	7 days	15 days
0.09/0.09	0.06/0.03	0.02/0.01	0.02/0.01	0.015/ 0.01	0.02/0.01	<0.01/ <0.01

Data are mean ± SD

Table 15. Diazinon Residues (ppm) After Treating Cattle with Neocidol EC 250 (600 ppm a.i.)

Tissue	Day 1		Day 7		Day 14		Day 21	
Steer No.	57	60	302	295	56	59	58	63
Muscle	0.06	0.06	0.01	0.01	<0.01	<0.01	n.a.	n.a.
Liver	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	n.a.	n.a.
Kidney	0.07	0.06	0.01	0.01	<0.01	<0.01	n.a.	n.a
Kidney fat	2.90	1.30	0.4	0.70	0.06	0.06	<0.01	0.01
Omental fat	2.50	1.40	n.s.	n.s.	0.20	0.12	<0.01	0.05

n.s. = not sampled, n.a. = not analysed

Table 16. Diazinon Residues (ppm) After Plunge Dipping Sheep with Neocidol EC 250 (250 ppm a.i.)

Tissue	Day 1		Day 3		Day 7		Day 14		Day 21	
Sheep no.	2483	1820	360	879	343	405	1217	586	707	1899
Muscle	0.15	0.13	0.08	0.05	0.05	0.04	0.03	0.01	0.01	0.02
Liver	0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01	0.01	< 0.01	0.01	0.01
Kidney	0.04	0.03	0.03	0.03	0.02	0.01	0.02	0.01	0.01	0.01
Kidney fat	2.60	1.20	2.20	2.10	1.60	1.00	0.67	0.63	0.29	0.24

Table 17. Diazinon Residues (ppm) After Plunge Dipping Goats with Neocidol EC 600 (600 ppm a.i.)

Tissue	Day 1		Day 3		Day 7		Day 14		Day 21	
Goat no.	2677	2682	2680	2684	2675	2676				
Muscle	0.14	0.06	0.03	0.04	0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Liver	0.04	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Kidney	0.08	0.02	< 0.01	0.03	< 0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Kidney fat	3.40	1.10	1.00	1.40	0.04	0.22	< 0.01	0.02	< 0.01	< 0.01
Omental fat	3.80	0.91	0.39	1.20	0.08	0.20	0.03	0.01	< 0.01	< 0.01

Table 18. Diazinon Residues (ppm) After One or Two Spray Treatments of Pigs with Neocidol 25 E (250 ppm a.i.)

Tissue	Day 1		Day 3		Day 7		Day 14		Day 28	
Pig no.	1	11*	2	12*	3	13*	1	11*	2	12*
Muscle	0.04	0.02	0.02	0.01	0.02	< 0.01	0.02	< 0.01	0.01	< 0.01
Liver	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Kidney	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fat	0.22	0.15	0.05	0.06	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Skin	< 0.01	0.05	< 0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

* Two treatments at an interval of 10 days

5.15.2 Sheep

Accumulation of Diazinon and Dursban Residues in Calves and Sheep; Leshchev, V.V., Kan, P.T., Talanov, G. A., *Khimiya v Sel'skom Khozyaistve*, 1972, **10**, 704. (Abstract only)

Twelve month old calves were sprayed with 0.2% aqueous emulsion of diazinon and fully grown sheep were dipped in a 0.05% emulsion of diazinon (Dursban was included in both formulations). The calves were killed at intervals between 1 and 19 days after treatment, and the sheep between 5 and 33 days. Residues were determined in organs, fat and muscle tissue. With calves, diazinon levels 5 days after application were 0.01 mg/kg in liver, 0.002 mg/kg in kidney and 0.330 mg/kg in internal fat. No residues were detected in other organs. In sheep, 0.008 mg/kg of diazinon was found in internal fat while no residues were detected in the other organs.

Determination of Diazinon Residues in Sheep Tissue and Fat; Bull, M.S., Ciba-Geigy Australia Ltd., NSW, Australia, 71/9/353, September 1971.

Sheep were jetted with diazinon at a concentration of 0.08% using either an EC or WP formulation. Fat and meat residues were determined 14 days after treatment to assess whether these values complied with the MRL for meat and fat (at that time) of 0.75 ppm. Omental, subcutaneous and kidney fat were analysed after mixing and homogenisation. Table 22 shows the residue levels detected 14 days post-treatment.

Table 22. Diazinon Residues (ppm) in Sheep Fat and Muscle

WP Formulation			EC Formulation		
Sheep no.	**Fat**	**Muscle**	**Sheep no.**	**Fat**	**Muscle**
Control	0.06	0.03	D	0.15	0.05
A	0.16	0.03	E	0.08	0.05
B	0.06	0.06	F	0.16	0.05
C	0.05	0.09	Mean	0.13	0.05
Mean	0.09	0.06			

It was concluded that 14 days was an adequate withholding period in order for this treatment rate and technique to allow compliance with the meat (in the fat) MRL of 0.7 mg/kg.

Comparison of the Stripping Rates of Diazinon and Wool Residues in Sheep Treated by Plunge Dipping and in a Sheep Shower with the Microencapsulated Formulation of Diazinon (A 7241H) and Topclip 40; Bull, M. S., Ochudzawa, Z., Adams, S., Ciba-Geigy Australia Limited, N.S.W. Australia, 87/11/1160, December 1987.

Two different formulations of diazinon used at 250 ppm for dip and shower treatments were compared for their stripping rates. Wool residues of diazinon were then determined over a period of 5 months to ascertain the longevity of the treatment and therefore length of efficacy against fly strike. It was found that the microencapsulated formulation resulted in less stripping and therefore provided a more regular, but lower dose of diazinon. Given that lower and more consistent diazinon residues in the wool across a group of sheep indicate a more consistent dose, the residues observed in tissues would also be expected to be lower and more consistent. It was shown that the microencapsulated formulation used at the same treatment rate as in the study would offer protection against fly strike for a maximum of 5 weeks. This period of efficacy was considered poor in comparison with the Topclip formulation. The study is not relevant to consideration of the meat (in the fat) MRL or the edible offal MRL.

Residues of Diazinon in the Fat and Wool of Sheep Treated with Topclip Gold Shield at 250 mg a.i./L; Bull, M. S., Kearney, E. M., Wicker, J., Ochudzawa, Z., Ciba-Geigy Limited, Australia, 90/3/1283, March 1990.

Ten sheep were treated by plunge dipping at 250 mg a.i./L for one minute. Two sheep were untreated controls. The sheep were killed in pairs at 7, 14, 18, 21 and 28 days after treatment and wool, subcutaneous fat and omental fat sampled. The treatment regime followed the recommended rate. However, the treatment time was four times that usually used and so the residues in both wool and fat were expected to be far higher than usual. In fact, the recommended treatment time for a plunge dip is 30 seconds, and should the animals be allowed to pass through as quickly as they choose, this time can be as low as 10 seconds (Manual of Australian Agriculture, R. L. Reid). Assuming good veterinary practice on the part of most users of dipping products then the treatment time used in this study is only twice rather than four times as long as the conventional treatment time. Table 23 shows the results obtained (Note: Tissues from the animal slaughtered at 18 days were not analysed).

Table 23. Diazinon (ppm) Found In Tissues/Wool After Treatment

Days after treatment	Subcutaneous fat	Omental fat	Wool
7	4.4	3.1	4400
14	3.6	1.4	2300
21	1.1	0.8	2000
28	0.4	0.2	2100

After 21 days, fat residues still exceeded the Australian MRL of 0.7 mg/kg. The current recommended WHP for sheep is 14 days.

Diazinon Residues in the Fat and Tissues of Sheep that have been Treated in a Plunge Dip with an Emulsion Prepared from a New Formulation of Neocidol EC250; Strong, M. B., Wiggins, D. and Bull, M. S., Ciba-Geigy Australia Limited, N.S.W., Australia, 86/5/1074, May 1986.

Ten animals were treated by plunge dipping in a diazinon solution containing 250 mg a.i./L. The animals were slaughtered in pairs at regular intervals after treatment and tissues analysed for diazinon content. The results of these analyses are shown in Table 24.

Table 24. Diazinon Residues (mg/kg) in Sheep Tissues Following Plunge Dipping (250 ppm)

DAT	Muscle	Liver	Kidney	Kidney fat
1	0.14	0.01	0.04	1.90
3	0.07	0.01	0.03	2.20
7	0.05	< 0.01	0.02	1.30
14	0.02	0.01	0.02	0.65
21	0.02	0.01	0.01	0.27

DAT = Days after treatment; data are maximum residue concentrations

Diazinon residues were highest in kidney fat. By comparison, liver had very low residues. Kidney fat residues decreased below 0.7 mg/kg on day 14.

Determination of Residues of Parent Compound in Sheep Tissues and Fat After Single Treatment of Microencapsulated Diazinon (A-7241 E); Kuhne, H, Ciba-Geigy Limited, Basel Switzerland, 4003/86, January 1987.

Six sheep were treated with a microencapsulated formulation of diazinon at 250 ppm for a period of one minute. All animals were slaughtered 14 days after treatment and their tissues analysed for diazinon residues. The analyses revealed that the tissue and fat residues for all six treated animals were very low. Table 25 shows the residue data for all six sheep.

Table 25. Diazinon Residues (mg/kg) in Sheep Tissues

Animal code	Muscle	Liver	Kidney	Fat	Omental Fat
1824	< 0.01	< 0.01	< 0.01	0.010	-
2157	< 0.01	< 0.01	< 0.01	< 0.01	0.016
2159	0.01	< 0.01	< 0.01	< 0.01	0.018
2160	0.01	< 0.01	< 0.01	< 0.01	0.023
2161	< 0.01	< 0.01	< 0.01	0.011	0.010
2162	< 0.01	< 0.01	< 0.01	0.013	0.017
control	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Residues of Diazinon in Sheep Tissues and Fat Following Treatment with Topclip Dri-Dress Powder (2% a.i. w/w Diazinon), Bull, M. S., Ciba-Geigy Australia Limited, N.S.W. Australia, 74/9/475, September 1974.

Blowfly strike wounds in sheep were treated with either 10 g (the recommended rate) or 30 g of Dri-Dress powder per animal. The treatment resulted in maximum residues 10 days after treatment as follows: 0.1 ppm in fat, 0.03 ppm in muscle; and < 0.01 ppm in liver. It was concluded that this use-pattern does not present residue concerns.

A Review of Recent Work on Diazinon Residues in the Meat and Fat of Sheep and Cattle and in the Milk of Cows Following Dipping and Spraying; Hastie, B. A., Geigy Agricultural Chemicals, N.S.W. Australia, July 1963.

Several trials to determine diazinon residues in meat and fat of sheep and cattle, and in milk of cows, after treatment with diazinon by spraying or dipping were carried out. Seven trials carried out in Australia involved the treatment of animals according to the regimes below:

Trial	Type of Animal	Trial Location and Date	Details of Treatment	Samples Taken
1A	Cattle	Riverstone, 15.8.62	Sprayed with 2.5 gallons at 0.15% conc.	Kidney, muscle
1B	Sheep	Riverstone, 15.8.62	Dipped at 0.02% conc.	Kidney, muscle
2	Cattle	Lismore, 4.10.62	Dipped at 0.06% conc. * Dipped 3 times in succession, others dipped twice	Kidney
3	Cattle	Riverstone, 30.10.62	Sprayed with (a) 2 gallons at 0.1% conc. (b) 2 gallons without	Kidney, subcutaneous fat

			stabiliser at 0.1% conc.	
4	Cattle	Lismore, 14.2.63	Dipped at 0.046% conc.	Kidney, subcutaneous fat
5	Cattle	Glenfield, 20.5.63	Sprayed with 2 gallons at (a) 0.1% conc. and at (b) 0.05% conc.	Milk
6	Cattle	Lismore, 24/27/30.5.63	Dipped 3 times at 3 day intervals at 0.05% conc.	Kidney, subcutaneous fat

The residues determined in kidney fat and subcutaneous fat are shown in Table 26. The two trials in which muscle was sampled gave no residue greater than 0.1 ppm after one day. Milk residues were found to be a maximum of 0.07 ppm one day after treatment, < 0.01 after 2 days and nil at 4 days (see Table 27).

Table 26. Diazinon Residues (ppm) in Fatty Tissues of Treated Cattle and Sheep

Trial	Sample	1 DAT	7 DAT	14 DAT
1A	Kidney fat	1.7	1.2	0.4
1B	Kidney fat	1.3	1.2	0.8
2	Kidney fat	3.6*	1.5	0.7
3a	Kidney fat	1.3	0.8	
	Subcutaneous fat	0.1	0.3	
3b	Kidney fat	1.2	0.9	
	Subcutaneous fat	0.2	0.6	
4	Kidney fat	1.0	0.5	0.5
	Subcutaneous fat	0.25	0.2	0.5
6	Kidney fat	2.0	0.7	0.7
	Subcutaneous fat	1.0	0.6	0.5

Table 27. Diazinon Residues (ppm) in Milk of Treated Cows

Trial	1 DAT	2 DAT	4 DAT
5A*	0.07, 0.05, 0.04	<0.01, <0.01, <0.01	nil, nil, nil
5B*	0.03, 0.04, 0.04	<0.01, <0.01, <0.01	nil, nil, nil

*Trial 5A used 500 ppm diazinon; trial 5B used 1000 ppm diazinon

The values obtained in this study were compared with those obtained in U.S. trials on yearlings where a treatment regime of spraying once weekly for 16 weeks at a rate of either 0.05% or 0.1% was employed. Samples were obtained by biopsy of the animals at 1 and 6 days after each spray treatment. The diazinon levels measured in the omental fat were averaged across the entire treatment period to give the values below (Ardsley and Kerrville are two laboratories where duplicate samples were analysed):

<u>0.05% spray</u>

1 day after treatment	< 0.37 ppm (Ardsley)	0.73 ppm (Kerrville)
6 days after treatment	0.24 ppm (Ardsley)	< 0.17 ppm (Kerrville)

0.1% spray

1 day after treatment	1.8 ppm (Ardsley)	2.3 ppm (Kerrville)
6 days after treatment	0.66 ppm (Ardsley)	0.65 ppm (Kerrville)

The average residue of 0.65 ppm 6 days after treatment at 0.1% was comparable to 0.55 ppm observed after 7 days in the Australian trials. The study concluded that high levels of diazinon are detected shortly after treatment due to the high treatment rates, but these residues are rapidly dissipated. It was found that repeated treatments (U.S. study) do not result in bioaccumulation.

Blood Concentration and Tissue Residues of Diazinon in Sheep Following Treatment with Topclip Gold Shield Scab Approved Sheep Dip and CS Disinfectant; Roberts, N. L., Cameron, D. M., Redgrave, V. A., MacDonald, I. A., Gillis, N. A., Huntingdon Research Centre Ltd., Cambridgeshire U.K., 455/881404, April 1989.

A group of sheep were dipped in a diazinon formulation at 400 ppm for one minute. Blood samples were taken from one group of six animals prior to treatment, and at regular intervals for the first two days after treatment. The animals were slaughtered in groups of four or six and subcutaneous and omental fat sampled. A maximum blood concentration of 0.042 ppm diazinon was observed 4 hours after treatment. By seven days after treatment, this value had declined to the detection limit of 0.005 ppm. The maximum level detected in subcutaneous fat was 2.34 ppm at 14 days after treatment. The residue concentration declined to 0.62 ppm 35 days after dosing. Omental fat showed a maximum residue of 2.07 ppm determined 7 days after treatment which decreased to 0.42 ppm at 35 days. While the high residues reported exceed the fat MRL of 0.7 mg/kg, this situation is accounted for by a use rate which exceeds that recommended on the label, and a treatment time which is 4 times that typically used in dipping treatments.

Residues in Sheep Milk After Dipping of Animals, 1973; Formica, G., Ciba-Geigy Limited, Switzerland, December 1973.

Sheep underwent a single dip treatment using either 0.04% or 0.02% diazinon. The animals were milked daily and diazinon residue levels determined. Maximum diazinon residues gradually decreased over 15 days from 0.18 ppm to 0.01 ppm (0.04% a.i. applied), and from 0.09 ppm to less than 0.01 ppm (0.02% a.i. applied). No indication was given of whether the residues were determined on a fat or whole milk basis.

5.15.3 Cows

Diazinon Residues in the Fat and Tissues of Cattle that have been Sprayed with an Emulsion Prepared from a New Formulation of Neocidol EC250; Strong, M. B., Wiggins, D. and Bull, M. S., Ciba-Geigy Australia Limited, N.S.W. Australia, 86/6/1075, June 1986.

Diazinon residue levels were determined after spraying steers with a 600 mg a.i./L emulsion. A pair of animals were slaughtered at one day after treatment and at seven day intervals thereafter, with samples of muscle, liver, kidney, kidney fat and omental fat analysed for diazinon residues. The results are shown in Table 28.

Table 28. Diazinon Residues (mg/kg) in Tissues of Steers Sprayed with an Emulsion

DAT	Muscle	Liver	Kidney	Kidney fat	Omental fat
1	0.06	< 0.02	0.07	2.10	2.00
7	0.01	< 0.01	0.01	0.55	n.s.
14	< 0.01	< 0.01	< 0.01	0.06	0.16
21	n.a.	n.a.	n.a.	< 0.01	< 0.03

n.a. = not analysed, n.s. = no sample taken

Muscle, liver and kidney contained diazinon residues at or below the limit of detection (0.01 ppm) at 7 days. The maximum residue of 2.10 mg/kg was observed in kidney fat one day after treatment. Residues dissipated readily from fat and levels were below 0.2 mg/kg at 14 days.

Diazinon Residues in the Milk of Dairy Cattle Following Treatment by Spraying with a New Formulation of Neocidol EC250 at a Concentration of 600 mg a.i./L; Bull, M. S., Adams and Strong, M. B., Ciba-Geigy Australia Limited, N.S.W. Australia, 86/6/1076, June 1986.

Five cows were individually sprayed with 10 L of an emulsion containing 600 mg a.i./L after which they were milked twice daily for four days, and the level of diazinon present in the individual milkings determined. Table 29 shows the maximum diazinon residue present in the whole milk from each of the milkings.

Table 29. Diazinon Residues in Whole Milk (mg/L) From Cows (n=5) Sprayed with an Emulsion

1st/7 hrs	2nd/21 hrs	3rd/31 hrs	4th/45 hrs	5th/55 hrs	6th/70 hrs	7th/80 hrs
0.35	0.11	0.07	0.03	0.03	< 0.01	< 0.01

Maximum milk residues were observed in the first milking after treatment for all cows. Residue levels were below the limit of quantitation 3 days after treatment.

Determination of Diazinon Residues in Milk and Milk Products from Lactating Cows Following Treatment with Nucidol 20; Bull, M. S. and McDougall, K., Ciba-Geigy Australia Limited, N.S.W. Australia, 74/4/440, April 1974.

A herd of sixty cows was sprayed with a diazinon solution containing 0.05% w/v of the active. Individual milk samples from five cows and a bulk sample from the herd were analysed. Milk residues were determined on a whole milk basis. In addition, the diazinon levels in skim milk, cream and butter were also determined. Diazinon levels determined by averaging the samples obtained from five animals (Table 30), and those determined from the bulk commodities obtained from the entire herd (Table 31) are shown.

Table 30. Diazinon Residues (ppm) in Whole Milk and Milk Products from Cows Sprayed with a Solution

Sample	1st milking	2nd milking	3rd milking	4th milking	10th milking
Whole milk	0.22	0.06	0.06	0.03	0.02
Skim milk	0.03	0.02	-	-	-
Butter	5.2	1.7	0.84	0.26	0.05

Data are mean values for 5 cows

Table 31. Diazinon Residues (ppm) in Whole Milk and Milk Products from Cows Sprayed with a Solution

Sample	1st milking	1st & 2nd milkings	3rd milking	3rd & 4th milkings
Milk	0.25	0.15	0.06	0.04
Skim milk	0.04	0.03	0.02	0.02
Cream	2.4	2.1	0.57	0.26
Butter	4.5	2.6	0.60	0.30

Data are mean values for bulk samples taken from the herd

Because of diazinon's affinity for fat, the commodities high in fat tend to concentrate the residue. The cream generated in the laboratory for the study had a higher percentage fat than cream which is typically sold for human consumption. Hence the diazinon level reported is higher than what might be expected for a commercially saleable cream.

Residues of Diazinon, Coumaphos, Ciodrin, Methoxychlor, and Rotenone in Cow's Milk from Treatments Similar To Those Used for Ectoparasite and Fly Control on Dairy Cattle, with Notes on Safety of Diazinon and Ciodrin to Calves; Matthysse, J. G. and Lisk, D., *J. of Economic Entomology*, 1968, **61**, 1394.

Cows were sprayed twice at an interval of 10 days with 0.06% diazinon and subsequently milked at regular intervals after treatment to assess the level of diazinon residues present in the milk. Milk was taken ½, 1 and 2 days after spraying. The maximum residue of 0.33 ppm occurred 1 day after the second spray, however diazinon residues were also high in the first milking after the first spray treatment. Within 7 days diazinon residues in the milk from treated animals were the same as in milk from untreated cattle.

5.15.4 Goats

Diazinon Residues in the Fat and Tissues of Goats Following Treatment by Spraying with Neocidol EC600 at a Concentration of 600 mg a.i./L; Bull, M. S., Adams, S. and Strong, M. B., Ciba-Geigy Australia Limited, N.S.W. Australia, 86/7/1084, July 1986.

A group of eleven goats was studied. Ten of these animals were treated by spraying with 600 mg/L diazinon solution. One animal was untreated and slaughtered to provide control sample residue levels. The other animals were slaughtered in pairs at regular intervals and tissue samples obtained for diazinon analysis. The results obtained are shown in Table 32.

Table 32. Diazinon Residues (mg/kg) in Tissues of Goats Sprayed with a Solution

DAT	Muscle	Liver	Kidney	Kidney fat	Omental fat
1	0.10	< 0.03	0.05	2.30	2.40
3	0.04	< 0.01	< 0.02	1.2	0.80
7	0.02	< 0.01	0.01	0.13	0.14
14	< 0.01	< 0.01	< 0.01	< 0.02	0.02
21	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Diazinon was preferentially deposited in the fat. With other tissues, residues were short lived and approximated the limit of detection by day 7 after treatment.

Diazinon Residues in the Milk of Lactating Goats Following Treatment with a New Formulation of Neocidol EC 600 at a Spray Concentration of 600 mg a.i./L; Strong, M. B., Wiggins, D. and Bull, M. S., Ciba-Geigy Australia Limited, N.S.W. Australia, 87/5/1116, May 1987.

Each of five lactating goats were sprayed with 5 litres of 600 mg a.i./L diazinon solution. The animals were milked by hand, morning and evening, and these milkings analysed individually for diazinon residue levels. Table 33 shows the maximum diazinon residues in each of the tested milkings.

Table 33. Diazinon Residues (mg/L) in Milk from Goats Sprayed with Neocidol EC 600

1st/7 hrs	2nd/24 hrs	3rd/30 hrs	4th/48 hrs	5th/54 hrs	6th/72 hrs	7th/78 hrs
0.25	0.09	0.10	0.04	0.05	0.02	0.02

Maximum residues occurred for all animals in the first milking. Three days after treatment, diazinon levels had decreased to values approximating the limit of detection. While the percentage fat of each milk sample was determined, the study did not indicate whether these fat contents were used to determine the diazinon residue on a fat basis or whether residues were expressed on a whole milk basis. The limit of detection for the residue analysis was 0.01 mg/L. Recoveries were shown to be 81% at a fortification level of 0.1 mg/L and 78% at 1.0 mg/L.

5.15.5 Pigs

Residues of Diazinon and Three of its Metabolites in Muscle, Liver, Kidney, Skin and Fat of Pigs After Spray Treatment; Formica, G., Ciba-Geigy Limited, May 1974.

Twenty pigs were sprayed once, or twice at a 10 day interval, with 5 L of diazinon suspension containing either 0.025 or 0.05% diazinon. The animals were then slaughtered in pairs at day 1, 3, 7, 14 and 28 (animals treated once) or at day 11, 13, 17, 24 and 38 (animals treated twice). Tissues were analysed for diazinon, hydroxydiazinon, G-27550 and diazoxon. Diazoxon was not found in any of the tissues analysed. Finite residues of G-27550 occurred only in kidney: 0.12 ppm on day 28 after a single treatment with 0.05% diazinon; levels ranged from 0.12 ppm (day 3) to 0.16 ppm (day 28) after two spray treatments at 0.05% diazinon. The only finite hydroxydiazinon residues observed were in fat, being 0.02 ppm 1 day after a single treatment with 0.025% diazinon, and 0.03 ppm at day 1 after a single treatment with 0.05% diazinon. Diazinon residues were detected primarily in muscle and fat. The maximum muscle residue was 0.08 ppm 1 day after a single treatment with 0.05% diazinon. By 14 to 28 days after treatment, muscle residues were at or about the limit of quantitation (0.01 ppm). The maximum fat residue was 0.22 ppm after a single treatment at 0.025% diazinon. Residues in fat were at or about the LOQ 14 days after treatment irrespective of the treatment concentration or regime.

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Appendix 2 Japanese and US MRLs for Diazinon

Commodity	Japanese MRL (mg/kg)	U.S. MRL (mg/kg)
Almonds		0.5
Apples	0.1	0.5
Apricots		0.5
Bananas		0.2
Bananas (pulp)		0.1
Bartlett pear	0.1	
Beetroot		0.75
Blackberries		0.5
Blueberries		0.5
Boysenberries		0.5
Brassica (cole)		0.7
Burdock	0.1	
Cabbage	0.1	
Carrots		0.75
Cauliflower	0.1	
Celery		0.7
Cherries	0.1	0.75
Chicory		0.7
Chinese radish (roots and tops)		0.1*
Chinese white cabbage	0.1	
Chrysanthemum	0.1	
Citrus		0.7
Coffee beans		0.2
Cotton seed		0.2
Cowpeas		0.1
Cranberries		0.5
Cucumbers	0.1	0.75
Dewberries		0.5
Eggplant	0.1	
Endives (Escarole)		0.7
Fat		0.7
Figs		0.5
Filberts		0.5
Garden radish	0.1	
Garden radish leaves	0.1	
Ginseng		0.75
Grapes	0.1	0.75
Hops		0.75
Irish potatoes	0.1	
Japanese pear	0.1	
Kiwi fruit		0.75
Leafy vegetables		0.7
Lespedeza		1.0
Lettuce	0.1	0.7
Lima beans		0.5
Loganberries		0.75
Meat and meat by products of cattle and sheep from pre-slaughter application		0.7
Melons	0.1	0.75
Mushrooms		0.75
Muskmelon	0.1	
Nectarines		0.5
Olives		1.0
Onions		0.75
Parsley	0.1	0.75

Parsnips		0.5
Peaches	0.1	0.7
Peanuts		0.75
Pears		0.5
Peas with pod		0.5
Pecans		0.5
Peppers		0.5
Persimmons	0.1	
Pineapples		0.5
Plums		0.5
Potatoes		0.1
Pumpkin	0.1	
Radishes		0.5
Raspberries		0.5
Rutabagas		0.75
Snap beans		0.5
Sorghum grain		0.1
Soybeans		0.1
Spanish paprika	0.1	
Spinach	0.1	0.7
Strawberries	0.1	0.5
Sugar beet root		0.5
Sugarcane		0.75
Summer orange (peel)	0.1	
Summer orange (pulp)	0.1	
Summer squash		0.5
Sweet potatoes	0.1	0.1
Sweetcorn		0.7
Swiss chard		0.7
Taro	0.1	
Tea	0.1	
Tomatoes	0.1	0.75
Turnip	0.1	
Turnip leaves	0.1	
Turnip roots		0.5
Walnuts		0.5
Watercress		0.7
Watermelon	0.1	
Wheat forage, grain and straw		0.05
White muskmelons	0.1	
Winter squash		0.75

Appendix 3 Australian Use-Patterns for Diazinon Agricultural Products

Crop	Pest	Application			Application timing	WHP
		Max. rate g a.i./100L (g a.i./ha)	No	Interval (days)		
Apples						14
Bananas						14
Beans	Bean Fly	24 (120)	unlimited	4-7	Spray thoroughly 3, 7 and 14 days after first plants emerge. Further weekly sprays with high pest pressure	14
	Bean Caterpillar	(560)	unlimited	not specified	Spray when necessary	
	Blossom Thrips	24 (280)	unlimited	not specified	Spray at flowering and when thrips are in damaging numbers.	
	Seed Maggot	(4000)	1	na	Spray soil before sowing and work into a depth of 5-8 cm	
Beetroot	Webworm	(800)	unlimited	not specified	Spray as necessary	14
Blueberries						14
Broccoli	Centre Grub	112 (560)	unlimited	10-14	Spray to run-off with good coverage as required	14
	Cluster Caterpillar					
	Green Peach Aphid					
	Cabbage Moth	112 (1120)	unlimited	10 - 14	Spray to run-off with good coverage as required	
	Cabbage White Butterfly					
	Cabbage Aphid					
	Looper	52 (560)	unlimited	10 - 14	Spray to run-off with good coverage as required	
Brussels Sprouts	Centre Grub	112 (560)	unlimited	10-14	Spray to run-off with good coverage as required	14
	Cluster Caterpillar					
	Green Peach Aphid					
	Cabbage Moth	112 (1120)	unlimited	10 - 14	Spray to run-off with good coverage as required	
	Cabbage White Butterfly					
	Cabbage Aphid					
	Looper	52 (560)	unlimited	10 - 14	Spray to run-off with good coverage as required	
Cabbage	Centre Grub	112 (560)	unlimited	10-14	Spray to run-off with good coverage as required	14
	Cluster Caterpillar					
	Green Peach Aphid					
	Cabbage Moth	112 (1120)	unlimited	10 - 14	Spray to run-off with good coverage as required	
	Cabbage White Butterfly					
	Cabbage Aphid					
	Looper	52 (560)	unlimited	10 - 14	Spray to run-off with good coverage as required	
Canola	Cabbage Moth	(560)	unlimited	not specified	Spray as necessary	14
	Cabbage White Butterfly					
Cantaloupe	Caterpillars	(1120)	unlimited	not specified	Spray as necessary	14

	Cutworms					
Capsicum	Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Carrots	Caterpillars Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Cauliflower						14
Celery	Caterpillars Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Cereals	Armyworm	727 (800)	unlimited	10	Spray when pests are first noticed and repeat if necessary	14
	Cutworm	727 (800)	unlimited	10	Spray when pests are first noticed and repeat if necessary	
	Australian Plague Locust	(560)	unlimited	not specified	Spray directly onto hopper bands and flying swarms	
	Spur-throated Locust Migratory Locusts	(680)	unlimited	not specified	Spray swarms in early morning or late evening when pests are roosting	
Chokos	Caterpillars Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Chou Mollier	Cabbage Moth Cabbage White Butterfly	(560)	unlimited	not specified	Spray as necessary	14
Citrus						14
Cotton	Australian Plague Locust	(560)	unlimited	not specified	Spray directly onto hopper bands and flying swarms	14
	Spur-throated Locust Migratory Locusts	(680)	unlimited	not specified	Spray swarms in early morning or late evening when pests are roosting	
	Cotton Flea Beetle Red Shouldered Beetle	(400)	unlimited	not specified	Spray when insects are present	
Cucumbers	Caterpillars Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Cucurbits	Thrips	24 (280)	unlimited	not specified	Spray at flowering and when thrips are in damaging numbers	14
Cumquats						14
Eggplant	Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Garlic	Onion Thrips	52 (560)	unlimited	10	Spray as necessary when thrips are in damaging numbers	14
Gherkins	Caterpillars Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Globe Artichoke	Webworm	(800)	unlimited	not specified	Spray as necessary	14
Grape vines						14
Hops						14
Kale	Centre Grub Cluster Caterpillar Green Peach Aphid	112 (560)	unlimited	10-14	Spray to run-off with good coverage as required	14
	Cabbage Moth Cabbage White Butterfly Cabbage Aphid	112 (1120)	unlimited	10 - 14	Spray to run-off with good coverage as required	

	Looper	52 (560)	unlimited	10 - 14	Spray to run-off with good coverage as required	
Kiwifruit						14
Kohlrabi	Centre Grub Cluster Caterpillar Green Peach Aphid	112 (560)	unlimited	10-14	Spray to run-off with good coverage as required	14
	Cabbage Moth Cabbage White Butterfly Cabbage Aphid	112 (1120)	unlimited	10 - 14	Spray to run-off with good coverage as required	
	Looper	52 (560)	unlimited	10 - 14	Spray to run-off with good coverage as required	
Lawns						14
Lettuce	Caterpillars Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Lucerne	Lucerne Jassid	(280)	unlimited	not specified	Spray with good coverage when pests are active	2 (G) 14 (H)
	Spotted Alfalfa Aphid	(560)	unlimited	not specified	Spray when there are 20 – 40 aphids/stem on mature plants or 1-2 aphids/stem on seedlings OR spray as soon as practical after cutting	
Macadamia nuts						14
Marrows	Caterpillars Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Mushrooms						14
Nursery plants						14
Oilseed crops	Australian Plague Locust	(560)	unlimited	not specified	Spray directly onto hopper bands and flying swarms	14
	Spur-throated Locust Migratory Locusts	(680)	unlimited	not specified	Spray swarms in early morning or late evening when pests are roosting	
Onions	Onion Thrips	52 (560)	unlimited	10	Spray as necessary when thrips are in damaging numbers	14
	Onion Seedling Maggot	52 (560)	unlimited	10	Spray foliage as necessary when flies appear, usually as plants emerge	
	Onion Maggot Wireworm	(4000)	1	na	Spray soil before sowing and harrow to a depth of 5 to 8 cm or irrigate after application	
Ornamentals and potted plants						14
Parsnip	Caterpillars Cutworms	(1120)	unlimited	not specified	Spray as necessary	14
Pastures	Pasture Webworm	(560)	unlimited	not specified	Spray as soon as damage is noticed (July/Nov.) spraying late in the day	14
	Australian Plague Locust	(560)	unlimited	not specified	Spray directly onto hopper bands and flying swarms	
	Spur-throated Locust	(680)	unlimited	not specified	Spray swarms in early morning or late evening	

	Migratory Locusts				when pests are roosting	
	Armyworm	727 (800)	unlimited	10	Spray when pests are first noticed and repeat if necessary	
	Cutworm	727 (800)	unlimited	10	Spray when pests are first noticed and repeat if necessary	
	Grasshoppers	(1120)	unlimited	not specified	Spray swarms in early morning or late evening when pests are roosting	
Pears						14
Peas	Caterpillars	(1120)	unlimited	not specified	Spray as necessary	14
	Cutworms					
Pineapples						14
Pumpkin	Caterpillars	(1120)	unlimited	not specified	Spray as necessary	14
	Cutworms					
Potatoes	Potato moth	470 (800)	unlimited	14	Spray immediately when 'blister' stage is noticed.	14
Rhubarb	Caterpillars	(1120)	unlimited	not specified	Spray as necessary	14
	Cutworms					
Rice	Brown Plant Hopper	(280)	unlimited	not specified	Spray when pests are active	14
	Bloodworm	(120)	unlimited	not specified	Spray first at or within 24 hours of sowing to flood bays. Apply further treatments as required until plants are established with satisfactory secondary root development	
Silverbeet	Webworm	(800)	unlimited	not specified	Spray as necessary	14
Stone fruit						14
Sorghum	Grasshoppers	(1120)	unlimited	not specified	Spray swarms in early morning or late evening when pests are roosting	14
	Sorghum Midge	(560)	unlimited	4	Spray from 90% sorghum head emergence to advanced flowering stage at intervals or as necessary depending on pest numbers	
Soybeans	Australian Plague Locust	(560)	unlimited	not specified	Spray directly onto hopper bands and flying swarms	14
	Spur-throated Locust	(680)	unlimited	not specified	Spray swarms in early morning or late evening when pests are roosting	
	Migratory Locusts					
Squash	Caterpillars	(1120)	unlimited	not specified	Spray as necessary	14
	Cutworms					
Sugarcane	Australian Plague Locust	(560)	unlimited	not specified	Spray directly onto hopper bands and flying swarms	14
	Spur-throated Locust	(680)	unlimited	not specified	Spray swarms in early morning or late evening when pests are roosting	
	Migratory Locusts					
Sweetcorn	Caterpillars	(1120)	unlimited	not specified	Spray as necessary	14
	Cutworms					
Tomatoes	Thrips	24 (280)	unlimited	7-14	Spray from the seedling stage and repeat at intervals as long as thrips are present	14

	Wireworms	(1120)	1	na	Spray soil either before sowing or transplanting and harrow to a depth of 50-80 mm or irrigate immediately after application	
	Cutworms	(1120)	unlimited	not specified	Spray as necessary	
Trees						14
Turnips	Cabbage Moth	(560)	unlimited	not specified	Spray as necessary	14
	Cabbage White Butterfly					
Watermelons	Caterpillars	(1120)	unlimited	not specified	Spray as necessary	14
	Cutworms					